Investigation of the Association between Video Game Usage, Personality, Psychological Needs, and Wellbeing

By

Florian Flueggen

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Abstract

Playing computer games has often been theorised to be linked to the wellbeing of users. However, the variables involved and the relationships and interactions between them have not been established. The purpose of the present study was to investigate, whether there are core aspects of game usage that are related to increased or decreased wellbeing, and the extent to which these depend on players' real-life situations.

The project comprised three studies and used an exploratory sequential mixed-methods design. In the first study, the ways in which players use games were investigated. To identify the key aspects of game usage for distinguishing and describing how players use games, in-depth interviews were conducted with 23 players of different games. This data and two subsequent quantitative tests, the first with 314 participants and the second with 770 participants, were used to develop a game-usage questionnaire and a framework with eight factors.

The relationship between game usage and wellbeing was investigated in a longitudinal study conducted over nine months with 531 participants. Personality – as proxy for internal characteristics – and basic psychological needs – as proxy for participants' situations in life – were taken into account as potential moderators of that relationship. Results showed that the overall correlations between game usage and wellbeing are weak and subsumed by players' needs and personality. However, there were interactions between game usage and needs: Some game usage factors seem to directly reflect real-life situations and wellbeing; others seem to be common responses to real-life situations with no impact on wellbeing; and others again appear to impact wellbeing depending on the real-life situation. Social game usage seems to be a key factor with relevance for wellbeing.

The contribution of this thesis is twofold. It provides a general framework of game usage that can be used in the field of game studies to interpret and compare findings more meaningfully, and it was shown that it is important to consider a person's game usage in context of their real-life situations. In addition, main game usage factors for future research on wellbeing and digital games are suggested.

Acknowledgements

I would like to use this opportunity to thank the people who were directly and indirectly involved in the writing and completion of this thesis. In a way it is the end (?) of a long journey that started 25 years ago with me playing my first video games, Mario's Early Years: Fun with Letters and Numbers. Since then I have had an ongoing interest in and engagement with various games, and plenty of conversations and discussions – or, in the case of my parents, rather arguments – about why I play and the roles and impacts playing games might have on me and others. It was interesting, and partly eye-opening, to recall my own usage of games over the years in light of the findings of my thesis. Many people were involved:

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1 Introduction

Virtual environments are receiving growing attention in various areas of psychological research (Lobel *et al.*, 2017). Originally, the focus was on possible negative influences; in line with Bandura's theory of social learning, there were fears that people could adopt the violent behaviours they experience in video games in their everyday lives (Colwell & Payne, 2000). However, more recently virtual environments have become a topic of interest in research on wellbeing (Turner, Thomas, & Casey, 2016). Games are increasingly viewed as social activities, and most so-called *massive-multiplayer-online-games* have global communities, some with millions of members (Kowert & Oldmeadow, 2015). Because of their social factors, it has been proposed that games have potential to improve various aspects of players' lives, including their social environments and mental wellbeing (Granic, Lobel, & Engels, 2014; Kowert & Oldmeadow, 2015). However, games have also been associated with depression, loneliness, decreased academic or job performance, and addiction (Jeong *et al.*, 2016).

Wellbeing is a complex construct and is influenced by various interactions in everyday life (Dodge *et al.*, 2012). To date it is not understood why some players seem to benefit from playing games and others' positive development seems to be hindered (Lobel *et al.*, 2017). While there is a large number of potential confounding variables, one of the most influential factors is assumed to be the ways in which players interact with games and other players (Johnson *et al.*, 2013). So far, most research in the area of game user experience has been conducted by game developers and focussed on *why* rather than *how* people play games (Mena, 2012). There can be, however, substantial differences, and, notwithstanding similar motivations, these can influence – if not determine – how players experience a game (Flueggen, Doyle, & Veith, 2018). These different experiences may in turn lead to different influences on players, making the way in which games are played a crucial variable.

The study at hand had two aims. The first was to develop an empirical framework to describe and distinguish how players use games. This framework was then used to investigate relationships between game usage and mental wellbeing in a longitudinal study. Participants' personality traits and basic psychological needs were considered as moderator variables on the basis that people with different personalities and needs are likely to be influenced differently by similar experiences.

The thesis is structured into three main parts comprising eight sections. Following this brief introduction, the background of the study and its motivation will be elaborated. The background section introduces conceptualisations of wellbeing, constructs of personality, psychological needs – as considered in Self-Determination Theory – and provides a brief overview of some of the most popular video games. Following that general information, the literature review provides a detailed overview of current knowledge and developments in the specific fields related to this study. The review of the literature leads to the development of a theory of relationships between game usage and wellbeing. Based on gaps identified in the literature, and specific hypotheses derived from this theory, core empirical questions are presented, which inform the overall design of the present project. The first core part of the thesis concludes with a presentation and discussion of the methods used in the study. The second part describes the three studies, and the third comprises a discussion of the combined results of the studies, as well as conclusions and implications for the wider research field.

2 Rationale and background

2.1 Rationale

The main aim of the present study was to contribute to our understanding of ways in which playing video games affects the wellbeing of players. Its motivation stemmed from my experiences as gamer, my observations as an assistant teacher in classrooms, and the findings of my previous research. A recurring theme was that some players seem to benefit from playing games, while others' wellbeing appears to be hindered by it. My interest was further consolidated by recent developments in this field, such as observations that players may be using computer games to compensate for a lack of social fulfilment in their lives (Kowert & Oldmeadow, 2015). Related to this, it has been shown that using computer games can have various positive influences on players, such as raising their self-esteem and self-acceptance, providing social support or enabling them to fulfil needs for autonomy or competence (Colwell, 2007; Granic, Lobel, & Engels, 2014). Therefore, computer games have been posited as having potential to be used to counter the serious issue of poor wellbeing (Turner, Thomas, & Casey, 2016). Especially adolescents – whose poor wellbeing has frequently been linked to adverse social interactions and lacking social support, and of whom over 50% in industrialised nations are estimated to use online games – could benefit from games that support their mental wellbeing (Burke *et al.*, 2017; Ciarrochi *et al.*, 2017).

In addition to entertainment, games and online services are getting used more and more as media to deliver interventions for various purposes. Engaging people in digital interventions and keeping them engaged are some of the key issues many developers of such interventions are facing (Cheek *et al.*, 2015), and topics with which the digital games industry has over 30 years of experience. It is also possible that some thresholds that contribute to people not seeking or accepting help could be lowered by using games. Mental health professionals sometimes feel as if they are trying to help people who don't want help, for example because they don't believe they need it, think the professionals can't help them, or because they don't know certain help-options exist (Fleming *et al.*, 2016; Gulliver, Griffiths, & Christensen, 2010). Furthermore, mental health issues such as depression are often experienced as social stigma, which results in some people who know they need help refusing to look for or accept it, as it would mean "outing" themselves (Christensen, Reynolds, & Griffiths, 2011; Fleming *et al.*, 2019). In some cases, outright "intervention games" may work, but in others an

intervention as a "hidden ingredient" or optional side-aspect, which is difficult to realise in other contexts, might be more effective. Games and gamification are also used increasingly in educational settings. Good games have been shown to have motivational aspects, be more engaging than standard teaching approaches, and can make some topics more "real" (Khan, Ahmad, & Malik, 2017; Yıldırım, 2017). One can, for example, be immersed in a historical setting or conduct virtual scientific experiments that are not possible in physical classroom settings.

Irrespective of the potential of computer games to improve wellbeing, studies have also identified several risks (Ferguson, 2015). Playing computer games has been connected with increased aggressive behaviour and depression, but, interestingly, also with decreased self-esteem and increased loneliness (e.g. Greitemeyer & Mugge, 2014). There are a few potential explanations for the apparent contradictions between the observed positive and negative effects.

The first posits that the individual ways in which players use games influence or even determine their experiences of those games, and that these different experiences lead to different influences on their lives and wellbeing (Kallio, Mäyrä, & Kaipainen, 2011; Stefan *et al.*, 2017). The present study focuses on the *eudaimonic* approach to wellbeing, which emphasises psychological functioning, self-fulfilment and healthy personal development (Steel, Schmidt, & Shultz, 2008). Most existing research only differentiates between players on the basis of time spent playing, an approach that has been described as insufficient (Blake & Klimmt, 2012). *Game usage* in the present study therefore refers to a variety of factors, including games played, behaviours exhibited in games, and game-related activities outside of the game[1].

A potential second explanation for contradictory research results in this area, which has been investigated in recent studies (e.g. Kardefelt-Winther, 2014; Lee & Leeson, 2015), is that *personal characteristics* – individual differences between players, such as personality – influence the effects that games have on them. Personal characteristics are likely to influence how players use games (Bean & Groth-Marnat, 2014), as well as how they

[1] In the present thesis the commonly used term *real-life* is avoided because of a potentially inadequate implication of that term. Instead respective activities and variables are described as *outside of the game* in contrast to in-game

experience situations in a game (Wiemeyer *et al.*, 2016). Both of these factors may moderate the influence games have on players, including their wellbeing.

A third explanation is that ways in which people play and the individual effects of play depend on the extent to which their *basic psychological needs* (Przybylski, Rigby, & Ryan, 2010) are satisfied.

The present study is intended to make three contributions to research on games in the context of wellbeing and to developing games to facilitate wellbeing. The first is a game usage framework, which characterises players using a set of specific but game-independent factors. Besides being useful for the study itself, the framework will allow researchers in the field of game studies to analyse and compare their observations more meaningfully (e.g. Lobel *et al.*, 2017). Second, the study will enable better understanding of relationships between game usage, wellbeing, personality and needs. This new understanding may contribute to resolving conflicting observations of positive and negative effects of playing games. Third, a more comprehensive description of the relationships between the four constructs will enable identification of aspects of wellbeing that can be facilitated through games, ways in which negative effects can be reduced, and which aspects of game usage contribute to facilitating which effects for which players. These contributions are crucial to realising the potential for games to effectively support wellbeing or being used in other serious contexts (Ceranoglu, 2010).

2.2 Overview of the Core Constructs of the Study

Core assumptions underpinning the present study are that there are individual differences in how players use games, and that these – in turn – may influence players' wellbeing in diverse ways. To evaluate links between game usage and wellbeing, confounding factors need to be accounted for as far as is possible. While numerous variables contribute to wellbeing and motivation, research has identified two general sets of constructs strongly associated with both: personality (Marrero, Rey, & Hernandez-Cabrera, 2016) and needs as defined by Self-Determination Theory (Ryan & Deci, 2017).

Game Usage

Game Usage is the least-researched of the four main constructs considered in the present study and one of the foci of this study. It is important to emphasise game *usage* over game *playing:* although often neglected, people's gaming-related behaviour goes beyond playing games (Kallio, Mäyrä, & Kaipainen, 2011). There is no comprehensive definition or description of what constitutes game usage, posing difficulties for comparing research on gaming (Blake & Klimmt, 2012; Hamari & Tuunanen, 2014). In the present study, g*ame usage* is intended to constitute aspects that reflect gamers' relevant game-related actions in and out of games. A more specific framework for game usage will be developed throughout this project.

Wellbeing

Wellbeing is a general concept with a wide array of aspects (Dodge *et al.*, 2012). Attempts to define the term have consolidated into two main approaches: *hedonic* wellbeing and *eudaimonic* wellbeing (Chen *et al.*, 2012). Hedonic wellbeing focuses on the experience of positive and negative emotions as well as a general sense of happiness with life (Steel, Schmidt, & Shultz, 2008). Eudaimonic wellbeing, on the other hand, focuses on healthy development and positive functioning (Dodge *et al.*, 2012). Even though it has been shown that these operationalisations have significant overlap they seem to be different constructs, and both hedonic and eudaimonic wellbeing have been shown to be related to various other variables often connected with wellbeing, such as self-esteem and depression (e.g., Chen *et al.*, 2012). The present study focussed on eudaimonic wellbeing, because its focus on positive development makes it a suitable frame of reference for the effects of playing computer games: Developing games to promote wellbeing would be aimed at supporting healthy development rather than aspects of happiness (Baranowski *et al.*, 2013).

To illustrate the hypothesised link between game usage and wellbeing, imagine several players, all playing the same online game. One mainly plays with a group of people online to have fun or relax after a hard day's work, which might be expected to increase their wellbeing by providing positive social contact. A second primarily tries to master difficult content playing alone, which could improve wellbeing by providing a feeling of personal achievement. A third mainly plays in an overly-competitive group, which could decrease wellbeing by causing pressure or feelings of stress or anxiety. However, personal factors might modify the choice and impacts of specific game usages: A person who is already

feeling very stressed might be more likely to play non-challenging content, a person who feels bored might try to find something entertaining in a game, and a depressed person might end up just slouching about in a game, not caring what is happening around them.

Personality

The constructs of *personality* refer to a theorised set of internal characteristics that differentiate people and are predictive – to some degree – of how they think or behave (Uher, 2015a). Personality constructs have been shown to be largely stable over the course of a person's life, with the biggest changes usually occurring in adolescence (e.g., Borghuis *et al.*, 2017). There is ongoing controversy about how to theorise personality constructs, but the most common approaches are *type* or *trait* models (Neuman, 2014), with trait models being prevalent in current psychological research (Ozer & Benet-Martinez, 2006). The present study defines personality in the terms of the widely-accepted Big Five personality trait model (Soto & John, 2017a). The five traits hypothesised by that model are *Extraversion, Agreeableness, Conscientiousness, Negative Emotionality,* and *Open-Mindedness*. A full discussion of the reasons for this choice can be found in section 3.3.

In the present study it is theorised that players with different personality traits may have preferences for specific game usages. For example, a player high on the extraversion scale might be more likely to engage with new players, and a player with higher conscientiousness might be more likely to be very focused while playing. Personality is also theorised to influence the relationship between game usage and wellbeing in that the same situations are expected to be experienced differently by players with different personalities. For example, playing in a very competitive group might cause some players to feel connected and experience personal growth rather than anxiety, while doing difficult solo-challenges might contribute to frustration or feelings of loneliness rather than to a feeling of personal achievement. Different personality characteristics are also expected to influence peoples' choices and experiences in life more generally, and therefore will be reflected in their wellbeing and the satisfaction of their basic psychological needs.

Self-Determination Theory

Self-Determination Theory was developed as a model to explain human motivation and is a broad framework comprising several sub-theories (Ryan & Deci, 2000). Its main assumption is that all people share three distinct basic psychological needs: for competence, autonomy, and relatedness. These needs have two implications. First, people will attempt to adjust their

lives so that these three needs are met. Second, if the needs are not met, this will negatively impact a person's wellbeing and often also their functioning (Milyavskaya & Koestner, 2011).

In the present study, Self-Determination Theory – as described by Ryan and Deci (2017) – is used to differentiate between the general life-situations players are in. The frustration of certain needs is theorised to provide motivation to use games in different ways. Referring to the example above, the first player may be playing with friends after work to satisfy relatedness needs, while engaging in challenging solo-content may be the second player's way of satisfying their need for competence. At the same time, if players have established a set game usage, their wellbeing may be affected differently by this depending on which needs are satisfied or frustrated in their lives at a given time. Needs might therefore be theorised to moderate relationships between game usage and wellbeing, and game usage might compliment, or compensate, for a person's needs. For example, the wellbeing of a player whose need for relatedness is satisfied might not improve from meaningful interactions with others in a game, and a player whose need for competence is frustrated might react negatively to inevitably sometimes losing in a challenging game.

2.3 An Overview of Modern Online Video Games

Computer games have become increasingly socially-oriented and complex activities (Cade & Gates, 2017). While not exhaustive, this subsection is intended to offer an overview of core aspects of currently-popular online games. It thereby provides a context for the motivation of the present study, for the studies discussed in the literature review, and especially for the aspects of game usage discussed and analysed throughout the thesis. Understanding of games, players and gamer culture is necessary to understand the diverse ways in which games may influence players (Cade & Gates, 2017). A lack of understanding of games may lead to shallow, inappropriate or incorrect conclusions about player behaviour; misrepresentations in research and media have contributed to distrust of game research in the gaming community (de Larios & Lang, 2014; Wood, Griffiths, & Eatough, 2004).

2.3.1 Popular games and common game types.

The list shown in Table 1 is based on a comparison of five lists of the 10 most popular online PC games in 2019 (newz00, 2019; Ranker, 2019; SportsShow, 2019; TechieGamers, 2019; WallStreet, 2019). Different sources have different rankings because the exact number of

active users of a game is often not available and has to be estimated. Many of the games in the list are estimated to have more than 10 million active players.

Table 1

Most popular online PC games in 2019 by type

Type	Name
Battle Royale-style First Person Shooter	Player Unknown's Battle Ground
	Fortnite Battle Royale
	Apex Legends
Objective-style First Person Shooter	Counter-Strike: Global Offensive
	Tom Clancy's Rainbow Six: Siege
	Overwatch
Multiplayer Online Battle Arena	League of Legends
	DOTA 2
Massive Multiplayer Online Role Playing Game	World of Warcraft
Creative open world game	Minecraft
Online collectible card game	HearthStone
Open world action game	Grand Theft Auto V (GTA V)
Sports game	Rocket League

Battle Royale-style First Person Shooter

First Person Shooters are one of the oldest types of games and have contributed greatly to controversy regarding violence in and through video games, mainly because of the signature feature: playing a character in first person perspective and shooting enemies. Current Battle Royale games are a relatively recent variation of First Person Shooters. Players play solo or in squads, usually comprising up to three players, against up to one hundred other players in a huge and more-or-less random and slowly shrinking arena, meaning players eventually have to fight each other. Players start each match essentially empty-handed and can find equipment – gear, weapons, shields and utility items – on the map. When players die, they are out of the match and all their equipment drops. It can then be picked up by whichever player gets there first. The last person or squad standing wins. Players have to make choices about where to go, which equipment to use and, especially, which fights to pick and when to hide or run.

Objective-style First Person Shooter

Objective-style First-Person Shooters are a more "classic" type of shooter. In these games players (usually) play as part of a squad and can choose one of several basic operator types and equipment at the start of each match, each with its own specialty. The aim is typically to achieve a certain objective, such as accessing, defending or destroying a certain point on the map, rather than killing or outlasting all enemies as in Battle Royale. Exact mechanics and goals in the games differ significantly across games, but all play in pre-determined and usually quite restricted areas.

Multiplayer Online Battle Arenas

The core idea of Multiplayer Online Battle Arenas (MOBAs) is that two teams, usually with three to five players each, start at opposite corners of a rectangular arena and fight their way into the opposing team's base. In these games each player chooses one of many unique characters at the start of each match, which they control from a bird's eye perspective. Periodically groups of computer-controlled units spawn in each base and move towards and attack the enemy's base. All kills give gold and experience to the killer. When a player character dies, they respawn in their base after a delay determined by their level. This simple idea becomes increasingly complex when details – characters with their synergies and weaknesses, the ability to use properties of the arenas, items characters can use, and many more – are considered. Winning a match requires good knowledge of all aspects of the game, fast and correct reactions to the others' actions, strategies and, especially, good coordination within the team.

Massive-Multiplayer-Online-Role-Playing Game

World of Warcraft and other Massive-Multiplayer-Online-Role-Playing games (MMORPGs) are probably the most diverse currently-popular game type. The general idea is that players create a character and then explore a huge online world from a first- or third-person perspective. Usually characters can belong to one of several classes, which determines that character's abilities. Over the course of the game, characters grow stronger, can explore new areas and engage with different content. What makes these games so diverse are the many options players have to interact with the environment and other players in the game and related forums, from gathering plants or crafting equipment, to engaging in group-fights against other player- or non-player characters, to player-developed ideas such as role-playing events or community-wide challenges.

Some games do not fit well into any common category and, while not unique, have combinations of characteristics that set them apart from similar games. For example, in Minecraft players can – alone or with others – build pretty much anything they can think of, which has, amongst other things, led to detailed reconstructions of entire cities. Hearthstone is a digital collectible card game in which players can use their decks to compete with other players or test them in AI-controlled "adventures" with special rules. GTA V gives players the freedom to do almost anything in the game – from going for walks with their dog in a virtual city to being a tow-truck-driver to killing anything on sight – and even enables them to create their own sharable content. Finally, Rocket League puts a new spin on indoor-soccer by having players control rocket-fuelled cars instead of people, with which they can – if they are good enough – perform all kinds of tricks to get a giant soccer ball into the other team's goal.

Two other types of games that are common but not represented in the top 10 lists are **real time strategy games** and **action role playing games**. The general concept of real time strategy games is that players start on a map with a main building and a handful of workers and need to gather various resources to build up their base and army in order to fight AI- or player-controlled enemies. "Real time", as opposed to turn-based, indicates that all players act at the same time. Action-Role-Playing-Games (ARPGs) are similar to MMORPGs in that players control one character of a selectable class which can level up to unlock new abilities and gain equipment to get stronger. In contrast to MMORPGs, ARPGs typically have faster gameplay, and instead of sharing one continuous world with thousands of others, each player has their own private instance of the game which they can open to usually only a handful of others at any time.

2.3.2 Summary of common aspects of the currently most popular games.

Despite the differences and intricacies of the different game types and individual games, there are a number of common aspects that are relevant in multiple or even all of the before mentioned game types. These aspects were developed based on comparisons of in-depth descriptions, player reports, experiences and interviews regarding the 13 most popular games mentioned in the previous subsection. They are intended as a very brief summary of aspects of gam*ing* rather than representing core aspects of the games themselves. The latter would require substantially more detailed information than is necessary for understanding the present thesis, while the former, although providing only a superficial understanding, was deemed sufficient for the purpose of this subsection.

Community

Community can play a role in all games. In some games the in-game community is essential for the game experience – for example, a group may be required to achieve something that cannot be done alone. In others a lot of the interaction between players happens outside the game through forums, websites or face-to-face conversations. A general aspect of game-related online communities is that they are usually international. An interesting recent tendency in many games is for groups to be created automatically, whereas it used to be usual for players to have to find or create groups themselves. A more modern aspect of the overall gaming community are live-streams or *streamers*, where players film themselves playing and share their screen with viewers and comment on their own gaming, or just talk about their day. Some streamers have millions of followers.

Challenge

Most games offer several difficulty-levels and different kinds of challenges. Some require a lot of knowledge of the game and its mechanics or careful planning and heavy preparation, others quick reaction times, good control of characters and adequate decision making, and others again, good communication with teammates.

Competition

All games to some degree entail competitive elements, even cooperative games. Examples are player-initiated races, community-designed challenges, and competitions to be the first in the world to achieve something specific in a new game. A special form of competitions are e-sports, in which players compete with others in tournaments for considerable prize money.

Customisable experiences and diversity

Another aspect of all currently popular games is diversity. Already because online games involve other players, every experience is likely to be different than the previous one. In addition to this, in most games players can choose from a variety of content, play multiple modes – some of which may greatly change the game experience –, experiment with numerous diverse characters and items, explore huge worlds, or can create and share their own content.

2.3.3 The social side of gaming.

The design of many popular games is based on real-time interactions between players connected via internet, some of which can only be played online. There is a wide variety of social features and mechanics common among most of those *multiplayer online games*. Multiplayer computer games usually allow or require players to play in groups, either to achieve something cooperatively or to play against other players. These games mostly provide real-time chat functions that enable players to communicate, as well as official and fan-made forums in which the players can exchange experiences, look for play partners, or provide and retrieve information. Interestingly, not all interactions are directly game related. Often, forums promote sharing of creative works such as stories and drawings and serve as a platform for exchanging opinions on almost any topic, or to organise events outside of the game, such as social gatherings, conventions, and tournaments. Through the forums and in-game chat functions and interactions, online games foster contact between players who have never met physically (Longman, O'Connor, & Obst, 2009). Furthermore, there is almost always someone available to talk to, at any time of day or night.

These social aspects make multiplayer online games and other virtual environments similar to, yet different than, physical environments (Holovatch *et al.*, 2017). One important difference is that players can choose who they want to interact with – as opposed to being at school or work, for example, where one usually has to accept the class or colleagues to which one is assigned. Another is that players can interact with people they have never met before, and those people may expose them to a wider variety of backgrounds and experiences than they experience in their physical environments (Visser, Antheunis, & Schouten, 2013). It has been found that social interactions can have a significant influence on wellbeing and development (Cohen & Wills, 1985). That multiplayer online games provide players with unique social opportunities is therefore a core reason for them having become increasingly interesting to researchers concerned with wellbeing (Ceranoglu, 2010; Turner, Thomas, & Casey, 2016).

However, not only social interactions are of interest. Many modern games offer rich stories, immense immersive environments that players can explore and interact with, and unique customisable challenges of various types and difficulties. These are additional aspects that may influence players' wellbeing (Ryan, Rigby, & Przybylski, 2006). Furthermore, some interactions relating to games happen outside the games in face-to-face conversations or forums, meaning that even single-player games can have social aspects. Finally, how "real"

the influence of interactions with non-player characters can be is a non-negligible but controversial topic of its own (Rigby & Ryan, 2007).

2.3.4 The serious side of gaming.

Games are increasingly becoming a topic of interest in serious contexts, such as education or digital interventions. Following is a brief overview of research in some of those areas.

Gamification

Gamification refers to the concept of using typical game elements outside game settings, for example in education or the workplace (Wiggins, 2016). Usually the main intention for gamifying an environment or task is to increase motivation and engagement. Another is to contribute to pervasive learning and integrating subject matter into students' lives outside school (Pløhn 2014). Especially in education the use of gamification principles has been adopted quickly since about 2010. Some of the most frequent elements are leader-boards, challenges, and achievements (or badges). Reliable research on the effectiveness of gamification, however, is often lacking or inconsistent (Stefan *et al.*, 2017; Tondello *et al.*, 2019). Exploring this in more detail, van Roy and Zaman (2019) found that care has to be taken when gamifying environments and that situational and player variables have to be considered for gamification to achieve the desired outcomes. A different potential use of gamification was showcased by Hanghøj, Lieberoth, and Misfeldt (2018). They point out that the main impact of game-based classrooms may be how they can change social interactions and how lessons are perceived, instead of just making them "fun".

Digital mental health interventions

Two of the most common mental disorders are anxiety and depression, with the latter being one of the leading causes of disability (Fleming *et al.*, 2015). Mental health interventions are targeted at supporting people with disorders, sub-threshold symptoms, and those at risk of developing them. One-on-one interventions are associated with a high cost in money and personnel. It is estimated that only 50%-65% of people with mental disorders in high-income countries get treatment; in low-income countries this ratio is estimated to be under 30% (Cheek *et al.*, 2015). The idea of digital interventions is that regular therapy visits can be substituted for by programmes designed to teach patients the same techniques. Besides being significantly cheaper and saving therapists a lot of time, digital tools can be accessed

anywhere and anytime, can be used for longer than an intervention typically runs, and personal barriers to access them may be lower than those for seeking out a therapist (Fleming *et al.*, 2019). However, it has been found that games and other digital technologies may be used differently by different players, which can change the effect of the tool, and that different aspects may appeal to different players (Orji, Vassileva, & Mandryk, 2014; van der Meulen *et al.*, 2019). Therefore it is suggested that the potential for customization should be carefully considered, and that the gap between intended and actual use of digital technologies could be bridged by considering the characteristics of different users (van der Meulen *et al.*, 2019).

Literature regarding addiction

Gaming addiction is a complex topic. Its psychological term is "Internet Gaming Disorder" (IGD), and it usually is considered a behavioural addiction similar to gambling. In 2013 it was included in the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as "*a condition warranting more clinical research and experience before it might be considered for inclusion in the main book as a formal disorder*" (American Psychiatric Association, 2013), and in 2018 it was included in the World Health Organisation's 11th revision of the International Classification of Diseases (ICD-11) as

> "*a pattern of gaming behavior ("digital-gaming" or "video-gaming") characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences.*
>
> *For gaming disorder to be diagnosed, the behaviour pattern must be of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning and would normally have been evident for at least 12 months*" (World Health Organisation, 2018).

In contrast to other behavioural addictions, IGD has repeatedly been linked to its original precursors, such as peoples' real life situations and needs, particularly to the frustration of autonomy and relatedness needs (Beard & Wickham, 2016; Li *et al.*, 2010; Mills *et al.*, 2018). This suggests that players show addiction-like behaviour most when needs are frustrated and less when they are satisfied, which is uncharacteristic for addictions and hints at a compensatory use of games.

Indications from the literature regarding links between gaming and violence

Concerns about violent video games potentially increasing violent behaviour in users, especially in children and adolescents, started with the first games with violent content. Two of the main figures in the controversy on whether there is an effect or not, Ferguson (a sceptic) and Anderson (a promoter) have been arguing about the effects of violence in games for almost 20 years. The following papers and their references provide a full discussion: (Anderson *et al.*, 2015; Anderson *et al.*, 2010; Ferguson, 2015, 2018). There seems to be a consensus that violent games can increase players' aggressive behaviour, but only if certain conditions are met (Ferguson, 2015). Examples of these conditions are players having pre-existing violent characteristics and traits, being exposed to violence in normal life, and playing those games in certain ways. It has been proposed and observed that how a game is played seems to be more important than the content of that game. For example, Peng, Liu, and Mou (2008) found that aggressive people played a game with potentially violent content more violently than non-aggressive people, which in turn led to different experiences of the same game. The specific variables of relevance are not known, however.

The topics discussed before cover a diverse range of research. Yet all point out the uncertain contribution of different ways in which players use games and the unknown interactions between game usage and environments outside of the game. This emphasises a need to regard game usage and different player experiences as key variables in research on the effects of games.

3 Review of the literature

3.1 Game Usage

3.1.1 General research on the usage of video games.

Game usage is the newest and least researched of the four main constructs in the present study. In their summary of research on computer game usage, Blake and Klimmt (2012) observed that most surveys only consider the average time players spend on games, but not how that time is being used. Researchers often neglect the social settings of games, that games differ significantly, and that many games allow more than one kind of playstyle (Blake & Klimmt, 2012). They concluded that research on games "is in need of better data about game usage" (p. 366) in order for the field to make progress and to develop and test theories. A big issue is the lack of a definition or even comprehensive description of what game usage comprises. Accordingly, the search for literature in this area – mainly through online databases such as ACM, Psyc, ProQuest, Scopus SpringerLink, Wiley – covered multiple search terms, such as *play style*, *game usage* or *player behaviour* and was then guided further by the terms used and articles referenced in the various publications found. Any literature was considered that described or could be used to infer how players engage with games or are influenced by them. Therefore, literature reporting on players' motivations and experiences was also included. A focus was on empirical studies and reviewing meta-studies.

Researchers over the past two decades have used various approaches. For example, Bartle (1996) assigned all players to one of four types based on what they enjoy in games, Bean and Groth-Marnat (2014) considered whether players primarily engage in player vs player, player vs environment, or role-playing elements, Yee and Ducheneaut (2016) differentiate players based on 12 motivations for playing, and Tondello *et al.* (2018) propose a trait model in which players can be oriented towards aesthetics, action, or goals. Overall, most approaches describing game usage can be classified into either of two categories: motivation-focussed and experience-focussed.

Motivation-focussed approaches

Over the past two decades many studies have set out to investigate what players do in-game. Often, though, the focus is on *why* players play certain games, rather than on *how*. This reflects the fact that much of the research in this field is done for and by game developers

who are mainly interested in finding out how to make games more appealing or engaging for players (Mena, 2012). One of the first widely-known descriptions of play styles is a taxonomy developed by Bartle (1996), based on a long-lasting online discussion from 1989 to 1990 between 15-30 experienced payers of a *multi-user-dungeon* (MUD, an early form of text-based online computer game). The topic of the discussion was "What do people want out of a MUD?" (Bartle, 1996, p. 2). Based on that discussion, he identified four main aspects that players enjoyed: *achieving* in-game goals, *exploring* the game, *socialising* with others, and *killing* – or annoying – others. His intended contribution was to help developers and programmers of MUDs make informed changes that appealed to these types of players. His taxonomy has been widely used by developers and researchers alike (e.g. Bostan, 2010; Johnson & Gardner, 2010; Przybylski, Rigby, & Ryan, 2010; Yee, 2006).

Another well-known conceptualisation of game usage is the "The Gamer Motivation Model" (Yee & Ducheneaut, 2016). Based on factors identified in their own previous research (e.g. Yee, 2006) and an extensive review of the literature, the authors developed a questionnaire asking participants to rate the importance of various aspects of video games. After several reviews and adjustments, based on factor analysis and clustering of data from over 200,000 participants, they proposed twelve different motivations that combined into six different main motivation groups: Action, Social, Mastery, Achievement, Immersion, and Creativity. In *Figure 1* the twelve motivations and two-to-four motivational aspects associated with each of them are presented. The motivational aspects are of interest because different motivations usually lead to different behaviours and might therefore directly imply certain usages of games (Huang, Yang, & Chen, 2015). As examples, players who enjoy elaborate plots in games might spend a lot of time following the story, might prefer to play alone and spend a lot of time outside of the game thinking about in-game characters, while power-focused players might instead spend a lot of time perusing the forums for guides on how to play more effectively. Bartle's and Yee's models have considerable overlap: Bartle's *killers* are represented in Yee's *action* and *social* motivations, Bartle's *achievers* in Yee's *mastery* and *achievement* motivations, Bartle's *explorers* in Yee's *creativity* and *immersion* motivations, and Bartle's *socialisers* in Yee's *social* motivation.

Figure 1: Motivations and associated aspects in the Gamer Motivation Model, copied from Yee and Duchenaut (2016); redacted because of copyright

However, it is important to be aware that motivation is not the same as game usage and, even when players have certain main motivations to play games, this in itself does not mean that they get to act on them in any given game. How players use games may, for example, be limited by the games they have access to, the social environment or the specific settings they play in, their own knowledge of different playstyles or a game's mechanics, and their willingness to try something new.

Though considered just one of six motivation groups by Yee & Ducheneaut (2016), social aspects of games have received special attention by many other researches investigating motivations for video game play. In their study with 409 participants, Kowert and Oldmeadow (2015), for example, focused on social skills and attachment. They found that participants' social situations could be an important motivation for online video game play. Particularly, playing video games was used to satisfy attachment needs. They use their results to challenge the assumption of many previous game researchers that entertainment is the primary motivator for gameplay. They argue that the motivational pull of online video games due to their social aspects may largely not just stem from fun, but rather from providing critical attachment functions, such as a sense of closeness. A similar view was expressed by Hamari and Keronen (2017) based on a literature review of motivations for playing games. Besides establishing that it is still unclear why games are being used, they conclude that it seems that enjoyment and usefulness are both relevant to understand why people play, and that social orientations seem to be a key aspect. Both Kowert and

Oldmeadow (2015) and Hamari and Keronen (2017) argue that researchers should not attempt to place all games and all players into one category and that games should be investigated with a more holistic approach including more varied measures.

Experience-focussed approaches

A second common basis for distinguishing players is their game-related behaviours and in-game experiences. Kallio, Mäyrä, and Kaipainen (2011) conducted a number of consecutive studies over three years that combined different qualitative and quantitative elements. They posited that, because games, players and play are embedded in the "real" world, the experiences and behaviours of players are influenced by many different, mainly social, variables. Additionally, they suggested that some of the findings of other researchers may have been interpreted incorrectly. For example, some players who reported playing games for social reasons turned out to prefer playing alone, and the social factor for them was sharing their experiences afterwards in person, rather than interacting with other players in the virtual environment. Kallio et al. developed a framework that distinguishes and describes play behaviour based on *session length, regularity of play*, and *intensity of concentration* on the game as part of what they called the "Intensity" component; *shared physical space, shared virtual space*, and *outside of the gamespace* for their "Sociability" component; and the *device and game used, genre of games preferred*, and how *easily accessible* the games are as part of their "Games" component. Lastly, Kallio, Mäyrä, and Kaipainen (2011) point out the important issue of the stability of player types. In their study they found that players adjust the games they play and how they play depending on their situation. They describe this as *fluid change*. Their study points out several shortcomings of other studies and makes many suggestions for future research. However, their framework, while an informative guideline, is very general and unspecific, limiting its use in correlational analyses.

Since Kallio, Mäyrä, and Kaipainen (2011) there have been multiple other studies investigating what is now often called *player experience* by researchers. To date there is no generally-accepted organising framework in this field of research, either, and studies on player experience, while having common aims, use individual approaches. Wang *et al.* (2011), in one of the earlier studies in this area, analysed surveys and in-game log data from a MMORPG, to show that game-play behaviour – such as crafting things and group-related activities – differed based on how experienced players were in the game. The same

observation was made by Mora-Cantallops and Sicilia (2018) in the different context of a Multiplayer-Online-Battle-Arena: They found that the experience of players differed with their rank in the game. In addition to social experiences, McGloin, Hull, and Christensen (2016) also considered different settings in the same game. Their results showed that the experiences of players varied with the kind of content they chose and on the outcomes of in-game scenarios. As an example, other players in the group were experienced as being positive in situations that resulted in success and negative in situations that culminated in failure. Overall, they found that players seemed to experience greater enjoyment in a cooperative than in a competitive setting. This is a very interesting result considering the currently popular gaming scene, which mostly consists of competitive games (e.g. Multiplayer-Online-Battle-Arenas and Battle Royales). However, many of the currently-popular games in fact offer *cooperative competitive* gameplay – playing with a team of known or random players against a different team – which the study by McGloin and colleagues did not consider.

Supporting the assumption that understanding what people do in games is important for evaluating player experiences, Flueggen, Doyle, and Veith (2018) conducted six in-depth interviews on the general experience and meaning the game *World of Warcraft* had in their lives with young adults, who had been long-term players of that game. The authors found that the players used the game differently, and that how they used the game determined how they perceived it. This in turn seemed to determine what the game meant to them and how it influenced them. Another interesting finding was that how the players used the game appeared to be related to their situations in life, particularly to critical psychological aspects that were lacking in their normal lives. An example is that a competitive person, who had to give up her main sport for reasons outside the game and felt she did not fit in with others in her class, started playing the game in a very competitive group who became her main circle of friends. Another is a person who felt bored and restricted in their normal life, who experimented in the game, even trying to abuse game-mechanics in order to find optimal solutions for in-game challenges. Similar observations were made by Oswald, Prorock, and Murphy (2014), who conducted an exploratory qualitative survey-based study. They asked 173 participants (mean age=23 years) who were recruited through online forums to describe the meaning of their most recent gaming experience. Their analysis identified 57 themes for six main categories of meanings: emotional responses, game play, social, outcomes of play, goals, and personal qualities. What they found striking was the complexity and diversity of

the responses and individual goals of the players, and that, apparently, social interactions were more important for the player experience than the content of the games themselves. They concluded that future research on games should focus on the experiences of players in games and assess those in detail, potentially even by directly asking players about their perceptions, rather than using pre-defined rating systems of game content. Finally, they suggest Self-Determination theory as a relevant framework to understand players. The authors posit that it may clarify players' motivations, as well as their different experiences while playing, and the diverse influences those different experiences have on them.

3.1.2 Operationalisations of game usage.

Over the past 15 years a variety of models and accompanying instruments have been developed to differentiate between players.

Two of the most commonly-used instruments are the Game Experience Questionnaire (GEQ; Johnson, Gardner, & Perry, 2018) and the Player Experience of Need Satisfaction (PENS) Scale. The GEQ was developed by IJsselsteijn *et al.* (2007) to measure user experience in digital games. It was based on theoretical assumptions about gamer experiences as well as findings from focus groups with experts, designed to capture diverse games and varied experiences. The result was a model measuring seven different aspects called *positive affect, negative affect, frustration, flow, challenge, immersion,* and *competence*. The PENS scale was developed by Ryan, Rigby, and Przybylski (2006) to incorporate the three basic needs – autonomy, relatedness and competence – plus two additional factors considered relevant for games called presence/immersion and intuitive controls. *Presence/immersion* describes to what degrees players feel they are in the game, both physically and emotionally, and *intuitive controls* describes whether players feel they have an intuitive understanding of the controls and can use them to execute what they intend. Both instruments were well received by the research community, despite lacking substantial empirical support (Johnson, Gardner, & Perry, 2018). Denisova, Nordin, and Cairns (2016) argued that one of the issues in the field is the number of different models, combined with the lack of a unified model of player experience, which makes it difficult to compare results across studies. They set out to analyse and compare PENS, the Game Engagement Questionnaire (GEngQ), and the Immersive Experience Questionnaire (IEQ) using regression and factor analyses with a sample of 270 participants. The IEQ focuses on the experience of immersion. Their results showed a structural weakness of the PENS in that immersion and relatedness were loaded by one factor, and competence, autonomy and intuitive controls by a second factor.

Especially the substantial correlation between controls and competence (r=0.55) caused them to question the distinctions in the original factor structure. Overall, they found that the correlations between the different instruments – based on averaged needs and engagement scores – were high. The GEngQ and IEQ had an overall correlation of r=0.8, the IEQ and PENS r=0.8, and the GEngQ and PENS r=0.7. Some of the individual factor correlations between instruments showed r>0.8. In addition, they reported the feedback of participants that some of the instruments' items seemed inappropriate for certain games. According to their study, the models have significant conceptual overlap despite having been developed with different theoretical aims. They concluded that it would be helpful and, based on their results, also feasible, to construct a more widely-applicable, unified method. The IEQ and GEQ ask very general questions, and the authors finish by noting that neither survey probes finer nuances, for example, regarding social interactions or challenges in games, and that more research is needed on those individual differences, an opinion that is shared by Hamari and Tuunanen (2014).

Another evaluation of PENS and the GEQ was conducted by Johnson, Gardner, and Perry (2018). In their study, both questionnaires were completed by 571 students in tertiary education who were asked to complete them with reference to their favourite game. The responses were analysed using exploratory (n=226) and confirmatory factor analyses (n=326). For the GEQ they noted that many items had poor loadings and selected a 5-factor interpretation – in contrast to the seven-factor structure proposed by the developers. The resulting factors were described as reflecting *positive feelings, negative feelings* and *stress*, *competence*, *immersion*, and a complex *story/exploration/engagement* factor. The confirmatory factor analyses indicated that the original seven-factor model had a poor fit and the revised five-factor model had moderate-to-acceptable fit, but also that several items should be adjusted to better measure the underlying factors. For the PENS the exploratory factor analysis indicated a 4-factor solution with items loading on three distinct *autonomy*, *relatedness* and *presence/immersion* factors and a combined *competence and intuitive controls* factor. The confirmatory factor analysis indicated a moderate fit for the original model and an acceptable-to-good fit for the revised one. The authors noted that asking about participants' most recent experience in their favourite games probably skewed their results, as positive experiences were likely to be over-represented. The descriptive statistics for the negative items showed floor effects; these items may have differentiated and loaded differently with a more balanced frame of reference for respondents. Furthermore, the

authors explained the high correlation between intuitive controls and competence – also observed by Denisova, Nordin, and Cairns (2016) – in terms of satisfaction of the need for competence being more likely in skilled or experienced players, who would generally be more familiar with the game's controls. Conversely, players struggling with the controls are likely to experience this as thwarting their competence.

A newer questionnaire, the HEXAD, was developed by Tondello *et al.* (2016); see also Tondello *et al.* (2019). These authors' main motivation was to develop a model that would enable personalisation of games by taking into account different gaming preferences. A precursor of the HEXAD, based on a variety of previous models and theories, including the Myer-Briggs' personality type model, was developed by Nacke, Bateman, and Mandryk (2014). This was a seven type gaming preference model, called BrainHex, which was later modified to the HEXAD, a model with six types, after leaning more heavily on Self-Determination Theory (Tondello *et al.*, 2016). These six types are based on six different hypothesised motivations, three of which directly come out of the basic needs described in Self-Determination Theory. They are considered to be: *change, autonomy, mastery* (competence), *reward, relatedness,* and *purpose*. In this model, players are assigned a type based on the motivation for which they score highest. Factor analyses with forced 6-factor solutions indicated moderate factor loadings, except for the autonomy and competence-related factors, which, on average, showed factor loadings of less than 0.5. Moderate-to-high correlations ($0.5<r<0.7$) were found between the six types (Tondello *et al.*, 2019; Tondello *et al.*, 2016). Confirmatory factor analyses indicated acceptable model fit. Finally, most correlations with the Big Five personality traits were weak ($r<0.2$); the only stronger correlations were between relatedness and extraversion and agreeableness and between competence and conscientiousness ($0.25<r<0.3$). One of the main issues with this model is that it ignores participants' scores and preferences not associated with their type. Also, the authors acknowledge, their model lacks empirical support and it is the trend in research to move towards trait- rather than type-models which better matches current views on personality in psychology (Tondello *et al.*, 2018). To develop a new, trait-based, model they constructed a new questionnaire based on the previous BrainHex instrument with additional items on participants' gaming preferences. Factor analysis of the responses suggested three core factors with acceptable factor loadings. These were labelled *action-*, *esthetic-* and *goal-orientation*. Finally, they compared their model to that of Yee and Ducheneaut (2016) and found that their results were similar. However, the labelling of the

factors by Tondello *et al.* (2018) may be misleading. The five items grouped under esthetic all reflect social aspects or exploring behaviours (e.g. "talking to other players" or "wondering what's behind a locked door"), and the items grouped under action represent suspense (e.g. "taking on a strong opponent in a versus match" or "completing a punishing challenge after failing many times"; both of these items also apply to chess and puzzle-games, which would not usually be considered to involve a lot of action).

Besides these theory-driven models, there also are more empirically based approaches. An interesting example was developed as part of a study by Worth and Book (2014). These authors tested a questionnaire with 38 items based on descriptions of activities in the game World of Warcraft, discussions about player behaviours on the forums, and Bartle's and Yee's models. Items were written for a frequency scale and completed by 198 players. Principal component analysis and subsequent parallel analysis revealed six components. The factors were named *Player-versus-player*, *social player-versus-environment*, *working* (comprising earning gold or reputation, or using the in-game crafting system), *helping*, *immersion*, and *core content* (comprising levelling, questing, and difficult group content). Scores on these components were then compared with participants' personality traits based on the HEXACO model (explained in section 3.3), with many of the correlations being between r=0.3 and r=0.4. In total, 23% of the variance each of the "PvP" and "Helping" factors could be explained by personality traits, compared with between 12% and 16% of the variance of the others. Worth and Book concluded by noting that the correlations between personality traits and in-game behaviour are consistent with their expectations from real-world behaviour, and that future research should aim to develop a more refined in-game behaviour questionnaire.

Finally, to investigate the effects of violent and prosocial games on social outcomes, Greitemeyer and Mugge (2014) conducted a meta-analytical review of 98 studies. They found that games do affect both violent ($d<0.25$) and prosocial behaviour ($d<0.42$, average around 0.3) positively and negatively, and that the nature of this influence depends on the content of a game. They concluded that which games are played is the most important variable. One main weakness of this study is the notion and categorisation of games being violent or pro-social: both game types are ill-defined, mainly in terms of the presence or absence of violence. It is dubitable, though, whether all games that (do not) include violent aspects in some form are comparable – for example, Pac Man and Battlefield. Additionally, many games with violent content can be played in prosocial ways, and some prosocial games by

intention can still be played in anti-social ways. Another issue is that the study included correlational, longitudinal and experimental studies – the former two of which are not suitable to establish causality – without providing information about how validity of results was ensured. However, independent of the authors' arguments about causality, their study provides support for the claim that behavioural outcomes and game type are consistently linked.

There are several general remarks to be made regarding the models and instruments presented in this section. First, all of the instruments have a contestable factor structure. On this note, the two most frequently-used questionnaires were not validated or compared with alternative models for more than 10 years after their development. Many researchers have called for a unifying, comprehensive and detailed instrument to measure player experience, in order to enable meaningful comparisons of results and to better understand the influences of games (Denisova, Nordin, & Cairns, 2016; Hamari & Keronen, 2017; Johnson, Gardner, & Perry, 2018). Finally, there is agreement that more research is needed – qualitative as well as quantitative – for "investigating more fine-grained phenomena rather than examining players only as seen through pre-defined factors" and to "[study] differences across game types, platforms and play contexts" (Hamari & Tuunanen, 2014, pp. 47-48). Furthermore, the review conducted here highlighted that, while the focus of research used to be on the games and their content, it appears that, to determine the influence on players, the key variables are inherent in the players, not in the games. This could be seen as contradicting the conclusion by Greitemeyer and Mugge (2014), or it could indicate that the link found by the latter connecting violence and game type results from certain players having a preference for certain ways in which to use games, a variable not considered by Greitemeyer & Mugge (2014).

The concepts discussed in this section – which have significant overlap and are used for the same purposes – have been referred to as *player type, style, experience, engagement, usage, motivation, preference,* and *behaviour*. This might have contributed to the development of a variety of similar instruments over the past 10 years, with many papers not acknowledging the existence of the others. The only two models that appear to be generally known are those of Bartle (1996) and Yee (Yee, 2006; Yee & Ducheneaut, 2016). However, the former is over 20 years old, very general and was developed in a gaming context that does not exist anymore. The latter is based on an instrument, data and analyses that are not publicly available, making it unverifiable.

Informed by this review, none of the existing instruments seemed adequate as a tool for the present study. Instead, it was decided to construct a new comprehensive framework and associated instrument that considers the different approaches, conclusions and suggestions discussed here. This new framework was developed on the basis of interview data from users of various games, tested and adjusted drawing on a diverse sample and using exploratory factor analysis to give it a strong empirical basis.

3.2 Wellbeing

3.2.1 Conceptualisations of wellbeing.

Wellbeing is an important but complex topic of research. To date there is no generally accepted definition of what the term encompasses. This is partly due to its diversity and due to it usually being described through its various facets rather than a definition (Dodge *et al.*, 2012). In this section some of the common approaches to describing wellbeing are presented. The search for literature on wellbeing went through several stages. First, searches focused around reviews of research on wellbeing. Afterwards, the various concepts of wellbeing were specified in the searches before the focus was shifted to concepts of eudaimonic and psychological wellbeing and different instruments to measure these. Finally, literature referring to wellbeing in the context of video gaming was searched. While this literature was searched very widely to get a general understanding of the current state of this field, only those publications were included in this thesis that make substantial contributions to the understanding of the interactions and that provide convincing support for their claims and conclusions. Therefore, some recent research, although it is interesting and promising for the future – for example research on passion or vitality (e.g. Lalande *et al.*, 2017) – is not presented here; in the current state of that research its contributions to the present study would be minor, but doing them justice would still require in-depth discussions that would overall be of little consequence for the present thesis.

Wellbeing as absence of illbeing: One common approach to describing wellbeing is through the absence of indicators of illbeing (Rose *et al.*, 2017). Typically, in research using this approach, wellbeing is established by noting an absence of negative symptoms such as depression or loneliness; the less strongly a person scores on various negative instruments,

the more 'well' they are assumed to be (e.g. Aldridge & Gore, 2016; Bech *et al.*, 2003; Deighton *et al.*, 2014; van der Aa *et al.*, 2009). One of the main points of criticism is that this approach and the related instruments do not allow differentiation of people with normal or high wellbeing (Cooke, Melchert, & Connor, 2016; Rose *et al.*, 2017). In addition, this approach does not have a general underlying conceptualisation of well- or illbeing. Instead, researchers choose specific aspects of illbeing they believe to be relevant for their study, which inevitably ignores other potential aspects of (negative) wellbeing.

Wellbeing as happiness: Another approach is to consider wellbeing as happiness (e.g., Ryff, 1989b). Under this approach, if a person is cheerful or experiences positive feelings *and* is not sad or experiencing negative moods, they are considered to have high wellbeing (Burns & Machin, 2010). There are many different aspects and uses of this approach in the literature, from positive and negative affect to satisfaction with life (e.g., Anglim & Grant, 2014). This conceptualisation is referred to as *hedonia*. Common critique of these approaches is that happiness can change quickly, its aspects are very subjective, and in the long term may not be meaningful (Vittersø, 2016).

Wellbeing as positive functioning: Wellbeing has also been described as representing healthy development and positive mental functioning (Ryff & Singer, 2008). This conceptualisation is often referred to as psychological wellbeing or *eudaimonia* (Waterman *et al.*, 2010). Instead of happiness, this approach focuses on whether a person feels that they lead a fulfilling life. In this view something unpleasant or stressful can contribute to a person's wellbeing by making them feel they are working towards something worthwhile. A core issue with this approach is defining a "fulfilling" life and the aspects that contribute to this sense of wellbeing (Chen *et al.*, 2012). The description as 'worthwhile' also implies that this definition of wellbeing may depend on a society's or person's values (Nastasi & Borja, 2016), or rather on an alignment between a person's values and their behaviour.

Miscellaneous aspects of wellbeing: Besides and between these major conceptualisations are numerous approaches that focus on individual aspects of wellbeing: Social wellbeing focuses on the experience of social relationships (Hill *et al.*, 2012); emotional wellbeing focuses on what emotions are prevalent in a person's thinking and how they are experienced (Cooke, Melchert, & Connor, 2016); and subjective wellbeing focuses on personal experiences of wellbeing (Steel, Schmidt, & Shultz, 2008). Already in 1978, Shin and Johnson (1978) – two early researchers attempting to define wellbeing – emphasised that wellbeing

has a strong personal aspect and is defined by people's own criteria. This makes subjective wellbeing a potentially problematic term, but it generally is associated with hedonic approaches, though this categorisation is disputable and depends on the specific operationalisation (DeNeve & Cooper, 1998; Harris *et al.*, 2017).

Many of the above conceptualisations have significant conceptual and statistical overlap (Chen *et al.*, 2012). In the context of the present study, though, it does not matter much if games lead to happiness, and – while important – it is not sufficient to determine if negative symptoms get worse or better. In the long term, it is most important for family, psychologists, and researchers to know if a person's positive development gets impaired or supported through using games. Therefore, the general eudaimonic approach was perceived as the most informative and relevant for the present study. But despite all approaches related to eudaimonia considering aspects that are assumed to be relevant for psychological functioning and healthy development, it still is a diverse concept because of a lack of consensus as to what contributes to and how to measure 'psychological functioning'.

3.2.2 Operationalisations of eudaimonia.

As consequence of the various approaches to describing wellbeing there also are numerous operationalisations. In a recent review considering only instruments with psychological aspects that were specifically developed to evaluate wellbeing, Cooke, Melchert, and Connor (2016) identified 42 currently used instruments. Only five of those were classified as having a clear focus on eudaimonia, and only two were instruments developed to measure a general concept of eudaimonic wellbeing: Ryff's psychological wellbeing scale (Ryff, 1989a) and the *Questionnaire for Eudaimonic Wellbeing* (Waterman *et al.*, 2010). However, there are other instruments with aspects relevant to eudaimonic wellbeing, which in that review have been assigned to different categories, making the true number of relevant instruments and operationalisations difficult to estimate.

Eudaimonia is generally focussed on positive psychological functioning and therefore often referred to as psychological wellbeing or mental health. But what contributes to "positive functioning" is not clear-cut (Proctor & Tweed, 2016; Vittersø, 2016). It is also often defined empirically through instruments rather than theoretically, which implies a lack of conceptual definition (Chen *et al.*, 2012; Dodge *et al.*, 2012; Ryff, 1989a). One of the first comprehensive attempts at developing a theory in this field was the concept of psychological

wellbeing developed by Ryff (Ryff, 1989a), and still is one of the most frequently-used and discussed models (e.g., Opree, Buijzen, & van Reijmersdal, 2018). Ryff's main motivation was the observation that, for the ageing population she dealt with in her research, happiness, satisfaction, or clinging to youth did not contribute much to their overall feeling of wellbeing. Trying to find a concept that explains the perception of that population, as well as that of younger generations, she drew heavily on life-span developmental theories, theories of personal growth and successful ageing, and current views of mental health. Finally, based on Jahoda's (1958) suggestions, she developed her model of six criteria that she posited as being relevant to explain and evaluate psychological wellbeing. These categories are *Self-Acceptance, Positive Relations with others, Autonomy, Environmental Mastery, Purpose in Life,* and *Personal Growth*. The theory was a big step in wellbeing research in that it drew from and connected different fields of general health and psychological research and provided a base for future discussions and comparisons. In subsequent research, Ryff (1989b) investigated three groups of people with average ages of 20 years (n=133), 50 years (n=108), and 75 years (n=80) to operationalise this new concept by developing an instrument later called "Ryff's psychological wellbeing scale". Her findings indicated that several of her dimensions of wellbeing were substantially correlated. For example, the correlation coefficients between self-acceptance and environmental mastery and purpose in life each were above 0.7, indicating that these factors may in fact be expressions of a single underlying factor. She justified her assumption of distinctiveness by pointing out that the different factors relate differently to other wellbeing constructs and measures, and that the correlations differed for the different age groups.

The weak empirical basis and especially the lack of evidence for six distinct factors have attracted much criticism (Abbott *et al.*, 2010; Abbott *et al.*, 2006; Burns & Machin, 2008; Chan, Chan, & Sun, 2017; Ryff & Singer, 2006; Springer, Hauser, & Freese, 2006). These studies all reproduced the high correlations between self-acceptance, purpose in life and environmental mastery that Ryff had noted in her original report (Ryff, 1989b), and some also found personal growth to be highly correlated. In contrast to Ryff, however, the critics cited above interpreted these correlations as evidence against the structure of her model being valid. The first attempt at using exploratory factor analysis to provide more insight into the structure was a set of studies by Burns and Machin (2008). Their scree-plot indicated six-to-nine factors but these solutions did not converge and the authors did not report the model specifications used for the analyses. Four- and five-factor solutions resulted

in substantial cross-loadings of items. They therefore adopted a three-factor solution. The resulting factors matched those suggested in other studies, with *self-acceptance, purpose in life, environmental mastery* and *personal growth* loading mainly on one factor, and *autonomy* and *positive relations with others* being separate factors. However, their three-factor solution showed a high sample dependence. In addition, in this solution most factors were poorly defined: Many items did not load significantly onto any of the three resulting factors and items from the personal growth aspect had low (<0.4-<0.5) loadings on the factor comprising four of Ryff's dimensions. The number of self-acceptance items and of purpose-in-life-items were halved when items with low loadings were removed. Nonetheless, even the autonomy factor in one of their studies had no loadings above 0.4. Therefore, while this study emphasised that Ryff's model is problematic, it could not provide a better alternative. Another study to have subjected Ryff's questionnaire to exploratory factor analysis was that of Chan, Chan, and Sun (2017). Their results indicated a solution with more than six factors and seemed to differentiate between positive and negatively worded items. However, these authors did not provide sufficient information on their analysis for further evaluation.

Another instrument designed to measure eudaimonic wellbeing is the Questionnaire for Eudaimonic Wellbeing (QEWB). It is based on a framework called flourishing, which can be understood as an aspect of eudaimonia (Waterman *et al.*, 2010). Waterman *et al.* (2010) used the ideas of *enjoyment of activities*, *intense involvement in activities*, *investment of effort in pursuit of excellence*, a *sense of purpose and meaning in life*, *perceived development of one's best potentials*, and *self-discovery*, which they see as underpinning flourishing (Waterman *et al.*, 2010). The main evidence on which they based their claim of validity were high correlations with other wellbeing related measures, a single-factor confirmatory factor analysis, adequate Cronbach-alpha values, and moderate test-retest reliability scores. However, some of these tests only assess reliability – which is a necessary, but not sufficient, condition for establishing validity – and a confirmatory factor analysis assessing only one model without a previous exploratory factor analysis has only limited validity (see sections 4.3.2 and 4.3.3 for in-depths discussions of the approaches and their uses). Garcia *et al.* (2016) subjected the QEWB to exploratory and subsequent confirmatory factor analysis. Their findings contradicted the original psychometrics of the questionnaire: their results indicated a three-factor solution. They described the likely factors as *sense of purpose, purposeful personal expressiveness,* and *effortful engagement*. They also eliminated 11 of the original 21

items due to cross-loadings and no loadings, casting serious doubt over the original instrument and its structure.

The last instrument discussed here is the five-item version of the World Health Organisation's wellbeing index (WHO-5). It was developed from a combination of other wellbeing instruments in an effort to create a short positive wellbeing instrument; the exact development and original validation process could not be reconstructed due to not finding all references (Bech *et al.*, 2003). Though often considered to measure subjective wellbeing (e.g., Bech, 1999; Topp *et al.*, 2015), it was based mainly on five items from the Psychological General Wellbeing Scale (Bech, 1999) and therefore should actually be considered a psychological wellbeing instrument. The WHO-5 contains five positively worded items and focuses on a positive state of mind such as feeling cheerful or calm, expressions of vitality such as feeling active or fresh, and being interested in life (Topp *et al.*, 2015). It assumes one general wellbeing factor and has been shown repeatedly to have good and stable psychometric properties (Brähler *et al.*, 2007; Topp *et al.*, 2015). Furthermore, it has been used widely in clinical and non-clinical settings in different countries and has been found to discriminate between people with high wellbeing as well as to be a reliable indicator of negative mental health conditions such as depression (Dadfar *et al.*, 2018; Krieger *et al.*, 2014). The various links to other measures that are commonly used as indicators for good or poor psychological functioning further support the claim that this instrument should be considered to measure eudaimonic wellbeing. As mentioned before, the usefulness of the term *subjective wellbeing* as categorisation is questionable.

In summary, there is a variety of different operationalisations of eudaimonic wellbeing. The main issues seem to be the diversity of the field and a lack of agreement on what it should constitute. This is exacerbated by a lack of empirical support for the structures suggested. What is intriguing is the apparently limited use of factor analysis in this field, and an inclination to develop completely new instruments based on similar concepts, which often turn out to have the same issues, rather than attempting to consolidate the already-existing knowledge, theories, and instruments into a single comprehensive framework. The Ryff scale is amongst the most comprehensive and most frequently used questionnaires for eudaimonic wellbeing (Chan, Chan, & Sun, 2017; Opree, Buijzen, & van Reijmersdal, 2018; Ryff, 2014). However, it has a contested factor structure, is long, and is inappropriate for

younger age groups (Abbott *et al.*, 2006; Burns & Machin, 2008; Opree, Buijzen, & van Reijmersdal, 2018). While Waterman *et al.* (2010) report a very good fit for a unidimensional structure of the QEWB based on their CFA, Garcia *et al.* (2016), using exploratory factor analysis and subsequent confirmatory factor analysis, concluded that several of the original items discriminate or load poorly and that a 3-factor model is more adequate and results in a better model fit for their sample. Furthermore, the QEWB has rather complex items and is a comparatively long questionnaire for a single factor. Finally, the WHO-5 is a well-established, short, simple, and apparently valid instrument, that has been shown to be indicative of various other measures of well- and illbeing, and it has been shown to be acceptable for use with older and younger participants (Topp *et al.*, 2015). These factors make it particularly appropriate for inclusion in a survey comprising a number of instruments and being administered to people with various levels of English-proficiency. Therefore, and because it was the only widely used and accepted instrument found without major concerns about its validity, it was selected as instrument to measure wellbeing in the present project.

3.2.3 Wellbeing in the context of video games.

The positive and negative influences of computer games are often explained with variants of four models: the *displacement hypothesis*, the *social augmentation argument*, the *compensatory use hypothesis*, and *social capital*. The displacement hypothesis posits that, because playing computer games takes time, players spend less time on other activities (Shen & Chen, 2015), *ipso facto* leading to negative impacts on academic performance or relationships with family and friends. Social augmentation, on the other hand, refers to the possibility of using games to be in contact with friends or family when one usually could not, or playing computer games with them instead of doing other activities together (Cuihua & Williams, 2011). The compensatory use hypothesis posits that playing games with social aspects may compensate for a lack of social relationships in other aspects of life (Bessière *et al.*, 2008; Kowert *et al.*, 2015). Social capital is a very general theory, that describes a person's relationships and the benefits the person gets from them. A concept of particular interest is that of "bridging" vs "bonding" capital (Shen & Chen, 2015). While the former describes superficial and temporary relationships, the latter means stronger and more personal relationships, which are typically assumed to be required to receive social support (Longman, O'Connor, & Obst, 2009). Social support in turn has been shown to be related to greater wellbeing (Cohen & Wills, 1985). The difficulty is that these theories partly compete

with each other, yet all have been supported by research, which is a reason for one of the main ongoing controversies in this field (e.g. Ferguson, 2015).

Wellbeing-related concepts frequently linked to playing video games are loneliness, depression, self-esteem, and perceived social support (e.g. Dolatabadi *et al.*, 2013; Levy & Sabbagh, 2008). For example, Lemmens, Valkenburg, and Peter (2011) investigated correlations between pathological gaming and loneliness, self-esteem, life satisfaction, and social competence in a Dutch sample of 543 gamers aged between 11 and 17 years using various game platforms. Pathological gaming in that study was defined as "excessive involvement with computer games that cannot be controlled" (Lemmens, Valkenburg, & Peter, 2011, p. 1), measured through an adapted pathological gambling scale. The authors employed a paper-based design and administered their questionnaires twice, to four schools, six months apart. They found that lower scores on the wellbeing variables were antecedents of higher scores in pathological gaming, while pathological gaming was an antecedent for loneliness. The correlation coefficients were low with values less than r=0.2. Their main conclusion was that playing computer games may increase loneliness, while it appears that pathological gaming may at the same time be a consequence of lower wellbeing. The main limitation of this study is that, even though it used a longitudinal design, it cannot establish causality. It is not known if poor wellbeing was causing pathological gaming and gaming is causing loneliness, or if both have a common cause not measured in the study. Another issue in interpreting these results is that they only focus on pathological gaming, which presumably is not representative of all players.

Kowert *et al.* (2015) followed up on the study by Lemmens, Valkenburg, and Peter (2011). They conducted three telephone surveys, contacting each participant once per year, and investigated "online video game exposure and involvement" instead of pathological gaming. Their study was conducted in Germany. In total, they included the results of 891 participants of at least 14 years of age to "older than 40 years" in their analyses. They found that playing online video games was positively correlated with life satisfaction for adolescents (r=0.21) and did not find significant negative relationships. For young adults, aged between 19 and 39 years, they replicated the results of Lemmens *et al.* (2011), that lower wellbeing tended to precede higher game involvement. For older adults, they did not find any significant correlations. They concluded that negative correlations found in other studies may be due to a focus on pathological players, that computer games do not generally reduce wellbeing and that their results support the theory of compensatory computer game use. Their results

also indicate that games may have different influences on players of different age groups. A specific issue with this study is their operationalisation of game usage: they only differentiated between online players and offline players and average weekly play time, both of which have limited meaning.

A study by Dolatabadi *et al.* (2013) with 444 students aged between 12 and 15 years supports part of the results of Kowert *et al.* (2015). They also found that, on average, adolescents who play computer games reported a higher quality of life than those who did not (Δ=0.25SD). Additionally, they found a weak negative correlation between the age at which participants started to play games and reported quality of life ($r<0.2$). No information about potential mediating variables or reasons why those students don't play video games – such as possibly socio-economic-status – was collected.

Considering game usage on a more nuanced level, Vella, Johnson, and Hides (2015) conducted a survey with 297 participants connecting video game play, need satisfaction in the game, and eudaimonic wellbeing (via the Mental Health Continuum Short Form). As game-play variables they considered game genre, the amount of play, and whether players played alone or with others, in addition to the experience of need satisfaction in the game. They found that about 12% of the variance of aspects of eudaimonic wellbeing could be explained through the players' experience of need satisfaction in the games they played, while other variables, such as amount of play or genre, were not significant. They concluded that players' experiences should be considered when evaluating the effects of games on wellbeing and that future research should deploy nuanced views of game play variables.

That time spent on games alone is not sufficient was also argued by Lee and Leeson (2015). Conducting an online survey with 626 players of MMORPGs, they found that social anxiety, few supportive relationships outside the game and low satisfaction with those, and expressing the "true self" in games were correlated positively with problematic MMORPG use ($0.2<r<0.55$), although 'problematic' MMORPG use was not well defined. The authors had modified an instrument on problematic internet use, the GPIUS, and did not test the new instrument. It is questionable whether items such as "I have played the game to make myself feel better when I was down or anxious" really measure "problematic" gaming, but these items would to some extent measure engagement in a game. Their results are in line with the compensatory-use hypothesis. Overall, the authors emphasised that time spent playing was only related to the number of in-game contacts and not to any of the other

variables – such as social anxiety –, indicating that playing time alone is not a relevant predictor of wellbeing. They concluded that a more meaningful model of game usage is necessary in order to investigate potential influences of specific aspects of players' social situations, and that players' social situations appear to be linked to playing behaviour.

Similarly, Kardefelt-Winther (2014), drawing on an online sample of 702 World of Warcraft players, highlighted the importance of mediating effects from outside the game on relationships between playing games and wellbeing. For players with high perceived stress and low self-esteem a significant correlation between the motivation to play games as an escape and pathological gaming (β=0.41) was found, but not for players with normal levels of stress or self-esteem. It was concluded that gaming may be a coping-strategy similar to compensatory use, implying that players may use games to make up for negatively-perceived aspects of their lives, and that it is important to consider aspects of participants' real-lives.

Lastly, in their review of over 200 papers, Johnson *et al.* (2013) focused specifically on wellbeing benefits. They found that games have been shown to have various positive correlates, particularly in social and emotional regards. Namely, helping players relax, providing relevant social contacts and support, reducing the likelihood of "risky friendship networks", assisting with positive mood alteration, stabilizing emotional states, contributing to increased self-esteem, and helping players cope with negative aspects of their normal lives. Another result is observed differences between non-gamers, moderate gamers, and excessive gamers regarding wellbeing. In average, non-gamers have been reported to have the overall lowest wellbeing and moderate gamers to have the overall highest wellbeing. The authors concluded that there is a need for better understanding the nature of these influences; especially who will benefit in which situations and when to expect negative influences of games. They also pointed out that amount of play seems to be less important for effects on wellbeing than how games are played.

In summary, research indicates several links between wellbeing and game usage. Excessive game usage appears to be both a consequence and predictor of poor wellbeing, while normal game usage seems linked to higher than average wellbeing. There are potential differences in the correlations of game playing with aspects of wellbeing, depending on the content of the games, how they are played or experienced, and the age of the players. Most of the studies employed cross-sectional designs and the few longitudinal studies that have been conducted were not suited to infer causal relationships between correlated variables.

3.3 Personality

3.3.1 Conceptualisations of personality.

Personality is an important psychological concept, used to explain various differences between people, including their different experiences and behaviours (for a comprehensive review, see Ozer & Benet-Martinez, 2006). A basic assumption of personality concepts is the existence of a set of traits that describe who or how we are (Uher, 2015b). Similar to wellbeing, the idea of personality in the social sciences is old and various different concepts have been developed (DeNeve & Cooper, 1998). These can generally be distinguished based on the representation of the underlying constructs as either types or traits. After an initial wide search for various personality constructs, the review of literature in this area focused around the Big Five- and HEXACO-models. Literature was included if it discussed personality mainly on a psychological basis, but some philosophical contributions were also considered.

Type-based models

Type-based models assume that personalities can be assigned to one of several basic types or combinations thereof. This leads to multichotomous representations of personality whereby all people of the same type are theorised to have a common set of characteristics. These models do not differentiate between different people within each type. The most popular of the type models is the Myers-Briggs Type Indicator (Lloyd, 2012). Its theoretical background lies in the theories of Carl Jung. Jung as a therapist in the early 20th century developed his theory based on experiences and observations of patients and others. A core element of his theory was that people can be assigned a type determined by how they perceive the world; for example, extraverts in his theory are more focused on the external world around them while introverts focus on their internal world (Stein & Swan, 2019). In the adaptation by Myers-Briggs, which departs from the Jungian framework in core aspects, all people are hypothesised to have a basic preference regarding each of four dichotomous dimensions (Myers & Myers, 1995). These dimensions are *extraversion vs introversion, sensing vs intuition, feeling vs thinking,* and *judging vs perceiving*. People are assigned to one of the 16 consequent types based on the combination of their preferences. Accordingly, the related questionnaires force respondents to choose one of two contrasting responses for each question. The resulting scores are not interpreted as the "strength" of each dimension – for example whether one is a strong extravert or almost an introvert – but instead represent

the certainty that one is an extravert; the model assumes a "true" type which has no increments (Lloyd, 2012). However, this theory does not claim that people only use the four main functions to perceive the world, only that people have natural preferences for one over another and therefore will tend to use those more and may be better at using them than using the others (Lloyd, 2012). Since its development there have been several attempts at providing empirical support for the theory. The first attempts tested the underlying assumption that the dimensions represent dichotomies. If this were the case, one would expect to find bimodal distributions for the scores of each of the variables on a population level. Despite some early controversy due to contradictory results in different studies, it seems that the dimensions show normal distributions, which implies the variables are continua rather than dichotomies (e.g., Lloyd, 2012; Stein & Swan, 2019). Research by Saggino, Cooper, and Kline (2001) investigated the model's factor structure using confirmatory factor analysis drawing on data from a total sample of 1,798 participants with varied backgrounds over a duration of five years; the average age of participants was 25 years (SD=10 years; Saggino, Cooper, & Kline, 2001). In their study they compared three different models based on the Myers-Briggs type indicator, a three-factor model, a four-factor model, and a five-factor model. All models had poor fit indices. The model that best fit their data was a five-factor model based on the Myers-Briggs type indicator but with strong resemblance to the so called *Five Factor Model* of personality, or *Big Five*, which is a trait-based model (Saggino, Cooper, & Kline, 2001).

Trait-based models

Trait-based models assume that personality is best described through a set of core (continuous) traits, common to all people. In these models each person's personality is described as a more-or-less unique combination of scores for each of those traits. The main value of traits comes from being able to compare people. For example, in a study relating peoples' personalities to their wellbeing scores, knowing a person has a specific trait score by itself is not as informative as knowing each person's percentile.

The first well-established trait-based personality model is the Five-Factor model, sometimes also referred to as Big Five (Goldberg, 1990). The original research by Goldberg was not theory-driven, but instead used a lexical approach. It was informed by a previous set of studies conducted by Cattell in the 1940s. The assumption was that important characteristics will have led to the development of a diversity of words describing them. Over many years,

in several semi-independent studies, Goldberg (1990) asked several hundred people – mainly his students – to rate themselves and others using lists of adjectives. Originally, those lists included over 2,000 adjectives, but eventually the list-size was reduced through clustering. Different kinds of factor analyses of these data showed largely the same five-factor structure (Goldberg, 1990). Those factors were named Surgency (or Extraversion), Agreeableness, Conscientiousness (or Dependability), Emotional Stability (or Neuroticism), and Culture (or Intellect or Openness). His research formed the basis for the Five-Factor model which has since been widely deployed, repeatedly confirmed, and slowly adjusted through the development of different instruments (Costa & McCrae, 1988; DeYoung *et al.*, 2016; Hamby *et al.*, 2016; Hofstee, de Raad, & Goldberg, 1992).

For the present study the trait-based models appeared more appropriate because of their stable empirical base and the possibility for detailed comparisons between participants. However, the philosophy of trait models also generally appears more appropriate. The key difference between trait- and type-models is not in the measurement of the variables, but in the interpretation of the results for individuals. As mentioned before, type-models assume a "truth" without increments (Lloyd, 2012). Participants scores are determined by their responses to a series of items which are expected to generate diverging results – otherwise types would be measured with a single item – and non-perfect results – meaning results that are not all in the same category – are considered as reflecting the instruments uncertainty; therefore, the existence of that truth cannot be falsified, which is problematic for a scientific hypothesis. Finally, experience has shown that in most regards, while we do have tendencies, it is the strength of these tendencies that differentiates us, and in which lies a lot of the power for predicting our actions. Sometimes we behave one way, and sometimes we do the opposite, so accepting the values in-between, or treating the type-certainty as probability of behaving in line with that type – which is essentially synonymous with seeing it as type-strength, or simply as trait – better reflects our reality.

3.3.2 Trait-based operationalisations of personality.

The most widely-used and accepted trait-based personality models are presently the Five Factor Model and the HEXACO model (Uher, 2015b). The newest operationalisation of the Five Factor Model is the Big Five Inventory 2 (BFI-2), which has been adjusted to represent the advance that has been made in the understanding of personality and assessment since the development of the model, and to address some if the issues identified with previous instruments (Soto & John, 2017a). It also is a reaction to the structure of the competing

HEXACO model and criticism by its developers. The new instrument was based on previous instruments, several specific goals to improve measurement and three subsequent studies. The first involved 685 participants with diverse backgrounds. It comprised self-reports using 885 different adjectives. The second study involved 1,000 participants and was designed to test and refine the items developed in the first study. The third study involved another 1,000 participants and deployed exploratory and confirmatory factor analysis to test the new instrument. This new operationalisation consists of Five factors with three associated lower-level facets each to describe people's personalities: *Extraversion – Sociability, Energy Level, Assertiveness; Agreeableness – Compassion, Respectfulness, Trust; Conscientiousness – Organisation, Productiveness, Responsibility; Negative Emotionality – Anxiety, Emotional Volatility, Depression; Open-Mindedness – Intellectual Curiosity, Aesthetic Sensitivity, Creative Imagination* (Soto & John, 2017a). Scores range from 1 to 5. The authors have developed a reliable 60-item version, a 30-item version, and a 15-item version of the instrument, though they note that the 15-item version is not suitable to reliably determine participants' facet-level scores (Soto & John, 2017b). An important aspect of the Five Factor Model is that it has been found to be largely stable over time after an age of about 18 years (Borghuis *et al.*, 2017).

The main competition for the Five Factor model is the HEXACO model, proposed by Ashton *et al.* (2004). It is also based on lexical studies, but instead of conducting one massive survey with a thousand participants and adjectives in one language, Ashton *et al.* (2004) used the data from several lexical studies conducted in seven different languages – Dutch, French, German, Hungarian, Italian, Korean and Polish – with about 400 participants and 300-600 trait-adjectives each. Using exploratory factor analysis, they found that in these studies the first four factors resembled those of the Five Factor Model. However, the fifth factor – originally called *intellect* in the Five Factor Model – was found to represent aspects of openness to experience rather than intellect, and in some of the studies it was replaced by a factor described as trustworthiness, greediness, and deceitfulness. Furthermore, they found that, in the studies in which the fifth factor was centred around trust, a sixth factor emerged, representing aspects of openness to experience, and in the studies in which the fifth factor represented openness to experience, a sixth factor concerned trust. Any seventh factor, however, related to various characteristics depending on language (Ashton *et al.*, 2004). Based on these results they proposed the existence of six rather than five factors of personality. Their model is very similar to the original Big Five, except that 1) their fifth

factor was centred around openness to experience; 2) their agreeableness factor did not contain any aspects of trust – while the corresponding factor in the Five Factor model does; and 3) they proposed a sixth factor called *Honesty-Humility* which, amongst others, includes elements of trust found in the agreeableness factor of the Five-Factor Model. In contrast to the original Five-Factor Model, the HEXACO model considered the six overall domains to be made up of four different facets each. These were identifiable in their data, improved the interpretability of the factors and were more useful for detailed predictions than the general domains (Lee & Ashton, 2004). Correlations between the two competing models highlight the similarities and differences: the honesty-humility factor is most highly correlated with the agreeableness scale of the Five Factor model; r=0.42, Emotionality with Neuroticism – in the modern version called negative emotionality; r=-0.51, Extraversion with Extraversion; r=0.72, Agreeableness with Agreeableness; r=0.62, Conscientiousness with Conscientiousness; r=0.76, and Openness with Openness; r=0.79 (Ashton & Lee, 2009; Lee & Ashton, 2013). The authors developed reliable 60-, 100-, and 200-item instruments for the model (Lee & Ashton, 2016).

Overall, the Big Five and HEXACO models are very similar and, with the BFI-2, some of the main criticisms of the Five Factor Model have been addressed. Therefore, the decision of which operationalisation to choose mainly came down to one of practicability. The key advantages of the Five Factor Model as operationalised through the BFI-2 are: that it is more established in the literature; the shortest reliable instrument of the Five Factor Model (the 30-item version of the BFI-2) is shorter than the shortest reliable HEXACO instrument (the HEXACO-60); and the items of the English version of the BFI-2-s were perceived as less difficult and less uncomfortable than those of the HEXACO-60 by a group of pre-testers in the present study. The latter could be particularly relevant when using the instrument with participants less proficient in English. Lastly, the key addition of the HEXACO model, the trust factor, is also covered in the BFI-2, even if not in as much depth. For these reasons, and because honesty-humility was expected to play a minor role in the context of games and wellbeing, the short form of the BFI-2 was deemed more appropriate for the present study.

3.3.3 Personality and Wellbeing.

Because of its general importance and wide implications, personality has frequently been linked to various variables, including subjective and psychological wellbeing (Anglim & Grant, 2014; Ozer & Benet-Martinez, 2006). Strong direct or moderating relationships

between wellbeing and personality make personality an important concept to consider when exploring the effects of an activity on wellbeing.

One of the earliest studies providing an overview of the correlation between wellbeing and personality was that by DeNeve and Cooper (1998). They conducted a meta-review of 142 research reports that correlated a trait-like personality measure with subjective wellbeing, measured as positive affect, negative affect, life satisfaction and happiness. They found that neuroticism (negative emotionality) was the strongest predictor of aspects of wellbeing ($|r|>0.23$), particularly of life satisfaction, happiness, and negative affect. Based on the definition of neuroticism, this relationship is not surprising and was interpreted in terms of people high in neuroticism tending to experience interactions more negatively than others. Their results were partly confirmed and expanded on by several later studies, including another review by Steel, Schmidt, and Shultz (2008). In their review, which considered different operationalisations of the Big Five and six aspects of subjective wellbeing – positive affect, negative affect, life satisfaction, happiness, quality of life, and overall affect – they found the strongest predictors to be neuroticism and extraversion. The total variance explained by combinations of personality traits ranged from 20% for life satisfaction to 36% for happiness. Similar results were reported by Cheng and Furnham (2013). In a national study in Great Britain involving over 8,000 adults aged 50 they also found the strongest predictors of mental health and wellbeing to be emotional stability (the reverse interpretation of neuroticism) with $r=0.55$, extraversion with $r=0.4$, and conscientiousness with $r=0.35$. A study by Harris *et al.* (2017) aimed at investigating the role of extraversion in the context of wellbeing through the use of structural equation modelling. Specifically, they hypothesised that the effect of extraversion might be explained by peoples' social interactions. Participants were almost 400 university students who completed a series of self-report questionnaires on subjective wellbeing, personality, social experiences, connections, and belonging. Students with higher extraversion scores tended to have more close friends, be more socially connected, and have a greater sense of belonging. While the effect of the number of friends was not significant, being socially connected and the sense of belonging were significant mediators of the association between extraversion and subjective wellbeing. This effect was also indirectly found in a study by Ullah (2017). She did not directly test for mediating effects but included aspects of perceived social support in her study correlating personality and psychological wellbeing measured with Ryff's psychological wellbeing scale. Multiple regression analysis indicated neuroticism and

conscientiousness together with perceived social support as being the most significant predictors for wellbeing, while the effect of extraversion was barely non-significant (p=0.05). As other studies have shown a relevance of extraversion, it is suggested that in her study the effect of extraversion might have been mediated by perceived social support.

Zhu *et al.* (2013) explored the relationship between personality and subjective wellbeing – measured as satisfaction with life – while testing social network characteristics and perceived social support as mediators in a study with 309 university students. For their analysis they used structural equation modelling to test several models. They found that the effects of agreeableness, conscientiousness and openness on subjective wellbeing were completely mediated by social network characteristics. In addition, they found that while the effect of extraversion was partly mediated by the social network characteristics, it also had a direct effect on perceived social support. Perceived social support in turn fully mediated the effects of extraversion and social network characteristics on subjective wellbeing. The only personality trait that had a direct significant association with subjective wellbeing was neuroticism, and the final model – meaning neuroticism and perceived social support as only significant variables left – predicted 37% of the variance in subjective wellbeing. They concluded that the social environment has an important influence on the relationship between personality and aspects of wellbeing. In addition, they theorised that the impact of personality attributes on other outcomes may also be mediated by other variables, and that personality traits may moderate the effect of variables on outcomes, such as wellbeing, by influencing individuals' experiences of social situations.

Finally, Marrero, Rey, and Hernandez-Cabrera (2016) conducted a study correlating the facets of the Big Five to both psychological and subjective wellbeing variables. They showed that aspects of psychological wellbeing could be predicted substantially better than subjective wellbeing, sharing up to 55% vs. 25% of variance, respectively. They also found that facets of the Big Five show higher correlations with wellbeing than overall factor scores. Besides this, they made the observation that the individual contributions of the facets depend on demographic variables such as gender. They concluded that, besides personality being useful to further research on wellbeing, attention should be brought to bear on the effects of demographic variables on the relative importance of individual facets. However, they used an adjusted version of Ryff's (1989b) instrument to measure psychological wellbeing, which has a contested structure and several items that are quite similar in wording to the NEO-Personality Inventory, which these authors also used. Since the high

values they reported stem only from correlations of selected combinations of personality facets with selected sub-aspects of wellbeing, this might indicate that the respective items of the different instruments are actually measuring similar constructs. Examples are high correlations between the self-discipline subscale of the NEO-PI-R and the environmental mastery aspect of wellbeing, between the achievement-striving subscale and purpose in life, or between the depression subscale and self-acceptance.

In summary, personality traits have been found to be significant predictors of subjective wellbeing – which was operationalised in the respective studies through instruments measuring hedonic aspects – and psychological wellbeing. Facets have been found to be more informative than the overall factors. Interestingly, personality traits were found to be more predictive of psychological than subjective wellbeing. This could reflect that eudaimonic wellbeing is a more stable construct, while the measures of subjective wellbeing used in those studies measured more situational constructs. The most important personality traits for predicting wellbeing are negative emotionality and extraversion, possibly also conscientiousness. Correlation coefficients are usually in the range from r=0.2 to r=0.5, but in multiple regression up to 55% of variance was found to be shared. Lastly, while the effects of extraversion seem to be explained at least in part through social interactions, the effect of negative emotionality is likely to stem from people with higher scores in this trait experiencing situations as more worrisome than those with lower scores. This, though, raises questions as to how different the constructs of personality and eudaimonic wellbeing are. In particular, negative emotionality, by definition, is linked to wellbeing.

3.3.4 Personality in the context of video games.

Given the utility of personality theory for explaining behaviour and its implications for wellbeing, it is expected that this concept may contribute to understanding the specific effects of computer games on wellbeing.

Braun *et al.* (2016) conducted a survey with almost 3,000 participants with an aim of identifying differences in personality traits between non-players, players of different genres, and players classified as addicted. Addiction was measured through an instrument previously developed by two of the authors of that study based on criteria commonly-used to establish substance addictions (Wölfling, Beutel, & Müller, 2012). They found that neuroticism, extraversion, and conscientiousness show statistically significant but weak correlations with computer game addiction. Non-gamers and players classified as addicted

showed higher mean neuroticism scores than non-addicted players. Players and non-players did not differ in extraversion, while addicted players had significantly lower scores. There were no differences between groups for openness or agreeableness, but all differed on conscientiousness with non-gamers having the highest and addicted players having the lowest. The authors also found various significant but small differences between players of different games. They concluded that personality traits are important variables to consider in research investigating gaming behaviour, that future studies should distinguish between game genres, and that non-gamers should be included for meaningful comparisons.

Bean and Groth-Marnat (2014) found similar results in an analysis of the Big Five traits for users of World of Warcraft. They compared users of the game with non-gamers and compared the personality traits between users with different game playing styles, defined as engaging primarily in player vs player, player vs environment, or role-playing activities. They found, similar to Braun *et al.* (2016), that, on average, gamers and non-gamers had similar scores, except for neuroticism, for which gamers had lower values. Additionally, they compared males and females and found that female players in average had higher (0.2 SD) values for neuroticism, agreeableness and openness than male players, and that there were significant differences between players who preferred different playstyles (between 0.3 SD and 0.5 SD). For example, players focussing on player vs player activities had an average extraversion score of 25.6 (SD=7), while players preferring role-playing only had a score of 22.5, and role-players had a score in neuroticism of 25.4 (SD=9), while player vs player players had a score of 20.7.

Over the past 10 years there have been many more studies with similar approaches, aims, and results. Graham and Gosling (2013) investigated the relationship between personality traits and different motivations for playing games, based on the work of Yee (2006). They found that combinations of personality traits were each associated with different motivations in Yee's model, but the correlations were weak. They concluded that, while personality appears to be linked to play style, more detailed research is necessary, and that special attention should be brought to bear on comparing trends and observations across games and even genres, to develop a better understanding of how different in-game behaviours might be understood.

Johnson and Gardner (2010) and Johnson *et al.* (2012) examined correlations between the personality traits of gamers, their preferred genre and their gaming experience, measured

using the PENS questionnaire. In a second study they used the GEQ instead of the PENS. They found weak but statistically significant correlations between personality traits and both the PENS- and GEQ-aspects. They concluded that personality is relevant but from their study it was not possible to tell whether people with different personalities seek out games that offer different experiences, or if people with different personalities experience games differently. Interestingly, in the first study they found a weak but significant correlation between personality and genre, while in the second study they did not. This observation implies that, if there is a correlation, it is not reliable.

Using different models, Yee *et al.* (2011), Worth and Book (2014), Seok and DaCosta (2015) and Collins, Freeman, and Chamarro-Premuzic (2012) all independently investigated correlations between personality traits and in-game behaviour. Yee et al. used player statistics that are accessible online for the game World of Warcraft. Worth and Book identified six aspects of behaviour based on a factor analysis of forum posts and own experience. Seok and DaCosta considered self-developed aspects of mobile game usage. Collins, Freeman and Chamarro-Premuzic differentiated between problematic and non-problematic MMORPG use. Most of these studies found significant but low correlations between their various variables of interest. The only noteworthy exception among these is the study by Worth and Book (2014). They found that their constructs of gaming behaviour (see section 3.1.2 for details) could be predicted substantially better than the constructs in other studies. They concluded that personality is a relevant factor in predicting game usage and that relationships between personality and behaviour in games seem generally to be similar to these relationships in other aspects of life. Nonetheless, they pointed out that the role of personality in the context of game usage is not well understood and that one of the complicating issues may be the ways in which gaming behaviour is operationalised. In this regard it is interesting that the highest correlations between personality and game usage were obtained in the only study that used an empirical approach to describing gaming behaviour.

The last two papers discussed here are not concerned with gaming in particular, but with the wider field of social media use. Lönnqvist and große Deters (2016) and Gerson, Plagnol, and Corr (2016) analysed relationships between personality traits, subjective wellbeing, and facebook-related behaviour. Both studies found weak but significant correlations between social network size, social comparison, and subjective wellbeing. The main result of these two studies, however, was that personality traits – extraversion in the first study and goal-

drive in the second – interacted with these variables. In the former study controlling for extraversion removed the significant association between network size and wellbeing. In the latter there was a significant interaction between goal-drive and social comparison when predicting wellbeing. This was interpreted as social comparison having a different effect, and possibly a different meaning, for people with different goal-drive scores. Both studies, therefore, concluded that potential interactions with personality should be in studies of the effects of social media use in general, but especially when investigating potential effects on wellbeing.

Most studies of personality in the contexts of wellbeing and game usage have used cross-sectional designs and are therefore are not suitable to infer causal relationships. In addition, many of the studies have used predominantly psychology students as participants, limiting generalisability. Despite these shortcomings, the studies imply that personality and wellbeing are linked and that the social situations of participants may be important mediators of that relationship. Additionally, these studies have generally reported weak but significant correlations between "playstyle", in-game behaviour or motivations for playing and personality.

Many studies have concluded that more detailed analyses and differentiations between in-game variables are required. Furthermore, it has been suggested that personality may interact with media-related variables in its effect on wellbeing. It has also been found that non-pathological players do not seem to differ significantly from non-players in their personality traits. The main personality traits that appear to be of relevance in the context of wellbeing and gaming are negative emotionality and extraversion, and to a lesser extent agreeableness.

3.4 Self-Determination Theory

3.4.1 Research on human needs.

Human needs have been a common concept in psychological research for at least a century (Meehl, 1992, citing Murray, 1938). In motivation research, needs are seen as strong internal drivers that can determine people's actions. Developing one of the most comprehensive early models, Murray (1938) identified 20 manifest needs, such as needs for dominance, achievement, or nurturance. One of the core aims of this model was to explain human

personality in terms of the different strengths of needs observed in different people (Costa & McCrae, 1988). Though the value of the underlying idea was recognised, a strong criticism was that many of the proposed needs were not general, but tied to social expectations, cultures, or specific situations (Meehl, 1992).

Ryan and Deci (2000) re-interpreted the concept of human needs in a different context as *motivational framework*. Instead of focusing on the wide variety of human behaviours and possible motivations, they focused on the differentiation of intrinsic and extrinsic motivations. Other foci were conditions that facilitate psychological growth, functioning and wellbeing (Ryan & Deci, 2017). Their studies and considerations finally led them to propose three basic – and universal – psychological human needs: the needs for *competence*, *autonomy*, and *relatedness* (Ryan & Deci, 2000). These needs, and the assumption that interactions and situations can either *satisfy* or *thwart/frustrate* them, is the core of their Self-Determination Theory (SDT).

The theory proposes that satisfaction of these needs leads to greater motivation and wellbeing, while frustration of the needs reduces motivation and may contribute to ill-being. It also proposes that a person needs to experience satisfaction of all three needs to function positively. A final core aspect of the theory is that people will attempt to adjust their lives so that the needs are satisfied, while need-thwarting situations will be avoided. However, while all people share the three needs, not all needs have to have the same value for all people, and the priority of the needs can change over time. This difference in *need strength* does not necessarily translate to different degrees of wellbeing being derived from satisfying them (Chen *et al.*, 2014). It is important to recognise that a person's striving to satisfy a need does not mean they will necessarily do so in an effective manner. On the contrary, this striving for satisfaction may contribute to detrimental behaviours such downwards spirals or addictions, if an action "should" but does not, in fact, provide the expected satisfaction (Vansteenkiste & Ryan, 2013).

A relevant discussion is whether all of the needs need to be satisfied in every aspect of life individually to achieve overall positive functioning, or if satisfaction of the different needs can come from different contexts. As a provocative example, does the satisfaction of the relatedness need in an intimate relationship make up for the frustration of that need in the workplace, and does the satisfaction of the autonomy need in the workplace make up for the frustration of that need in the intimate relationship? Or will both – the workplace and

intimate relationship – be experienced negatively because one of the needs is frustrated in each context? This question becomes especially interesting in regard to potential effects of playing video games. To understand this question, a more focussed theory within SDT is required. The SDT framework constitutes six so called *mini-theories:* (1) Cognitive Evaluation Theory focuses on explaining intrinsic motivation, (2) Organismic Integration Theory focuses on extrinsic motivation and internalisation, (3) Causality Orientations Theory focuses on describing how and why people seek to satisfy their needs, (4) Basic Psychological Needs Theory focuses on the needs and their meaning for psychological wellbeing and functioning, (5) Goal Contents Theory focuses on peoples' self-set goals and the implications, and (6) Relationships Motivation Theory focuses on the relevance of relationships in different context and their various links to SDT.

Basic Psychological Needs Theory focuses on links between needs and psychological wellbeing. It has been used, researched and validated in many different contexts, giving it a strong empirical base (for a comprehensive review and more references see Ryan, Soenens, & Vansteenkiste, 2019). Key-findings of that body of research are that the needs seem to be universal, and that satisfaction of these needs has positive consequences for wellbeing (e.g., Chen *et al.*, 2014; Church *et al.*, 2012; Vansteenkiste & Ryan, 2013). Even people with strong affiliations to autonomy or competence experience the satisfaction of the relatedness need positively, and – contrary to what might be expected – that satisfaction is as important to their wellbeing as for people with an affiliation to relatedness Chen *et al.* (2014). In other words, the relationship between need satisfaction and wellbeing does not seem to be moderated by aspects such as individual motivations or valuation of specific needs (Chen *et al.*, 2014; Sheldon & Schuler, 2011).

The search for literature in this area focused on general empirical underpinnings of SDT and on the various contributions of SDT to the understanding of video gaming and its effects on players. While all research that linked SDT and consequences of video gaming was considered while searching the literature, only papers with direct implications for the present thesis were included here. Some recent publications were excluded from being presented here for the same reasons discussed in section 3.2.1.

3.4.2 Operationalisation of Self-Determination Theory.

The main general instrument to determine overall needs satisfaction according to Self-Determination Theory, the Basic Psychological Needs Scale, has been criticised frequently (Sheldon & Hilpert, 2012). It has been considered to be unbalanced item-wise, to include individual items that may be associated with multiple needs, and – possibly most importantly – it has been found to have an unclear factor structure. Some researchers used the scale for one general needs satisfaction factor and others for three separate ones. Later research indicated that three factors plus a negative factor representing negatively-worded items fit better (Longo *et al.*, 2014). This observation, together with further research on negative scales in related research fields, led to the conclusion that the negatively-worded items may have an important meaning for the concept of needs, rather than simply satisfying standards of instrument construction (Sheldon & Hilpert, 2012). Therefore, subsequent work led to an adjustment of the theory and the development of the Basic Psychological Needs Satisfaction and Frustration Scale (Chen *et al.*, 2014). In this adjustment, the frustration of needs is not seen as the opposite end on a satisfaction continuum, but as a related albeit separate construct. Accordingly, this new instrument evaluates the satisfaction and frustration of each of the three needs individually for a total of six factors. The resulting factor scales showed good structural validity and better correlations with other wellbeing concepts. Results also indicated that each factor makes a unique contribution and relates to a different aspect of wellbeing or ill-being (Chen *et al.*, 2014). Since its development the validity of the scale has been confirmed in independent studies in various countries and languages and with different age-groups (e.g., Heissel *et al.*, 2018; Liga *et al.*, 2018).

A comprehensive review and description of SDT and the role of the needs and their interactions with other constructs can be found in a paper by Vansteenkiste and Ryan (2013). These authors define competence as "*the experience of a sense of effectiveness in interacting with one's environment*", relatedness as "*the experience of love and care by significant others*", and autonomy as "*the experience of volition and the self-endorsement of one's activity*" (Vansteenkiste & Ryan, 2013, p. 2). They also reiterate that humans are proactive in organising and influencing their environments to enable integrity, and that this process does not happen automatically but requires the three needs to be satisfied. They note that low satisfaction can reduce positive development and that frustration of needs may cause psychopathology, emphasising the importance of the distinction between the low satisfaction and the frustration of needs. They conclude with a discussion of need

substitutes. Need substitutes are interpreted as adjusting one's goals in an effort to make up for the lack of satisfaction of a need – such as over-emphasising social status to compensate for the lack of relatedness satisfaction. This has been found to generally only provide a fleeting sense of need satisfaction and has been linked to reduced wellbeing in the long run (Vansteenkiste & Ryan, 2013).

3.4.3 Studies on Self-Determination Theory and wellbeing.

The focus of Basic Psychological Needs Theory is the linkage between need satisfaction or frustration, and wellbeing. This relationship has been studied in detail by many researchers in a variety of social and cultural contexts (Ryan & Deci, 2017). Both eudaimonic and hedonic wellbeing have been studied, though SDT lends itself more naturally to the study of eudaimonic wellbeing due to the shared focus on positive functioning.

Chen *et al.* (2014) conducted four studies with participants from Belgium (n=559), China (n=633), the USA (n=298) and Peru (n=244). They related need satisfaction according to Self-Determination-Theory to different aspects of wellbeing – as measured through self-esteem, depression, life satisfaction, and vitality – and need valuation. They first verified and adjusted their instrument, the Basic Psychological Need Satisfaction and Frustration Scale, using exploratory and subsequent confirmatory factor analysis. They found that, independent of culture, need satisfaction in various areas of life substantially predicted wellbeing, while need valuation had low or non-significant correlations. They also found no significant interaction between need valuation and need satisfaction. They concluded that need satisfaction appears to be a globally-applicable concept related to wellbeing, independent of different need valuations found in different cultures. Overall, need satisfaction and frustration together explained 49% of the variance in life satisfaction and 53% of the variance in vitality. Only need frustrations explained variance, 36%, in depressive symptoms, supporting the claim that need satisfaction and frustration should be considered separately.

In regard to the role of culture, Church *et al.* (2012) found similar results. They conducted surveys with college students in eight independent samples in the USA (n=153), Australia (n=122), Mexico (n=158), Venezuela (n=102), Philippines (n=167), Malaysia (n=268, China (n=223), and Japan (n=191). In contrast to Chen *et al.* (2014) they considered more needs as well as personality as additional variables Their core instrument probed the satisfaction of five needs – the three from SDT plus self-actualisation-meaning and pleasure-stimulation

(Sheldon *et al.*, 2001) – in five different social roles (e.g. with parents, friends, strangers, …). Besides needs, they also measured wellbeing as positive and negative affect, meaning-in-life, and Ryff's psychological wellbeing. They also included questionnaires on the Big Five and participants' cultures. The needs each made a unique contribution to explaining variance in wellbeing constructs. Correlations ranged mostly between r=0.35 and r=0.50. Overall, for most nations, between 20% and 41% of the variance in wellbeing was explained by need satisfaction. In many cases, all five needs and not just the SDT needs, made significant contributions. The strength of the relationship between need satisfaction and wellbeing did not differ significantly between Asian and non-Asian cultures. The big five personality traits together – mainly extraversion, conscientiousness and emotional stability – explained substantial variance in wellbeing – here it was unclear to which construct the authors were referring – from 20% in Venezuela to 52% in China. Including the needs explained additional variance, from 5% in China to 28% in Venezuela, meaning combined needs and personality traits explained between 48% and 57% of the variance in wellbeing. This indicates again that needs and wellbeing are correlated, but also that there are additional needs besides the basic psychological needs that can add power to predictions. Importantly, part of the association between wellbeing and needs was shared by personality. A major issue with this study, however – besides their samples probably not being representative of nations' populations, but rather of the universities they were conducted at – is that the wellbeing-factor used in their later analyses is not defined. It is known that they used a variety of instruments, but what scores they used for the correlations is not.

Liga *et al.* (2018) and Heissel *et al.* (2018) set out to validate the Basic Psychological Need Satisfaction and Frustration Scale in a mental health context in different languages, the former in Italian (n=2,204) and the latter in German (n=334). Liga *et al.* (2018) measured mental health as vitality, self-esteem, and depression, and (Heissel *et al.*, 2018) measured it as depression and satisfaction with life. Both studies verified the model using confirmatory factor analysis to compare three different pre-defined factor structures. In both studies a model with six factors – the three needs satisfactions and three frustrations as individual but correlated factors – showed the best fit to the data. Liga *et al.* (2018) found only the frustration of needs to be significantly correlated with depression (total r^2=0.34), and only satisfaction to be significantly correlated with vitality (total r^2=0.34). However, both satisfaction and frustration were significantly correlated with self-esteem and together explained 75% of variance. Competence satisfaction and frustration were the strongest

individual predictors of the three wellbeing measures. Heissel *et al.* (2018) combined the six individual need satisfactions and frustrations into two factors, one for all need satisfactions and the other for all need frustrations. They found significant correlations between need satisfaction and satisfaction with life (total r^2=0.18), between need frustration and depression (total r^2=0.53) as well as between need frustration and satisfaction with life (total r^2=0.12). Need satisfaction was not significantly correlated with depression. The result found by both Liga *et al.* (2018) and Heissel *et al.* (2018) – that need satisfaction is associated with positive wellbeing aspects and need frustration is associated with negative wellbeing aspects, while both make unique contributions to overall wellbeing – is important to evaluate the extent to which need satisfaction can compensate for need frustration.

No study has comprehensively investigated whether satisfaction of needs in one area of life can compensate for frustration in another. However, the view presented by Vansteenkiste and Ryan (2013) allows for a tentative hypothetical answer: If need satisfaction and frustration are independent constructs – as opposed to combining into a general satisfaction variable – people can experience the consequences of both. Hence, a person could, through a relationship develop a sense of closeness and relatedness in their life, and also, through work, develop a feeling of being socially rejected, both of which would be represented in their everyday experiences and overall feeling. Need satisfaction and frustration of all needs will likely be relevant in each aspect of life separately. At the same time, it will be relevant whether needs are satisfied sufficiently for a person to function well in life, or frustrated strongly enough to result in ill-being. An indication of this interpretation can be found in the results of Liga *et al.* (2018) and Heissel *et al.* (2018) who found that only frustrations were significantly correlated with depression, and only satisfactions were significantly correlated with vitality. However, both satisfactions and frustrations were significantly correlated with self-esteem and satisfaction with life. Very similar results but with different measures of well- and ill-being were found by Chen *et al.* (2014). The individual (non-) significant correlations shown by them support the hypothesis that people who experience need frustration in some areas of life may experience ill-being despite also experiencing need satisfaction in others. At the same time, that both satisfaction and frustration are significant for more general concepts such as self-esteem or satisfaction with life supports the hypothesis that both combine for an overall feeling of need satisfaction.

3.4.4 Psychological needs in the context of video games.

As a theory of human motivation with links to wellbeing, SDT lends itself to the study of the impact of games on mental health. But applying it in this context raises questions: Can games satisfy basic psychological needs? If so, can the satisfaction of needs in a computer game make up for the frustration of needs in other areas of life? In an extreme case, what happens when most needs are met in a game, while hardly any are met in other areas of a person's life?

Can games satisfy basic psychological needs?

One of the earliest studies connecting digital games and needs was conducted by Selnow (1984). He adapted an instrument developed to measure needs fulfilment through watching television to the context of visiting video game arcades. His results, based on factor analysis, indicated five relevant factors – three *social*, one *action* and one *escapism* – that correlated with playing at arcades. He concluded that playing games provides a sort of electronic friendship, thereby fulfilling social needs. Selnow neglected to acknowledge, though, that people often went to the arcade with friends or to meet other like-minded people, so some of his social factors may not have reflected needs fulfilled by the games as such, but rather by the social context of the arcade.

Building on Selnow's research and other similar studies, Colwell (2007) set out to analyse the relationship between potential needs and the motivation to play computer games. He first conducted group interviews with young adolescents on the topics of leisure activities, computer game play and reasons for playing. The results were used to adapt an earlier questionnaire focused on social needs (Colwell & Payne, 2000) to investigate more generally the needs that playing games might fulfil. This questionnaire, together with questions on frequency and duration of play, was then deployed with school students between 11 and 15 years of age. Colwell identified four factors that he labelled *companionship, prefer to friends, fun challenge,* and *stress relief*. While all his factors were significant predictors of game play – measured as frequency and duration of play – multiple regression analysis identified sex and age as strongest predictors (explaining about 3% unique variance each), followed by fun challenge (2.3%), prefer to friends (1.2%), and stress relief (1%). Together, these variables explained 27% of the variance in total weekly play. Companionship was not a significant predictor in the multiple regression analysis. Colwell and Payne concluded that engaging with games does seem to be at least in part motivated by needs. Playing games was used to

cope with negative experiences, to regulate mood, and to fulfil social (friendship) needs. Finally, Colwell and Payne argued that the fun and challenge factors may be motivated by social interactions as an expression of group norms, competing with friends, or "being cool". However, the authors did not distinguish between different games and the final claim is hardly supported by the data.

Research conducted by Przybylski, Rigby, and Ryan (2010) contradicts the final claim of Colwell and Payne, showing that fun and challenge can represent the satisfaction of autonomy and competence needs, independent of social needs. Furthermore, Ryan, Rigby, and Przybylski (2006) found that satisfaction of each of the basic psychological needs in games independently predicts enjoyment of players and their intention to play the game again in the future. All needs combined explained 10% of the variance in the intention to play the game again, 45% of the variance in enjoyment of the game, and 20% in the variance of positive mood change during gameplay. They also found that their model of need satisfaction produced significantly higher correlations with these three variables than the other main motivational model – that of Yee (2006). One possible explanation for the difference in the predictive power of the models is their purpose. Yee (2006 and 2016) only aimed to explain motivations for playing a game, not for enjoying it, and there could be a significant difference between these two concepts. For example, it could be that what causes players to start is motivation (e.g. as defined by Yee), but what causes them to enjoy the game and what keeps them playing is more influenced by how they feel while and after playing. This second aspect is something not represented in most motivational models but is an integral part of Basic Psychological Needs Theory.

Can the satisfaction of needs in a computer game make up for the frustration of needs in normal life?

Reinecke (2009) asked 1,614 participants to report how much they play video games in general and, specifically, how often they play after stressful situations or when they want to recover from stress. In addition, they included questionnaires on work-related fatigue, daily hassles, recovery experiences, coping style, and social support. They found that the combined recovery experience – such as psychological detachment, relaxation, mastery and control –, coping style, work related fatigue and daily hassles explained 56% of the variance in reported game playing for recovery purposes, which in turn explained 10% of the variance in general game usage. They also found a weak but significant moderation effect of social

support on the relationship between work-related fatigue and playing games to recover, indicating that people with low social support use games for recovery more than those with high social support.

Two years later, they followed up on their survey-based research with an experimental study (Reinecke, Klatt, & Krämer, 2011). For this experiment they subjected 160 participants to a difficult task to elicit a need for recovery, and then exposed them to one of four different recovery conditions – playing a drag-and-drop puzzle game, watching a recording of that game, watching a popular comical animated video clip, and not doing anything. All conditions lasted five minutes. Overall, they found a main effect of recovery condition on recovery experience (η^2=0.12), with the recovery experience being highest for the participants playing the video game (between 0.5SD and 1SD higher than the others). They concluded that video games can serve to fulfil recovery needs.

Rieger *et al.* (2014) partly supported those results in a similar but more specialised study. They also subjected participants (n=46) to a frustrating task and then evaluated the effect playing Mario Cart (a comic-style racing game) had on them. Measured were mood before and after playing, the ranking achieved in the game, enjoyment, and the autonomy and competence factors of the PENS. They found that, after playing, participants had higher positive and lower negative mood and that in-game success predicted mood repair. The correlation between in-game success and enjoyment was fully mediated by the satisfaction of the competence and autonomy needs, together explaining 47% of the variance in enjoyment. They concluded that in-game success drives mood recovery, while need satisfaction drives enjoyment.

What happens when most needs are met in a game, while hardly any are met in other areas of a person's life?

Beard and Wickham (2016) as well as Mills *et al.* (2018) studied the phenomenon of problematic video gaming or internet gaming disorder using the framework of SDT. In the former study, a self-developed instrument designed to measure "gaming-contingent self-worth" – essentially a measure of whether in-game experiences influence self-esteem – was administered together with an instrument measuring Internet Gaming Disorder to a sample of 600 game users. Their self-developed instrument was based on other self-worth and self-esteem questionnaires, SDT, and different gaming motivation operationalisations, such as Yee's. They identified and labelled four factors: *validation seeking, reward orientation,*

competition focused, and *being detached* – the latter being interpreted as self-esteem being experienced as being unaffected by in-game experiences. Using hierarchical regression analysis, they found that 46% of the variance in the Internet Gaming Disorder score was explained by their "predictor" variables, with the greatest impact coming from self-worth and self-esteem. The latter study by Mills *et al.* (2018) included 1,029 participants and used an Internet Gaming Disorder scale, a scale measuring frustration of each of the three basic needs in daily life, and a gaming motivation scale. They found that each of the frustrations were significantly correlated with Internet Gaming Disorder-scores. The gaming motivations they evaluated – intrinsic motivations and four types of extrinsic motivations – showed larger correlations, ranging from r=0.36 for external motivation to r=0.65 for introjected motivation – meaning participants felt an uncontrolled internal pressure to play. Their most interesting result was that, while all models had very good fit, the best was for a model that hypothesised need frustrations as a partial mediator of motivations and problematic gaming. This is difficult to explain, as it implies that the motivations themselves, especially introjected motivation and amotivation, predict the frustration of needs, which then predicts problematic gaming. One tentative explanation might be that both of these motivation types can contribute to a strong disengagement from real-world environments, which would lead to increased need frustrations. They support this argument with the results of a study that showed "*PVG* [problematic video gaming] *is strongly related to the perception that the online gaming community is the only place in which one is valued and appreciated"* (Mills *et al.*, 2018, p. 556, referenced as Liu & Peng, 2009). While the article referenced by Mills *et al.* does not actually say *that*, its authors *did* find that that a *preference for a virtual life* – which was partly defined over items such as feeling more valuable or more respected in the virtual world than in the real world – significantly predicted a psychological dependency on MMOG playing (Liu & Peng, 2009). Thus, researchers have hypothesised, and found, indicators for a link between Internet Gaming Disorder and needs frustration in daily life. In other words, in an extreme case, a person could mainly experience need satisfaction in games and not in normal life, which may contribute to withdrawal from analogue environments and the development of Internet Gaming Disorder.

Based on these observations, needs theories in general and SDT in particular, promise to be a helpful and relevant approach for evaluating the relationship between game usage and wellbeing. Peters, Calvo, and Ryan (2018) argued that considering basic psychological needs can help to elucidate and evaluate the effects games and other digital technologies can have

on wellbeing. They propose considering needs at different points of an interaction, such as the motivation for using games, and also for evaluating specific interactions with games. However, no study has evaluated game usage, wellbeing, and the role of needs together.

3.5 Conclusions and Implications from the Review of the Literature

A major gap that has been identified in the literature review is a common taxonomy of the way in which computer games are used by players. Currently, most studies on computer games only consider the time spent playing, the motivations for playing, the generally-preferred mode of playing, or the genres of games. It has, however, been pointed out repeatedly and in different research contexts – from motivation-, to personality-, gamification- and wellbeing-related research – that these variables are not sufficient to portray the multitude of playstyles exhibited by users. There seems to be growing consensus that how a game is played is more important than its content, and that the categories considered in previous research do not sufficiently differentiate between players. It seems necessary to look at player behaviour in and out of games in more detail and to develop an empirical conceptualisation rather than using pre-defined categories based on researchers' assumptions.

Another gap in extant research concerns the prediction and understanding of the influences of playing video games on players. The nature of the relationships between game usage and outcome variables is not understood. It is proposed that considering players' needs and personality traits might be good starting points for research on identifying potential moderating effects.

Finally, there are presently only few experimental or longitudinal studies in the literature on the effects of gaming, and most of those produced weak or ambiguous results. Despite contrary claims in the media, there is a lack of clear and tangible indicators of directional relationships between gaming and key variables.

Combining the different findings discussed in the sections of the literature review, a better understanding of game usage might be expected to provide insights into the diverse influences playing computer games has on various relevant variables. One of these – with fundamental importance for people's development – being mental wellbeing.

3.6 Connecting the Concepts: A Game Usage & Wellbeing Theory

In this section, an overarching theory connecting individuals' game usage, personal characteristics and wellbeing is laid out. Of particular importance for this theory are the concepts of Self-Determination Theory and particularly basic psychological needs theory. Some of the underlying ideas have already been mentioned by others under the broad term of "compensatory use" but have not previously been formulated as a discrete theory.

The main function of this theory is providing an explanation for how and why playing games may influence wellbeing. The hypothesised influences of the four core constructs of this theory – *game usage, wellbeing, personality,* and *basic psychological needs* – on each other are depicted as arrows in *Figure 2*. First, game usage will directly influence and be influenced by wellbeing. Playing games in certain ways may contribute to a feeling of meaning or may take away time for other meaningful interactions, both affecting wellbeing. Vice-versa, low wellbeing may lead to spending more time on the game or to taking the game more seriously. Next, another key concept in this theory are psychological needs. Based on SDT, needs met or frustrated will directly influence wellbeing. But, as previously discussed, needs will also be a motivator for certain game usages. The reason for these arrows in the model not being bi-directional is that in this model *Psychological Needs* refers to the satisfaction of needs outside of games. It is assumed that needs met outside of games and needs met inside games can be differentiated and that neither wellbeing nor game usage can affect the satisfaction of needs outside of the game. This assumption will be further discussed in the overall discussion in section 8, because especially social interactions in and outside of games might be inseparable. A key aspect of this theory is the third influence of psychological needs, a hypothesised interaction of needs with game usage. As implied by compensatory use combined with Self-Determination Theory, players may subconsciously – or consciously – play games to satisfy needs that are not satisfied in their normal lives. If these needs were satisfied in the game, this would in turn lead to increased wellbeing, connecting the three concepts used in this study. This means that needs have a double role in this model regarding game usage: they may explain different game usages and also provide a mechanism through which playing games might influence wellbeing. Finally, the theory also considers personality as an internal variable. Personality may directly influence all of the other concepts: players with different personality traits may tend to have different needs satisfied, may tend to play games in certain ways, and may tend to experience life more

positively or negatively. Additionally, personality may moderate the interactions between needs and wellbeing, between needs and game usage, and especially between game usage and wellbeing. In other words, it is theorised that the game usage required to satisfy a specific need of a player will in part depend on their personality. Links between needs and personality are not specified *Figure 2* because the focus of this model is the interaction between game usage and wellbeing.

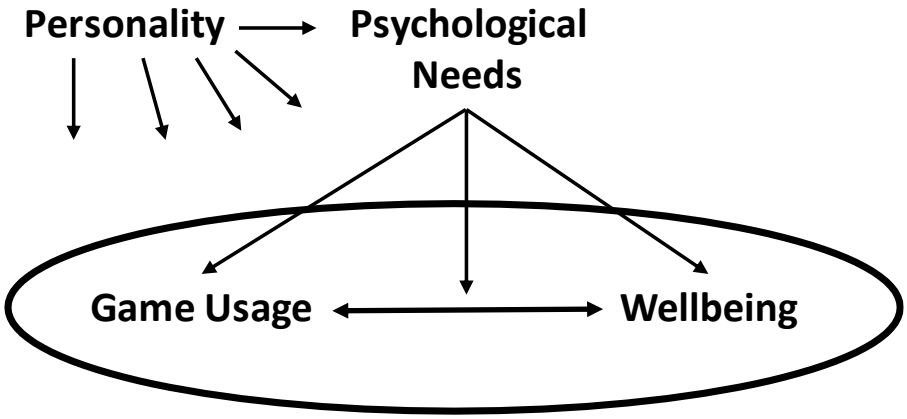

Figure 2: Schematic depiction of the hypothesised interactions between the four core constructs of game usage and wellbeing, influenced by needs and moderated by personality

Reportedly, not all players develop higher wellbeing when playing; in forums there are multiple reports of players claiming gaming has "ruined their life". The theory formulated here provides two complementary explanations for negative impacts of gaming. The first is that, in contrast to what one might assume, players do not necessarily "freely" choose how they use games. An obvious reason is that, to a certain degree, players' options are limited by a game's mechanics. A related but less obvious reason is that, while there are hundreds of games offering numerous possibilities for game usage, not all players can access all games, and most often don't even know about a majority of them. Players' knowledge of games is limited to what they read or hear about. While many games offer multiple game usages, sometimes it does not occur to a player that they could use a game in a way that would address their needs. Furthermore, often players hear about a game from friends and then play with them, meaning what they can do is additionally limited by what their friends want to do. Or, quite simply, a person may have habitually played games a certain way and this does not change despite changes in their situation and needs, which would lead to the game

having a different – possibly negative – influence, despite the game usage originally being positive.

A second explanation is that conscious or subconscious efforts to rearrange one's life to fulfil one's needs are not necessarily successful. In the context of games this may mean that a chosen game does not support a specific game usage well. For example, if a person tries to fulfil their competence needs in a very competitive game in which one would expect to lose 50% of the time, the likelihood of the need not getting fulfilled is high; especially if – as many players have experienced – their own judgement and focus get poorer with every loss. In this case, a player with high need frustration at the beginning finishes feeling even worse due to that need – and possibly also others – being further frustrated.

Implicitly posited in the examples above is a possible mis/match between game usage and players' needs. Self-Determination Theory proposes that, if a person experiences low satisfaction or even frustration of a basic need in their life, this will lead to poor mental wellbeing. The theory developed in the present study proposes that, if a person's usage of computer games matches those unsatisfied or frustrated needs, this may maintain or even improve wellbeing. The other side of the coin would be that – as described in the example above – a mismatch between needs and game usage might decrease wellbeing. And if a person's specific need is satisfied in their normal life, game usage that would also satisfy that need may not have any significant effect on wellbeing.

It is interesting to reconsider Internet Gaming Disorder in light of this theory. From this perspective it is easy to understand how addictive behaviour can develop: If, for example, a person, experiences hardly any satisfaction of their needs in their normal life but does experience it while playing a game, this will create a strong motivation to play and will demotivate involvement in other aspects of life. It is important to point out that, for these players, playing a game does not just mean following addictive behaviour; it also provides a way to fulfil a basic psychological need. This would have to be considered in any potential intervention or treatment.

The theory can be summarised as follows: The situational variable that most impacts wellbeing is the satisfaction or frustration of needs. A key variable that, essentially as secondary avenue, can be influenced in order to increase wellbeing of a person is their game usage. Personality is a variable in the background influencing all of the involved concepts directly and may also interact with their respective influences on each other.

4 The Approach and Design of the Study

4.1 Aims of the Project

The overall goal of the present project was to investigate the relationships between players' usage of video games and their wellbeing. There were two specific aims. The first was to determine the aspects that best describe and distinguish different players' usage of computer games. This required a comprehensive framework comprising relevant aspects of game usage and a valid instrument to measure players' propensities on those aspects.

The second aim was to establish relationships between players' game usage and wellbeing. This involved investigating correlations between game usage factors and wellbeing and considering potential moderators and mediators of those correlations, as well as analysing the correlations of these variables over time.

4.2 Overall Design

An *exploratory sequential design* was used (Creswell, 2009). Exploratory sequential designs are a case of mixed methods research in which first a qualitative study is conducted to gain general insights into the topic of interest, before the observations made are further explored, generalised or quantified with a larger sample in a quantitative study.

The purpose of the first study was to identify a comprehensive set of relevant aspects of video game usage that could be used as the core of a framework for describing players' different game usages and to inform the construction of an associated questionnaire. To ensure this framework is empirically based and reflects players' aspects relevant for game users, a qualitative approach was chosen for this first study. Qualitative research is a general approach to understanding the world and draws on various kinds of non-statistical data; one of its strengths is its potential for exploring complex topics and interpreting their meaning (Denzin & Lincoln, 2011). In the present project, the qualitative component consisted of interviews with 26 users of different video game types. An approach to data analysis well suited for the purpose of this study due to its inductive nature and flexibility is thematic analysis, which aims to identify key themes supported by the data (Guest, MacQueen, & Namey, 2012).

Two of the strengths of quantitative research are its potential to test the relevance of findings from smaller studies in larger samples, and to gain insights into the associations between variables of interest on a general – rather than individual – level (Stevens, 1986). In the present project the quantitative component comprised studies two and three. In study two a questionnaire was constructed based on the aspects identified in study one and tested with two samples, the first comprising 316 participants, and the second 770 participants. After each test the framework and instrument were adjusted based on factor analyses of the responses and the feedback of participants.

The third study was longitudinal with three data-collection waves over nine months and included the final version of the game usage instrument developed in the first two studies, as well as established instruments to measure wellbeing, basic psychological needs, and personality. The main purpose of this study was to explore the relationships between game usage and wellbeing, while also considering personality and basic psychological needs. A longitudinal design was used to test the stability of the measured constructs and to further investigate the nature of the relationships between them, as well as for tentative indicators of causality.

All three studies were approved by the human ethics committee of Victoria University of Wellington.

4.3 Quantitative Methodology

This section provides introductions and brief discussions for the quantitative methods used in the studies reported in the present thesis. As it only pertains to one of the studies, the detailed information for the qualitative methods used is instead presented in section 5.2. An overview of all analysis methods used throughout the present thesis with additional information on how exactly they were deployed can be found in Appendix A.

4.3.1 Linear regression analysis.

Linear regression is a commonly used tool in quantitative data analysis. An underlying assumption is that two or more measures are linearly associated and that their relationship can be expressed through an equation of the form $y=\beta_0+\beta_1*x_1+\beta_2*x_2+...+\beta_n*x_n$; β_0 is the so called *intercept* and describes the value of the dependent variable y when all independent variables x_i are zero. The other β_i are the *slope-coefficients* which express how much the dependent variable changes for each unit of change in the corresponding independent

variables x_i. When there is just one independent variable the process is called *simple linear regression*; with several independent variables it is called *multiple linear regression*. The purpose behind using linear regression usually is to describe data, estimate proportions of variance uniquely and jointly shared by independent variables and the dependent variable, and to make predictions (Montgomery, Peck, & Vining, 2012). In the social sciences a main motivation for using it often is analysing the strength of correlations between measures. This is typically done by considering the correlation coefficient r and its squared value r^2, which indicates the percentage of variance in the dependent variable accounted for by the independent variables. The difference implied in the previous sentence is crucial: regression analysis shows statistical correlations between measures, it does not of itself imply a meaningful – or causal – relationship (Stevens, 1986). Statistical correlations can also occur when observed variables are mutually influenced by other, unobserved, variables, artefacts of the measurement process, or statistical noise. The latter leads to a consideration of the *significance* of results. The significance of a result indicates the probability that a pattern would be observed in a sample that is not present in the population; in the case of regression this would mean that a correlation is found in a sample despite the correlation in the population being zero. By convention a probability of 5% – or $p=0.05$ – is used as cut-off value for statistical significance, meaning only observations with $p<0.05$ are considered significant. However, even at $p=0.05$, in one of 20 cases a *type I error* is made, which means that an observation that is not a characteristic of the population is treated as significant. This contrasts with *type II errors,* which refer to actual effects being treated as non-significant (Everitt & Hay, 1992).

A more advanced use of linear regression is afforded by *hierarchical* linear regression analysis. Under hierarchical regression, different independent variables are added to a multiple linear regression one-by-one, in different orders. The purposes of this approach are to determine if variables make significant and substantial contributions to the overall regression after accounting for the effects of other variables and to determine their unique and joint contributions to the variance in the dependent variable (Montgomery, Peck, & Vining, 2012). A final note in this regard is the general advice to use an *adjusted* r^2 rather than the normal r^2 in any form of multiple regression. By the nature of regression, considering additional variables will almost always improve the overall explained variance and can never reduce it, even if it is entirely random. Therefore, standard r^2 is not a reliable measure to determine the contribution of additional variables unless it is adjusted to

account for the additional variance a random variable would explain (Montgomery, Peck, & Vining, 2012).

Multiple regression analysis can also show *mediating* effects of variables if a previously-entered variable becomes non-significant when another is added (Little *et al.*, 2007). In that case the contribution of the first variable is entirely accounted for by the second. Testing for *moderating* effects is more complicated. Moderation means that a third variable influences the association between an independent and dependent variable. In other words, the correlation between the independent and dependent variables vary according to the values of a moderating variable. Analysis typically involves an hypothesised moderator variable to be entered into the analysis together with an independent variable, and a moderation-term – usually the standardised moderator variable multiplied by the standardised independent variable (Little *et al.*, 2007). If the moderation-term is significant and adds statistical power beyond the independent and moderating variables by themselves a moderating relationship can be concluded. This is not the only approach to test for moderation, but the others depend more strongly on the specific context.

Linear regression is a basic approach to analysing the relationship between two or more variables. Typically, the results of interest are the variance shared by the variables, r^2, and the significance of the correlation, p. However, care has to be taken when interpreting the results. Even a strong correlation does not necessarily indicate a causal relationship. At the same time, weak but significant correlations should not be ignored. In the social sciences many measures of interest can be expected to be affected by a multitude of influences. If all of these were uncorrelated with each other this would imply that each may only share a small amount of variance with the dependent variable.

4.3.2 Exploratory factor analysis.

Factor analysis, and more specifically *Exploratory Factor Analysis* (EFA), is a method for analysing the variance shared by multiple variables, such as items in a questionnaire (Raykov & Marcoulides, 2010). It usually is used to identify a set of factors that can explain the variance observed in the data but has fewer factors than the original data has variables (Thompson, 2004). These factors are called *latent* variables in contrast to the observed variables because they are not measured directly. EFA assumes that observed variables, for example scores on tests, can be explained by the interaction of a factor, for example intelligence, with characteristics of the test, for example the difficulty of questions, plus a

unique contribution for each measured variable, for example experience with a particular question. Mathematically this approach can be expressed through the equation $\underline{X} = A * \underline{f} + \underline{u}$, where $\underline{X}$ is a vector containing the observed variances, A is a matrix with the specifications of the test called factor loadings, $\underline{f}$ is a vector containing participants' values in the factors of interest, and $\underline{u}$ is a vector containing the unique variance and an error term for each observed variable (Raykov & Marcoulides, 2010). This means that the value in each observed variable is expressed by a linear combination of the values of each factor multiplied by the respective loading for that factor of each variable. For example, the variance of a score in a physics test may be 60% determined by understanding of physics, 30% determined by understanding of mathematics, and 10% determined by being able to recall a specific value. EFA employs an iterative algorithm that estimates factor loadings in the matrix A until the model describes the observed variances as closely as possible.

A key issue in factor analysis is deciding the number of factors to accept as a solution. There are two common suggestions for this. The first is the Kaiser-criterion, according to which factors need to have an Eigenvalue≥1 (Thompson, 2004). The reasoning behind this rule is that the Eigenvalue indicates how much of the total variance a factor explains, and an Eigenvalue<1 would mean that a factor explains less variance than an individual variable would if the data were uncorrelated. This criterion often leads to a large number of factors and is seen as stating a maximum number of factors rather than making a suggestion for how many to choose (Fabrigar & Wegener, 2012). The second suggestion is using *Scree plots* (e.g. *Figure 4*). Scree plots plot the value of Eigenvalues against their number in the extraction sequence and are so named because they typically resemble the aftermath of a landslide. Under this approach, the ideal number of factors is around the number of factors where there is an "elbow" in the plot and it becomes level (Thompson, 2004). Another criterion is that the chosen factor structure should be stable; it should not vary substantially with the number of factors or different approaches to the factor analysis. Finally, an essential criterion is the interpretability of factors, which depends on the items that are loaded by each factor in the different factor-solutions. A factor-solution that makes mathematical sense but cannot be interpreted in a meaningful way is not useful.

Related to the choice of the number of factors is a series of decisions in respect of which variables to retain and which to remove. As one aim of EFA is to represent the data with a smaller number of underlying factors, variables that are redundant or not relevant within that structure should be removed. Care has to be taken when removing variables because

their factor loadings will depend on the number of factors extracted and on the other variables retained. Some guidelines for acceptable factor loadings of variables are that loadings should for each factor ideally be >0.6 with at least four variables per factor, or at least >0.4 if the sample size is at least 300 (Stevens, 1986; Thompson, 2004).

There are multiple approaches to conducting EFAs. Possibly the most common ones are Principle Axis Factoring (PAF), Maximum Likelihood Factor Analysis (MLFA), and Principle Component Analysis (PCA; Fabrigar & Wegener, 2012; Raykov & Marcoulides, 2010). The latter, Principle Component Analysis, is similar to, but not technically, an EFA-approach. PCA aims to reduce the number of variables while retaining as much variance as possible, instead of focusing on explaining only shared variance (Fabrigar & Wegener, 2012). In that detail also lies the core mathematical difference, in that EFAs distinguish between the variance common to the factors and unique to each variable, while PCAs take into account the entire variance, not just the common portion. The difference between Principle Axis Factoring and Maximum Likelihood Factor Analysis is minor and mainly technical. In essence, MLFA is more efficient and allows for various consequent statistical procedures regarding the testing of the factors, but it only works well with data that fulfils the requirement of normality. PAF, on the other hand, works equally well with all kind of data, but lacks the potential for additional (direct) statistical tests.

Another aspect of EFAs is *factor rotation*. Factor rotation is the process of aligning and organising the factors identified in the original analysis. This adjusts the loadings of individual factors on the items, which can therefore influence which factor an item is mainly associated with. It is used to attain clear factor structures. Two common choices are either varimax rotation or oblimin rotation (Raykov & Marcoulides, 2010). The key difference is that varimax rotation maximises the differences between the factors and attempts to hold factors orthogonal, while oblimin rotation minimises correlations between factors. For both the general method of factor extraction and the choice of rotation it is considered best practice to conduct the analysis with multiple approaches in order to test if the specific factors and overall structure are reproduced (Fabrigar & Wegener, 2012).

Finally, before an EFA is conducted, it should be tested if the data are suitable. Bartlett's test of sphericity indicates whether the variance matrix of the data is different from the identity matrix – meaning items are unrelated – which implies that common factors would not be identifiable (Cramer & Howitt, 2004). The second test is the Kaiser-Meyer-Olkin measure

(KMO), a measure used to establish sampling adequacy and suitability for factor analysis (Kaiser, 1974). It indicates the proportion of variance that is shared by the variables, a requirement for EFA to be able to identify factors. The higher the KMO the better, but it is suggested to be at least >0.5, ideally ≥0.8.

EFA is a powerful tool for analysing variance shared by multiple variables and for identifying structures underlying observed data. But however useful it may be, it is complex and involves numerous decisions on the part of the researcher. Besides selecting the variables to be included in the analysis in the first place, the researcher has to choose the general method of factor extraction, the rotation, the number of factors, and magnitude of factor loadings is deemed adequate. In addition, the researcher has to describe, interpret and name the factors, all of which can influence how other researchers perceive the results. For this reason, strong caution is advised when using and evaluating EFAs. Best practice involves the use of multiple approaches to check for the stability of factors across approaches and solutions.

4.3.3 Confirmatory factor analysis.

A different approach to factor analysis is *Confirmatory Factor Analysis* (CFA). CFA is a simple case of Structural Equation Modelling and combines path analysis with factor analysis. Its key aspect is that it uses various statistical techniques between observed and associated latent variables or even between different latent variables in order to test how well a specified model fits the data (Raykov & Marcoulides, 2010). It provides quantified information that EFA does not and can therefore be used to inform decision making about which model to choose. In that respect it is seen as superior to EFA in which a lot of decisions are guided by the data but essentially made on a subjective basis (Thompson, 2004). However, discussions about superiority largely do not give enough emphasis to the point that both kinds of factor analyses have different uses and purposes. CFA is used to compare and inform the choice of exactly-specified models, including the number of factors, the numbers of items and which relate to which factors, and which factors are correlated. EFA, on the other hand, is used to explore the data without preconceptions and to identify possible models that can then be tested and compared with CFAs (Thompson, 2004).

In that regard, however, the use of CFA is sometimes exaggerated, leading to it being misused. Researchers who perceive CFA to be superior tend to use it first and only conduct an EFA if their theory is not supported by the CFA (Thompson, 2004). Hypothesised models can fit the data well despite not reflecting an actual underlying structure, and that one model

fits does not imply it is the most accurate model. CFA only compares specified models and cannot make suggestions for alternative models on a basis of meaning; the indices of expected change provided by many analysis packages are purely statistical information and should on be used with great care (Fabrigar & Wegener, 2012). Therefore, Fabrigar and Wegener (2012) suggest to always conduct EFAs first to identify all plausible models. They explicitly include the adaptation of questionnaires where it should be verified if the new items suggest models that were originally not considered.

There are a multitude of statistics that can be used to describe the appropriateness of a specified model in CFA. The most commonly used ones are (Lai & Green, 2016):

Chi-square test of significance, which tests if an observed structure likely is due to chance. Significances of <0.05 are usually accepted.

Root Mean Square Error of Approximation (RMSEA), which determines the difference between the observed correlations and those predicted based on the hypothesised model. Values <0.10 are usually accepted, with values <0.06 being good.

Comparative Fit Index (CFI), which compares the hypothesised model with a baseline model in explaining the observed variances. Values >0.9 are usually accepted, with values >0.95 being good.

Ideally, all measures of fit are in agreement, but it can happen that they do not align, indicating issues with the model or data collected from the sample (Lai & Green, 2016). In those cases, the model in context of the study, reasons for the divergence, and the suggested more or less arbitrary cut off values need to be considered. It is suggested to refrain from using mathematical "tricks" to improve statistical model fit without them being reflected in the interpretation of the model, such as correlating error terms (Raykov & Marcoulides, 2010).

4.3.4 Item Response Theory.

Item Response Theory (IRT) is a framework for scale evaluation and construction. A motivation for using IRT is that variables, for example items in a test or questionnaire, have different difficulties and the scale-points are not necessarily equally distributed (van Schuur, 2011). The aim of IRT often is to recalibrate ordinal data as interval data and to thereby estimate participants' scores in a measure more accurately. This is done via an iterative process during which scale locations of the response options for each item are determined

based on the distribution of all participants' responses to all variables (van Schuur, 2011). The results of IRT are scale locations of response categories for all items, and the estimated scores associated with each observed response pattern.

This is very helpful for the construction of scales that are intended to distinguish well between different levels of participants' scores, because items can be identified and chosen that discriminate particularly well in different ability regions (Raykov & Marcoulides, 2010). Due to the increased accuracy of IRT scores, this framework is especially useful in longitudinal studies. Here IRT scores can counteract random fluctuations in participants' responses because the non-equal difference between scale locations are especially impactful.

5 Study 1 – Developing the Preliminary Game Usage Framework

5.1 Study 1 – Introduction

Study 1 was the first step to addressing the first aim of the project – determining the aspects that best describe and distinguish players' various usage of computer games. "Usage" here refers to any game-related activity and can include activities outside games, such as talking with others about experiences in a game. The intention was to develop a comprehensive framework that could be used as basis for the construction of a corresponding questionnaire to measure participant's usage of games later in the project. Interviews with users of video games were deemed to be the most appropriate method for the first step. The purpose of the interviews was to gain insight into how online computer games are used by players. The foci were the aspects of game usage that players find relevant to describe how they play – in contrast to what developers and researchers assume – allowing for meaningful differentiation between players. This step was followed by a quantitative study to verify and adapt the aspects identified in the interviews.

The framework and instrument developed in studies 1 and 2 will enable researchers in the field of game studies to interpret and compare their findings more meaningfully. The questionnaire was also used in study 3 of the present project as operationalisation of game usage.

5.2 Study 1 – Methods

5.2.1 Approach.

The aims of this study fit an interview approach referred to as the *conceptual interview (Kvale, 2007)*. Conceptual interviews aim to define a concept through interviewing people with experience with the topic. Important during this kind of interview are a sense of personal relationship between participants and the interviewer and that the interviewer practices active listening and acts on potentially small hints (Kaufmann, 1999; Kvale, 2007). Furthermore, it is important to set aside preconceptions and to be willing to let the participants guide the interviews, as different people may have different experiences and assumptions (Kaufmann, 1999). Overall, the intention in this approach is for an interviewer to assume the role of a conversation partner who elicits information from a participant more than that of an anonymous researcher.

Interviews were semi-structured and in-depth (Lapan, Quartaroli, & Riemer, 2012), loosely following the guide presented in Appendix B. Because this stage of the study was exploratory – it was not known which aspects would be relevant – this guide and its role in the interviews had to be managed carefully. An overly specific guide might narrow the focus of participants' responses, and thereby limit the potential of the study to find something new, which is a strength of qualitative research (Corbin & Strauss, 2008). The interview approach aimed to engage participants in discussion to reduce the likelihood of them only answering the prepared questions. On the other hand, overly general questions can confuse participants and lead to unfocused responses, which may be difficult to compare and interpret meaningfully (Kerr, Aronoff, & Messe, 2000). The guide therefore included several prompts to help the researcher start a conversation, reorient if the conversation seemed to be stuck, and ensure that key topics were covered. Questions and prompts had to be applicable to a variety of game types or had to be adjusted for the specific context during each interview, and the structure of the guide was flexible. Examples from the guide include asking the participant to describe a game they play, when and why they started playing it, who they play with, and why they kept playing after they started. After those introductory questions, the key question was phrased in three ways: "How do you use games? What aspects would you say are relevant to describe to someone else how you play? What aspects are relevant to distinguish how you use the game from how others use it?" Later prompts were, for example, to ask participants to compare their usage of their main game with another game they played then or in the past, or whether their game usage had changed over time. Finally, participants were asked if there was anything else that they thought of or wanted to mention.

5.2.2 Recruitment.

Sampling for this study was purposeful and aimed at maximising variation in relation to participants' played games, level of experience, and demographics (Johnson & Christensen, 2014). Advertisements were posted on international game-specific forums such as Diablo 3, steam for DotA 2, or League of Legends, and on popular general gaming forums such as MMO Champions or GameFAQs. In selecting game specific forums, care was taken to represent the different popular game types. General gaming forums were included to broaden the game-spectrum and selection of participants and their geographic locations. The advertisements (see Appendix C) comprised two sections. The initial section provided a brief outline of the research and its purpose – finding out how games are being used – and the second section provided more information about the researcher and the details of

participating. All current users of games of at least 12 years of age were invited to participate. The decision to not exclude new players by focusing explicitly on experienced players was made because beginners might have experiences, reasons, or behaviours that seasoned players may not remember or do not view as relevant anymore. Participants were also offered the option of providing an anonymous *written response* on the survey platform Qualtrics instead of participating in an interview.

Users of games registered interest in participating in interviews by completing a brief online form on Qualtrics, the link to which was on the advertisements. This form asked for participants' e-mail addresses and the game(s) they played. After the initial contact, participants were sent the information and consent forms (see Appendix D) and were offered to invite friends or guild-mates to participate in the interview with them. Next, participants were asked to suggest times that would suit them for an online interview, and whether they preferred zoom or skype for the interviews.

All people who volunteered were accepted. Initially, recruitment was supposed to last two months, but was extended in order to ensure there were at least four participants per major game type – Multiplayer-Online-Battle-Arena (MOBA), Massive-Multiplayer-Online-Role-Playing-Game (MMORPG), First Person Shooter (FPS) – and at least one participant per other common game type discussed in section 2.3.1. After three months and 17 interviews it was felt that, while stories and foci differed, the content discussed in the interviews overall was similar. Therefore, three more interviews were conducted and as no new aspects were brought up – indicating data saturation – recruitment was concluded.

5.2.3 Participants.

In total 26 people participated in this study. There were 18 individual interviews, one interview with two people, one interview with three people, and three written responses.

To make participants feel more comfortable with sharing personal experiences – some concerns were raised by some of the readers on the forums about the study potentially being a scam to gather users' personal information and some forums specifically prohibit any requests that involve identifiable information – and because it was not generally of relevance for this study, demographic information was not collected pro forma. However, participants freely brought this information up where it was relevant to their experiences. While it is not ideal, information such as sex and estimated age could also be inferred from the video, if they were not mentioned directly during the interview.

Participants in the report from the first step will be referred to by identifiers based on the main game discussed in the interview, except for W1-W3, who provided written responses. Most participants in the interviews were in their (early) twenties, and four were probably in their early thirties. Three of the participants in the interviews were female. Based on the information provided in the interviews, almost all participants were studying at universities in Europe (mainly Germany and the Netherlands), the USA, or South Africa. Written response 1 differed from other participants in that he described himself as impaired war veteran of over 50 years of age. An overview of the general information for each participant together with games discussed is presented in Table 2. Games highlighted in green were the main game types discussed; if several game types are green, they were discussed equally.

Table 2

Information about each participant and games discussed in each interview

Main game types discussed	Gender	Region
MOBA 1, Real Time and Turn Based Strategy	Male	EU
MOBA 2, MMORPG, FPS	Male	USA
MOBA 3	Male	EU
MOBA 4, Turn Based Strategy, MMORPG	Female	EU
MOBA 5, MMORPG	Male	EU
MOBA 6, MMORPG	Male	SA
MOBA 7, MMORPG	Male	SA
MMORPG 1	Female	EU
MMORPG 2	Male	EU
MMORPG 3, MOBA	Male	X->USA
MMORPG 4, MOBA	Male	SA
MMORPG 5, Open World Action	Male	USA->NZ
MMORPG 6, MOBA (these were three players)	Male	EU
FPS 1	Female	CA->EU
FPS 2, MOBA	Male	EU
FPS 3	Male	USA->EU
FPS 4, action sports game	Male	EU
Real Time Strategy (RTS), FPS, MOBA (these were two players)	Male	EU
Turn-Based Strategy (TBS), MOBA, MMORPG	Male	EU
ARPG, FPS, MMORPG	Male	EU
MMORPG (Written response 1)	unknown	unknown
MMORPG (Written response 2)	unknown	unknown
MMORPG, ARPG (Written response 3)	unknown	unknown

Note. "->" indicates participants had moved from one region to another. MMORPG 3 had lived in multiple different regions before moving to the USA.

Other information not provided in Table 2 is that:

- MMORPG-player 2, FPS-player 1, MMORPG-player 3, MMORPG-player 6.1, and W1 were assumed to be at least 30 years old;
- W1 mentioned he was a widowed war veteran with severe physical impairments;
- MMORPG-players 5, 6.1, 6.2, 6.3, and MOBA-player 4 were personal contacts of the researcher.

5.2.4 Procedure.

Interviews

The topic of the interviews was complex and elaborating on their thoughts may involve participants sharing personal experiences. Additionally, gamers have been found to often feel misrepresented in the media and feel confronted with prejudices (de Larios & Lang, 2014). These factors were considered in preparing for the interviews. Throughout the interviews, it was attempted to establish the personal relationship required for open in-depth interviews. It was relevant that the researcher is part of the gamer-culture himself and that this was recognised by participants (de Larios & Lang, 2014). The researcher prepared interviews on games he was unfamiliar with by watching introductions to and reviews of the respective games and their gameplay on YouTube. Having an understanding of the games to be discussed was assumed to be important because it allowed the researcher to ask specific questions and to better understand participants' explanations. Furthermore, showing some knowledge of, and interest in, specific games invites participants to share more detailed, and possibly personal, opinions and experiences. The intention was to make participants feel comfortable and for the researcher to engage in discussion with the participants. This was done to draw out detailed information and ensure that responses were understood correctly. Care was taken to avoid directing participants' responses and to instead support them to elaborate their thoughts.

Most interviews were conducted using Skype, but some participants chose Zoom. While the researcher activated his webcam, this was not requested of participants; about half of them did, anyway. All interviews were audio-recorded and took between 31 minutes and 124 minutes, with a majority taking between 40 and 55 minutes. They focussed on the experiences and opinions of the participants as "experts" in their respective games. During the introduction the researcher talked about the background of the study and asked general questions about the game and the participants' gaming history. This served to let both

parties relax, get to know each other, and establish a relationship. Once the general questions were asked – usually after about 15-25 minutes – the key question, regarding what aspects are most relevant to describe the game usage of participants, was asked. Most participants rephrased or repeated the question in their own words to confirm that they had understood it correctly. The researcher used participants' responses to initiate discussions about the aspects mentioned by them and let those thoughts lead the interview. Where appropriate, the interviewer shared his own thoughts, impressions, or experiences of the game being discussed – or a similar one, if the researcher was not familiar enough with a specific game. If participants could not think of potentially-relevant aspects of their game usage, they were asked to describe how they play and what they do in the game and it was attempted to initiate discussions about their game usage from there. At the end of the interviews, participants were invited to bring up anything not previously discussed that might be related to the topic of how people use games.

Participants were engaged, and all interviews involved animated discussion. Most offered to be contacted if any clarification was required. After the analysis was complete all participants were sent a summary of the results and given the opportunity to provide feedback. While several acknowledged the e-mail by noting they would like to be informed about future parts of the project, none commented on the results in detail.

Written responses

The written response form, an alternative to participating in interviews, comprised 19 prompts covering various aspects of game usage that were assumed be relevant (see Appendix E). These assumptions were based on suggestions from the literature and previous discussions with gamers. At the same time, the questions were kept as open as possible. The form started with the key question: "Please brainstorm: What are different aspects that would in your eyes be required to describe how you use the game? (Imagine you want someone else to understand how you play/use the game. What would that person need to know about?" Despite being complex, this question was put first so that participants had a chance to respond to it before being potentially influenced by the subsequent prompts, although they might have previewed the remaining questions anyway. Responses varied in length between a sentence and an entire paragraph per prompt.

5.2.5 Analysis.

NVivo12 was used to organise and manage the qualitative data because of its many useful functions. The general approach chosen to analyse the data was thematic analysis because it can easily be adapted to suit specific research intentions (Braun & Clarke, 2019). Thematic analysis is a common approach to analysing qualitative data. Its defining feature is the aim of identifying meaningful themes across a set of data (Braun & Clarke, 2006). A key theme does not have to be the most common one but depends on its relevance for the purpose of the study and within the greater topic; this also means that thematic analyses can focus on specific aspects of the data (Braun & Clarke, 2012), which aligns well with the aim of the present study. However, the present study departs somewhat from thematic analysis as described by Braun and Clarke (2012) because its focus is not on the interpreted meaning of themes, but on identifying and describing them. Thematic analysis shares the limitations of most other analyses, in that every set of data can tell many stories, and the story reported depends on the purpose of the study, posing risks to credibility (Guest, MacQueen, & Namey, 2012). This is exacerbated by the presumption that it is impossible to conduct a qualitative analysis completely inductively because our experiences and attitudes influence what we find to be relevant (Braun & Clarke, 2012). Sample suggestions for attaining credibility of research results are requesting feedback from participants, verifying the face validity of results with colleagues, reporting results clearly, and using different kinds of data to check the results and their hypothesised structure (Guest, MacQueen, & Namey, 2012).

While preparing the analysis – listening to the recordings and producing transcripts – it was noticed that substantial parts of some interviews were not relevant to the aim of the study in detail, such as the researcher's introduction, participants' verbose anecdotes, or information about participants' real lives. Therefore, selective transcriptions of the interviews were made (McLellan, MacQueen, & Neidig, 2016). Passages that were related directly to the aim of the project were transcribed verbatim, while unrelated statements were only described or summarised. If the researcher could not decide how relevant a passage was, it was summarised with an appropriate level of detail and marked in the software. Here the ability to link parts of the transcripts with times in the recording was very helpful: The original audio could easily be referenced afterwards and was used to verify the accuracy of the summaries the researcher made and to confirm the relevance of passages.

The specific approach leaned on were the six steps suggested by Braun and Clarke (2006): familiarising oneself with the data, coding the data, developing themes, reviewing the

themes, defining and naming them, and producing a report. A visualisation of the process used in this study is presented as diagram in *Figure 3*. The fifth step – defining the themes – is not shown in the diagram because it is the focus of section 5.3.

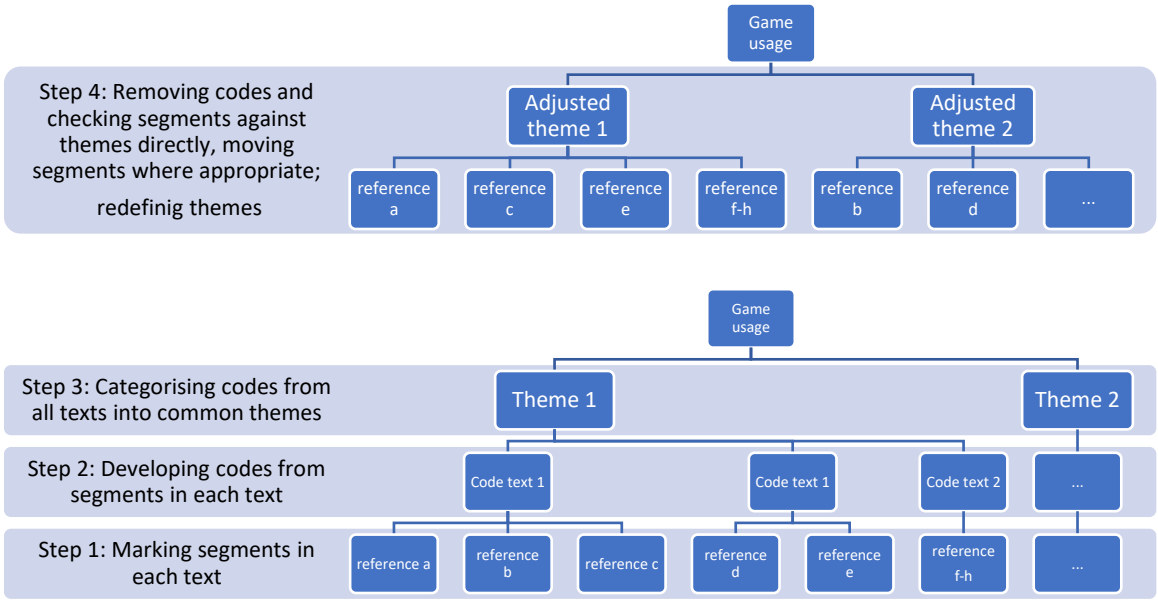

Figure 3: Diagram of the approach to the thematic analysis

In **step 1**, the 23 transcripts plus the three written responses were read carefully. During this step the parts of the transcripts that were only summarised were re-evaluated; some summaries were elaborated on or replaced with verbatim transcriptions. Multiple memos were written during this process, containing thoughts on potential codes, interesting statements that might be worth analysing further, or similarities and differences between participants' descriptions. A specific focus during this step was to identify and mark all segments in the transcripts that appeared to be relevant to game usage. R*elevant* meant either that participants indicated that an aspect was related to their game usage, or the researcher assumed this to be the case. For example, the ARPG-and FPS-player said that he liked to plan things and that this was an important aspect of how he used games, while his statement that "you need some brains for the game" was assumed to be relevant by the researcher.

In **step 2** codes were developed for the marked segments in each interview, with some being assigned to multiple codes. In an effort to analyse the data inductively and prevent preconceptions or misinterpretations, it was attempted to minimise the influence analysing interviews had on the perception of subsequent interviews, for example, by not automatically reusing codes from previous transcripts. In total 685 codes were developed,

ranging from 24 for MOBA-player 3, to 38 for MMORPG-player 5 and 40 for MMORPG-players 6. In Table 3 a selection of codes is presented to showcase how marked segments were coded and to give an indication of the breadth of codes. *Prevalence* is a measure of how commonly codes were used during analysis. *Very common* indicates the code – or a synonymous one – was used in the analysis of almost all transcripts, *common* in over half, *rare* in less than half, and *very rare* codes were used in less than five transcripts.

Table 3

Selection of codes and exemplary segments by interviewee to showcase coding

Name of code and source-interview	Prevalence of codes	Example segments from the transcripts
Accessing information (MOBA-player 3)	very common	What is good also depends on guides; I want to see how it is played on a high level
Purpose (MMORPG-player 3)	very common	At beginning to play with people from the LARP; I see it like some people might see a bar; I wanted to have more friends, it was difficult as immigrant
Friends (FPS-player 1)	very common	I generally prefer to play by myself; playing to hang out or talk with my family; much more likely to be a try-hard when playing with friends
Priorities (Real-time-strategy)	common	I first played 30-60 minutes, and everything else came afterwards; That is spontaneously, plan B as other things have priority; only when I have time
Responsibility (FPS-player 4)	rare	In Yu-Gi-Oh as 1 vs 1 if I lose only I lose and not a team; when you are the last survivor you know everyone is watching you and if you mess up
Experimenting (MOBA-player 5)	rare	don't like being a meta-slave; like to switch things up; meta-focus made experimenting difficult; not everyone is open to new things or stupid ideas
Acceptance of gaming (FPS-player 2)	very rare	may be a culture thing as in Korea players may be stars
Analysing gameplay (MOBA-player 2)	very rare	I do have certain philosophies I believe are important; we break down the fundamentals of why we lane the way we do

Examples provided in Table 3 are intended to show the variability in segments assigned to specific codes within a transcript to give the reader a better understanding of how the researcher went about coding and interpreting segments. The full list of codes by interview can be found in Appendix F.

In **step 3**, the lists of all codes across all interviews were merged. Some codes were unique, some similar, and others identical. Duplicates were removed and similar codes – such as "improving" and "becoming better" – were integrated into a single code when appropriate. The resulting codes were then compared in order to develop themes. Examples of codes that were merged are "advancing" and "progress", or "clan" and "guild". This resulted in the 685 codes from the different interviews being reduced to 164. Whether the merging and integrating of codes was appropriate was confirmed in step 4. The resulting list of codes was then analysed by content in search of common themes as categorisations. This process involved multiple iterations. First, themes were developed based on a few similar codes – for example, helping, exploring and experimenting were all in-game actions. Each iteration introduced new themes, added more codes to existing themes, changed associations between codes, or combined several themes into fewer more general ones. The process resulted in ten themes with between four and 30 associated codes each. To showcase this categorisation, in Table 4 the ten themes are presented with example codes. The codes presented were chosen to reflect the variability within each theme and to give the reader a better understanding of how codes were interpreted and assigned to themes. To explain some of the possibly less intuitive associations, for example *efficiency* referred to players only doing essential actions in a game to progress as quickly as possible which therefore describes a behaviour. Likewise, *anonymity* referred to statements around either openly sharing personal information in interactions with others or attempting to keep interactions on a superficial level, therefore also reflecting behaviour in the game. And *game as break* referred to players only playing as break between other activities, indicating they did not allocate a lot of time to playing, in contrast to those who organised their day around playing.

The last category, *Unrelated to game usage,* contained segments that were generally interesting but not deemed relevant for this stage of the project. There were also segments that seemed relevant but did not fit into any of these 10 themes. The full list of codes organised by themes can be found in Appendix F.

Table 4

Themes emerged, and selection of codes associated with each

Themes	Prevalence of themes	Number of codes	Example codes
In-Game Behaviour/Playstyle	Very common	21	playstyle; communication; training; helping; main class; efficiency; explore; experiment; anonymity
Subjective Experience of Gaming	Very common	21	negative feelings; freedom; community; expressing oneself; game as part of RL; responsibility
RL Variables and Influences	Very common	17	priorities in life; time and duration; control over playing; game as break; game as habit; RL-money; phases
Level of Involvement	Very common	16	skill; seriousness; focus; progress; learn/improve; doing well; effort
Choice of Content/Setting/Game	Very common	27	content; complexity; guild; playing with others; challenge; friends; variety; solo; game type; language
Game Related Activities	Very common	12	forums; modify game; RL-activities involving in-game friends; accessing information; thinking/planning
Thinking/Analysing	Very rare	5	tech-side of things; analysing gameplay; game mechanics
Motivation/Goal	Very common	26	fun; social; story; being someone else; advancing; winning; rewards; completing; challenge; own goal
Purpose	Very common	9	relaxation; to feel good; distraction; entertainment; processing RL
Unrelated to game usage	Rare	4	personality; other things; non-game

For **step 4**, all of each codes' marked segments were assigned to the themes directly while the codes as "containers" were removed (see *Figure 3* for a visualisation). This was done to check whether themes accurately represent the original segments, to determine if some

segments fit better into other themes, and to define the themes drawing on the segments rather than on the codes, ensuring the final interpretations are based on the data, not on previous – possibly already inaccurate – interpretations. Segments that did not fit into any of the themes were used to question and restructure the themes or to develop new themes. It was attempted to ensure that most segments were represented in the final themes. This was because the aim was to develop a comprehensive framework, and if relevant segments did not fit into any of the themes, this indicated a theme was possibly missing or ill-defined. During step 4 it was found, for example, that there was no conceptual difference between *Game-related activities* and *Thinking/Analysing*. Thinking/Analysing instead appeared to be a sub-category of Game-related activities. Similarly, it became evident that the segments for *Motivation/Goal* and *Purpose* had significant overlap. Combined with several previously not assigned segments, they were reinterpreted as indicating players' *Intentions* while playing. Several adjustments were made:

- *In-Game behaviour/Playstyle* was relabelled to just *In-game behaviour*, and *playstyle* became one of its subcategories, in differentiation to the *social interaction* aspect of in-game behaviour.
- *Level of involvement* was relabelled *Involvement in and attitude towards the game*.
- *RL variables and influences* was relabelled *Allocation of RL resources*.
- *Thinking/Analysing* was incorporated into *Game related activities*.
- Major aspects of *Motivation/Goal* together with previously unassigned references became the new category *Intention while playing*.

All of the seven final themes emerged and seemed important in all interviews, and almost all of the previously unassigned segments could be assigned to one of these themes.

At the end of this step, sub-themes were developed, set within the definitions of each theme and closely representing the original segments. The themes and sub-themes are presented and defined in the following sub-section.

5.3 Study 1 – Results

5.3.1 Basis for the Game Usage Framework.

Seven main themes and several sub-themes emerged. They are displayed in Table 5 and constitute the preliminary version of the Game Usage Framework developed in the present project. A description of each theme follows.

Table 5

Final seven themes and sub-themes that describe game usage based on interviews

Themes	Associated sub-themes
In-game behaviour	Social Interactions
	Playstyle
Choice of content, setting, and game	Playing with/against others
	Joining a set group/clan/guild
	Content (its aspects, e.g. challenge)
Involvement/Attitude towards game	Focus
	Level of play
	Seriousness
Subjective experience of gaming	Experience of social interactions
	Negative feelings
	Positive feelings
	Gaming as self-determined
	Immersion
Game related activities	Thinking/Analysing
	Planning/Preparing/Informing
	Streams/Videos
	Meeting/Talking in RL
	Creating game relating things
Allocation of RL resources	Time spent on games
	Priority of gaming
	Control over gaming
	Money
Intention	Achievements/Collecting
	Being good/Becoming better
	Winning
	Social
	Fun
	Story/Narrative
	None

In-game behaviour

In-game behaviour relates to all player- and game-oriented actions in a game. It is split into two subthemes. The first comprises all *social interactions*, such as whether and how players communicate with others, but also how they interact on an avatar-level; the second sub-theme comprises everything that could be considered *playstyle*, such as tending to be aggressive, explore or focus on efficiency. All participants mentioned that it was important, at least to some degree, to consider how players behave in games. Players' social interactions were diverse. Some focused on building up relationships: "I loved creating relationships, having a group where everybody knew each other" (MMORPG 3); others used the purely practical side of communication: "We could organise what we do and our hero composition around what we want to do" (MOBA 2); and others again emphasised the unfriendly side of social interactions: "You only add someone after a game to insult them" (TBS). Playstyles also were diverse. Common differences were aggressive vs. defensive playstyles: "It is about if you play aggressively or defensively" (MOBA 7); experimenting vs. sticking to standard playstyles: "Experimenting does not mean I am trolling, I still try to win" (MOBA 1); and focussing on the team vs. playing as if one was alone: "I often am the one who has to change his operator back because I notice the team does not need him right now, but rather someone else" (FPS 4).

Choice of content and setting

Choice of content and setting refers to all general choices players make in games. This category was split into three main aspects: *who one plays with and against*, what kind of *social setting* one chooses in games, and the kind of *content* one chooses to engage in. For example, some people emphasised that they preferred to play alone despite playing an online game which is based around team-play: "I often play off-lane where I can be alone" (FPS 2). Social groups seemed particularly important, and while some decided to avoid them, others joined groups that represented friend-like settings, sometimes with strong personal statements "Never Alliance. My guild website used to have a banner that said, 'Friends don't let friends play Alliance.'" (Written Response 1). The choice of what kind of challenge players engaged in was another commonly discussed difference "[For the player] It's the competition against others online; I have friends that never played LoL online [the participant meant *matchmade* rather than *online*], can't understand that, it's always the same and no challenge." (RTS).

Involvement in and attitude towards game

Involvement in and attitude towards games describes players' general attitude and involvement and all actions that reflect it. The sub-categories of involvement were *focus*, *seriousness*, and *level of play*. Two quotes that clearly show how different the focus of players can be are "[the game is] something to keep my fingers busy while watching something else" (FPS 1) and "I hate when teammates feel they can watch TV while playing a game" (FPS 4); the first quote implies that the game is just an activity on the side while the player mainly does something else, while the second quote expresses how strongly the player feels that when playing the full focus should be on the game. Two different levels of seriousness are expressed in a single quote by FPS 3: "A guy reached out to me [to play together] and he wanted to do almost like an interview with me and I was like 'You know what, I don't care that much'". The "guy" in that quote took the game very seriously to the point that he did not want to play with others before having made sure that they are a good fit, while the interviewee did not care enough about having a good teammate to put effort into finding one. Large differences in level of play and how different interpretations can be among players were highlighted by MMORPG 5: "[...] saying they [gamers] do [play competitively] when they only do a few BGs [battlegrounds, a player versus player mode anyone can engage in], or say they don't while being half way through mythic [the most difficult kind of player vs. environment challenge in World of Warcraft, usually completed by less than 1% of players]".

Subjective experience of gaming

This aspect represents the breadth and complexity of feelings games can elicit in players. It is organised into *experiences of social interactions*, *positive* and *negative feelings, feelings of freedom or responsibility*, and *immersion*. This was possibly the most diverse category and one that seemed to play a significant role for all participants. The diversity of different experiences of social interactions was reflected particularly well in the interview with three players, as experiences ranged from "Everything is anonymous, you don't know them" to "I got to know a couple of people rather well, and talked to them over voice chat, and had their e-mails" (both two different interviewees from MMORPG 6). Positive feelings, such "When playing with friends it's like a wildcard, winning is fun, but losing is also fine." (MOBA 3) stood in contrast to negative experiences, such as "I got annoyed by having to re-learn old champs frequently" (MOBA 5) or "The atmosphere was different, because all players had that pressure the game wasn't as fun anymore." (TBS). Freedom, or acting self-determined,

also seemed to be an important aspect "[the game] is very self-determined, one can decide oneself what one does or does not want to do in the game" (MMORPG 1), as did immersion "It was different because I completely immersed in the game, my VL [virtual-life] was bigger than my RL [real-life]" (ARPG FPS).

Game related activities

Game-related activities is a broad aspect that covers everything game-related that happens outside of the game itself. Examples are *analysing the game or gaming* itself, *planning or informing oneself*, *watching streams or videos*, *talking with others about game-related content*, or *creating game-related content*. Falling into both, the analysing and talking with others sub-themes, one of the RTS, for example, noted "We may next day after playing, for example in the cafeteria analyse the game", while for MMORPG 2 analysing the game even was one of his reasons for engaging with the game: "RoM [Runes of Magic] was about the analysis and what happens behind the scenes of the game"; others, again, did not think much about their games at all when not playing. Planning was another very important sub-theme that some players engaged in excessively, for example "I prepared for maps that were played in ESL [Electronic Sports League], planning exact routes and timing on maps, I planned possible behaviours for every fight and possible fight location." (ARPG FPS), or "When I start dreaming about it [the game] I played too much." (MOBA 4), while when others exit the game they stop thinking about it and just decide what they want to do in a game spontaneously. Another frequently mentioned aspect was watching streams or videos of other people playing a game, which some of the players did for entertainment or as sign of involvement in the game: "I couldn't image I would watch someone else playing, but now I am lying in bed and watch someone else" (FPS 2), or "I think it matters, not a lot but a bit, because it, e.g. [sic.] lore or watching championship, shows how invested you are in the game." (MOBA 7). While many players specifically met to talk about games, for some it was just a normal part of their day: "I have discord [a common voice and text chat application that can also be used as forum] on my phone, sometimes when people ask questions I will go into detail with them, not just on what they should do, but also on how and why they should do it this way." (MMORPG 4); and others hardly talked about games with friends at all. The last sub-theme, creating game related content, was mentioned several times, but only few of the participants actively created content, such as MMORG 2 "It [his main game] is being played mainly to record videos, I do that on the side for my YouTube channel".

Allocation of real-life resources

Allocation of resources outside the game refers to all aspects where resources outside the game affect game-play or vice-versa. Sub-themes are *time spent on games*, *how important the game is* relative to other aspects of life, whether people feel they have *control over their gaming*, and how much *money* they spend on it. An ubiquitous sub-theme was that of time, be it critical: "The big problem I have with Warframe and the grinding is that some people might get caught up in the loop and that would obviously take more and more time and at the end of the day would take over their personal life [on checking he clarified that he had experienced this]" (MMORPG 4); as a statement on the side: "… but who has the time for MMOs?" (MOBA 2); or a statement indicating increased awareness of time being limited: "Simply because of a lack of freely allocable time, increasing responsibilities; because of a decrease in free time I organise it more consciously" (MOBA 3). Priority was also frequently mentioned, commonly as games either being used only if there was nothing more important to do: "Check if I have anything important to do. If not, then gaming it is!" (Written response 3); or as playing being a key part of each day: "I wanted to finish school and get home where the actual exciting stuff would start [referring to playing the game]" (MMORPG 5). Another topic noted by participants as important was the issue of control: "I have situations where I know I have to stop after this round, and then next thing I know the sun is coming up." (FPS 3), or "Playing 1-2 hours a day is fine, but it quickly becomes more" (MOBA 1); however, some noted they heard this being a problem for others without having experienced it themselves. Regarding spending money on games, participants' views diverged considerably, from "I only want to pay once for a game" (FPS 1), to "I have probably already put 1000 Euro into it already because I bought every season again the pass, where it again gives an [purely cosmetic] armour or something" (ARPG FPS).

Intention

This last theme refers to the aims players have while playing, such as winning, having fun, or completing an in-game collection. While they can go together, it is important to note that an intention while playing does not have to be the same as the motivation for playing the game. Intention and motivation will often be linked because intention is likely to be oriented towards fulfilling the motivation, but they may also be independent. For example, the motivation for playing a game may be its action content, but the intention while playing may be progressing through the story or exploring a virtual world together with a friend. Some participants focused on *improving (*"… with AoE [the game Age of Empires] I want to

improve while I don't care with Rocket League and don't question why I lost", RTS*),* others on *making progress (*"I just clicked on exclamation marks [ending and starting quests], didn't care what enemies I was killing as long as I got exp [to level up]"; MMORPG 6*),* others again only cared about *winning (*"Sometimes I really just want to win"; MOBA 6), some did not care about the game itself and focussed on *social aspects (*"I see it like some people might see a bar, where you go and meet your friends", MMORPG 3), some on *having fun (*"Particularly within Europe, they tend to be a lot more hardcore than NA [North America], you either play to win or you don't play in Europe, while in Canada it is much more common to play for fun [this participant was originally from Canada and in games did care much about winning; she wanted to make sure everyone, especially her personal contacts, had a good experience while playing]*",* FPS *1),* others want to experience the *story (*"I play RPGs, it's like reading a book, when I want to experience a game's story, MOBA 5) and – most infamous among players – *completing* something, such as a collection ("It is about completeness", MOBA 4) or achievements ("I'm an achievement hunter", MOBA 7).

Summarised, seven main themes with multiple sub-themes emerged in the analysis of the interviews. While these themes were very common and were each referred to by almost all participants, participants differed significantly on each of these themes. Especially the sub-themes seem promising to meaningfully distinguish between participants usage of games.

5.3.2 Additional findings of study 1.

Related to the overall project but not directly to the development of a game usage framework was the observation of downwards spiralling indicated in several interviews. MOBA 1 described this extensively for the time after a romantic relationship outside of the game had ended. He wanted to play a competitive game to feel better, to experience competence and being part of a group, but – as is the nature of many competitive games where players are matched evenly so that they are expected to have win-rates of about 50% – he lost the next game, felt worse, wanted to play another one to feel better, but by now started losing his focus and lost the next game, too, and the spiral continued. Importantly, as also reported by the Turn-based Strategy player, winning a match does not necessarily stop that spiral if the match or one's performance are not considered to have been good according to one's own standards ("One gets frustrated when one loses because a teammate or oneself plays badly", "… [talking about good matches] a good five-man team or five good enemies, because it also is stupid when the enemies are bad", TBS).

A secondary observation of potential relevance for the project was that participants explained the same games differently. These disparate explanations reflect how diversely games are experienced. For example, grinding was described as "core-mechanic" of the game Warframe by MOBA 7, while it was hardly mentioned by MMORPG 4 in regard to the same game. Or Turn Based Strategy-player described his game, Hearthstone, as highly competitive, technical, and complex, while MOBA 4 said it is casual and simple. Many of the participants expressed to some degree that they assume their own way of playing to be the "standard" way and therefore to be a characteristic of the game, for example MOBA 2 used to think "*this is how it should be played*" or "*oh, okay, I'm not playing that right*". These expectations and generalisations were mentioned, for example by MOBA 2 and FPS 1, as factors contributing to toxic behaviour in competitive communities. Some players are not aware or tolerant of the fact that others may use the games differently than they do. Different expectations regarding behaviour can thus lead to arguments. Part of these different experiences is that not all players are aware of all of a game's mechanics, and that how a game is played may be different at different levels of play; *"I only played against AI or played with cheats, I wasn't interested in building up a base, I gave myself the resources and just started beating up the enemy; that strategic aspect I only learned to appreciate now"* (RTS). Often beginners do in a game whatever they feel like and do not even know of core interactions or effective roles in a game, which determine how the game is played on a more experienced level. Lastly, also connected to the previous point, are the prejudices that players of one game can have concerning other games and its players. When asked about it, MOBA-player 3 explained it as analogous to the more difficult rules in sports, such as offside in soccer. When people do not know all of the rules and less-obvious interactions – such as bullet drop in shooters or armour types in strategy games –, they will often not understand the complexities that go into decision making – such as aiming or choosing good units –, or not even recognise a difficult or clever play; "You really have to learn before you can jump in or even watch it" (FPS 3). According to MOBA 3 and ARPG and FPS, this does not only affect the general public's view on certain games, but also that of other players.

5.4 Study 1 – Contribution to the overall project

This study was the first step and provided the basis for developing a comprehensive game usage framework. This discussion focuses on the role of the results for the bigger project and on the findings of this study that are unrelated to developing the framework. The in-

depth discussion of the game usage factors and a comparison with models from the literature can be found in the overall discussion of the project in section 8.1.

Everyone is here to play, but not everyone is here for the same thing (MOBA 2)

This quote from MOBA-player 2 succinctly summarises the main findings of this study and emphasises the importance of considering game usage on a detailed level. Overall, the study had three findings: a set of relevant aspects of game usage; reports linking game usage, needs, and wellbeing; and the observation that even players are not necessarily aware of the partly substantial differences in players' usage of games, which can result in negative influences on their gaming experience.

First to the main finding: aspects of game usage. It became clear during the interviews that even participants who played similar games varied in how they played them. One of the clearest differences were their intentions, but there were also several other aspects of game usage that were important to participants and useful for differentiating them. The seven main aspects of game usage based on this study were *In-game behaviour; Choice of content, setting, and game; Involvement/Attitude towards game; Subjective experience of gaming; Game related activities; Allocation of RL resources;* and *Intention*. These aspects promise to be a good basis to construct a framework and questionnaire for describing and distinguishing video game usage in the next part of the project: all of these aspects can potentially be applied to almost any multiplayer online game, because they mostly describe general behaviours, attitudes and choices of the players. The categories are likely even relevant for singleplayer games for the same reason, though social interactions in the context of singleplayer games are of a different nature than in multiplayer games. Furthermore, in the interviews it became clear that even in this small sample players vary considerably on these aspects, which is an important observation if the aspects are to be used to differentiate between players. Of particular value for describing and differentiating between players are the sub-themes displayed in Table 5, most of which can be presented as continua. Lastly, it appears that the aspects may largely be independent of each other, which also is of advantage when using them to describe players; if a participants' scores for one aspect determined their score in another, there would be no point in considering both. However, some of the categories do overlap and distinctions between some sub-categories are not sharp. Especially in-game behaviour and choice of content overlap, but also choice of

content and attitude towards games, and choice of content and intention. Lastly, based on informal evaluations with colleagues, the seven aspects appear to be generally plausible, comprehensive, and relevant.

In the context of wellbeing, in-game behaviour likely is directly related to motivations, and specific activities may contribute to players' wellbeing in certain situations. Similarly, specific choices in games may reflect players' motivations, and different choices in different situations may foster or hamper wellbeing. Involvement in and attitude towards games may have particularly diverse interactions. For example, a person who is very involved in games is likely to be affected more strongly by winning or losing than one who cares less. The interaction between caring about the game but losing in it may lead to the reported downwards spirals. Subjective experience of gaming is expected be one of the most important variables in the context of wellbeing. What became most evident while talking to participants was that different players can have many contradictory experiences in similar situations. Social interactions were described by one interviewee as friendly and close, and by the another as anonymous and hurtful. Playing was described by one as exciting, challenging and providing a sense of accomplishment, and by another as boring and a waste of time. One player highlighted the experience of freedom and acting self-determined, while another felt pressured and restricted by obligations. Similarly, in-game communities were described as both friendly and toxic. A tentative explanation offered by some was that how people experience games may in fact to a certain degree reflect their own mind-set and approach to playing a game. In the context of wellbeing, game related activities may be of relevance due to showcasing the influence of gaming beyond the game and by providing opportunities for more meaningful social interactions than are likely to happen in certain games, for example those with limited chat-functions. Regarding allocation of real-life resources, especially interesting will be potential links between the amount of time spent on gaming and a person's overall wellbeing. Finally, often players witch different intentions – which may manifest in different ways of playing the game – end up playing together, sometimes leading to conflict.

As last result, different participants explained the same games differently. Differing expectations and generalisations were mentioned as a source of toxic behaviour in competitive games: Players do not seem to be aware – or tolerant of – that others may use games differently or might have different intentions, and the mismatch of expectations

regarding each other's behaviour can lead to arguments and frustration. Being aware of this may help players deal with those situations in a more positive manner.

The present study shows tentative evidence of relationships between different game usages and wellbeing, and thereby confirms the approach of the overall project as promising to identify potential explanations for observations of positive and negative influences on wellbeing. It also provides new information about aspects that should be taken into consideration when developing games for educational or health purposes, such as different intentions.

One core issue in this study is the similarity of participants. Though it was attempted to recruit diverse participants for the interviews, in the end almost all were university students, albeit from different countries and different fields of study. This similarity may have limited the potential of the study to find different aspects of game usage. Two further limitations of the study must be emphasised. First is the issue of subjectivity. The results of this study were strongly influenced by the researcher through the creation of the interview guide, his interactions with participants during the interviews, his interpretations of participants' responses while coding, and his organising the codes to develop themes. In all these situations different researchers might have come to different conclusions. However, it was attempted to minimise the subjective influences by staying as close to the original segments as possible and sending participants a summary of the results – in form of the seven themes and sub-themes – and asking them if anything is missing or should be changed. Next, it was attempted to present the results clearly in the previous section so that readers can evaluate codes and themes themselves. And finally, the core strategy for reducing the influence of subjective decisions in this stage of the project was to test the themes in a quantitative pilot study in the next part of the project.

6 Study 2 – Constructing and Testing the Game Usage Questionnaire

6.1 Study 2 – Introduction

The aim of study 2 was to test the framework for video game usage developed in study 1, re-evaluating the factors that describe and distinguish players' usage of computer games. The approach was to first construct and pilot a questionnaire with a diverse quantitative sample and to investigate the data using exploratory factor analysis. The original items were developed based on the sub-themes that emerged in the analysis of the data in study 1. Factor analysis was used to find an empirically-supported underlying structure and to select a suitable set of items. The new version of the framework was then tested and adjusted again with data from a second, substantially larger, sample. The final version was used in the subsequent longitudinal study which constituted the final part of the project.

6.2 Study 2 – Part 1 – Methods

6.2.1 Participants.

Participants for this study were recruited through various official and fan-made game related forums (e.g. Diablo 3, Path of Exile, mmo-champion.com), through subreddits (e.g. true gaming, Warframe, Monster Hunter), facebook, paper-based advertisements distributed at one New Zealand and one German university, and by word of mouth through friends and previous participants. Most participants were users of official forums and subreddits.

In total, 406 people started the questionnaire and, of these, 316 completed it. Two respondents were removed because their ages and responses were identified as having probably been misreported. Two-hundred and seventy-seven of the respondents identified as male, 29 as female, four as gender diverse, and four did not provide that information. The average age was 25 years (SD=8), the youngest participant was 12 years old, and the oldest 69 years old. Participants lived in various countries, including the USA (95), Germany (36), New Zealand (35), and Canada (23), but there were also multiple participants each from the UK, Sweden, Singapore, Poland, Netherlands, Hungary, Finland, Brazil, Austria, and Australia, and smaller numbers from various other countries.

6.2.2 Instruments.

The questionnaire for this study was constructed around the themes and subthemes identified in study 1, which were presented in Table 5. Items were based on statements of participants or generalisations thereof. More information on the construction of the questionnaire can be found in Appendix G.

The questionnaire comprised 10 sections. It started with a few standard questions about demographics such as age, gender, and country lived in most over the past six months. Next was a section comprising general questions about participants' main game(s), such as what genre it belongs to or what console it is played on; this section will from now on be referred to as *general gaming information*. After this, the items for each of the seven aspects of game usage were presented, sorted by aspect, each on its own page. Some items required an individual scale, but where possible 6-point Likert-type scales were used for agreement and frequency, ranging from *completely disagree* to *completely agree* and from *almost never* to *almost always*. This core part of the instrument contained 63 items. The final section invited participants to provide feedback on the questionnaire in a free-text box. The full instrument is presented in Appendix H. The average time it took participants to complete the questionnaire was 15 minutes (SD=11).

6.2.3 Procedure.

The questionnaire was set up as online survey on the platform Qualtrics. Advertisements – online as well as in paper form – linked to a website set up for the study, as well as directly to the online questionnaire. The website, https://game-usage.weebly.com, provided more information about the researcher and the study. Before they got to the actual questionnaire, participants were shown an information sheet for the study, which they had to scroll through. Participants were asked to complete the questionnaire in regard to the last month. After completing the questionnaire, participants were invited to suggest additional response options for some of the items and to provide feedback on the questionnaire in a free-text box. Participation was anonymous.

6.2.4 Analysis.

Responses were analysed by evaluating descriptive response statistics and patterns for certain items such as the game demographics, as well as using exploratory and confirmatory factor analysis on all Likert items. Before the factor analysis could be conducted, some items had to be removed.

The aim of the factor analysis was to 1) identify and describe a potential underlying structure and 2) to reduce the number of items while maintaining the overall factor structure and as much of the total variance as possible. Based on the framework developed from the data of study 1, it was assumed – and intended – that the underlying factors are largely independent. Considering this intention and the two aims, the specific approach chosen for these analyses was Principle Component Analysis with varimax rotation. The former because it is best suited to reduce the instrument size, and the latter because it separates factors most strongly (see section 4.3.2 for a discussion of different kinds of factor analysis). However, all combinations of principle component analysis, principal axis factoring, and maximum-likelihood factor analyses, each with varimax and oblimin rotations were used to test for significant differences in interpretations. Missing values in responses were excluded listwise and factor loadings <0.3 were ignored.

The analysis of the questionnaire was an iterative process, involving rerunning the principle component analysis after each step. Items that did not load substantially (>0.3) onto any of the factors in multiple of the different factor solutions were eliminated on-by-one, if it was decided that an item did not add substantial value to the overall questionnaire content-wise – meaning it addressed an aspect not otherwise covered in the questionnaire. The factor analysis was then repeated following the same procedure as above. Items that had cross-loadings of similar strength were also removed, if they were found to not add substantial value.

After reducing the item set and deciding on a solution of the exploratory factor analysis, model fit was tested with confirmatory factor analysis and the scales were evaluated by determining Cronbach's Alpha for each factor.

Feedback of participants was first roughly sorted by topic and then evaluated individually.

6.3 Study 2 – Part 1 – Results

6.3.1 General gaming information.

Twenty-nine percent of players had played a single "main" game during the month previous to responding, 32% had played two games more or less equally, 28% had played three games equally, and 11% played four or more games, with none being a clear main game. Interestingly, despite fewer than 30% of players reporting that they had only one clear main game, 71% considered the game they referenced when completing this questionnaire to have

been their main game during the last month. Finally, 80% of players considered their game usage as indicated in the questionnaire to be representative of how they use multiplayer online games in general, and of those 71% either mostly or completely agreed. Accordingly, 20% of players did not consider how they use the game they referenced in this questionnaire to be representative, and of those, most (59%) only tentatively disagreed. This indicates that, even though the questionnaire only asked about the usage of one game, the evaluated aspects appear to be more-or-less general.

Nine percent of players reported having no main games, a further 9% stated their main game switches more or less weekly, 46% said it switches every few months, 18% about once a year, and the remaining 18% considered their main games to be constant over years. Thus, 82% of players maintain the same main games for at least a month.

The games reported were diverse and 71 different games were listed as main games. Different installations within the same franchise were treated as different games, but updates or expansions of a game were treated as the same game. The games mentioned most were Monster Hunter world (96), Warframe (63), World of Warcraft (22), League of Legends (20), Overwatch (17), Path of Exile (10), Rainbow Six Siege (9), Destiny 2 (9), Hearthstone (7), and Final Fantasy XIV (7). These ratios do not resemble the official player numbers of those games, but instead reflect the channels in which recruitment was most successful. In terms of game types this means most of the participants played a MMORPG (>60%), followed by different FPS (~15%) – e.g. Overwatch, Rainbow Six, or Destiny – followed by the MOBA League of Legends (6%) and the ARPG Path of Exile (3%).

Regarding genres, 81% of players consider their main game to be an action game, 24% to be a strategy game, 24% to be an RPG, and 5% to be a simulation game. Players could choose multiple categories and the question specifically asked for players' perceptions of genres, not for the official categorisations. This may explain the discrepancy between only 24% describing their main game as a RPG, while, based on the official categorisations of the games, over 75% played a RPG.

Finally, 83% of participants mainly played their chosen game on a PC, 16% on a console, and 1% as a browser game. Mobile games were not included in this part of the study.

6.3.2 Exploratory factor analysis of the original game usage questionnaire.

Results for the different combinations of principal component analysis, principal axis factoring, and maximum likelihood factoring with varimax and oblimin rotations were nearly identical, the only differences being specific factor loadings. Therefore, only the results of the principal component analysis with varimax rotation are presented here.

The data of 292 participants on 59 items was included. The KMO-test produced a score of 0.81 which indicates "meritious" adequacy for factor analysis (Kaiser, 1974). Bartlett's test indicated a significance of <0.000, meaning the variables are not orthogonal and common factors are likely. The scree plot presented in *Figure 4* indicates a likely four-to-11 factor solution. A nine-factor solution was accepted. For the evaluation of this factorisation, results were compared with forced four, six, seven, eight, and 11 factor solutions.

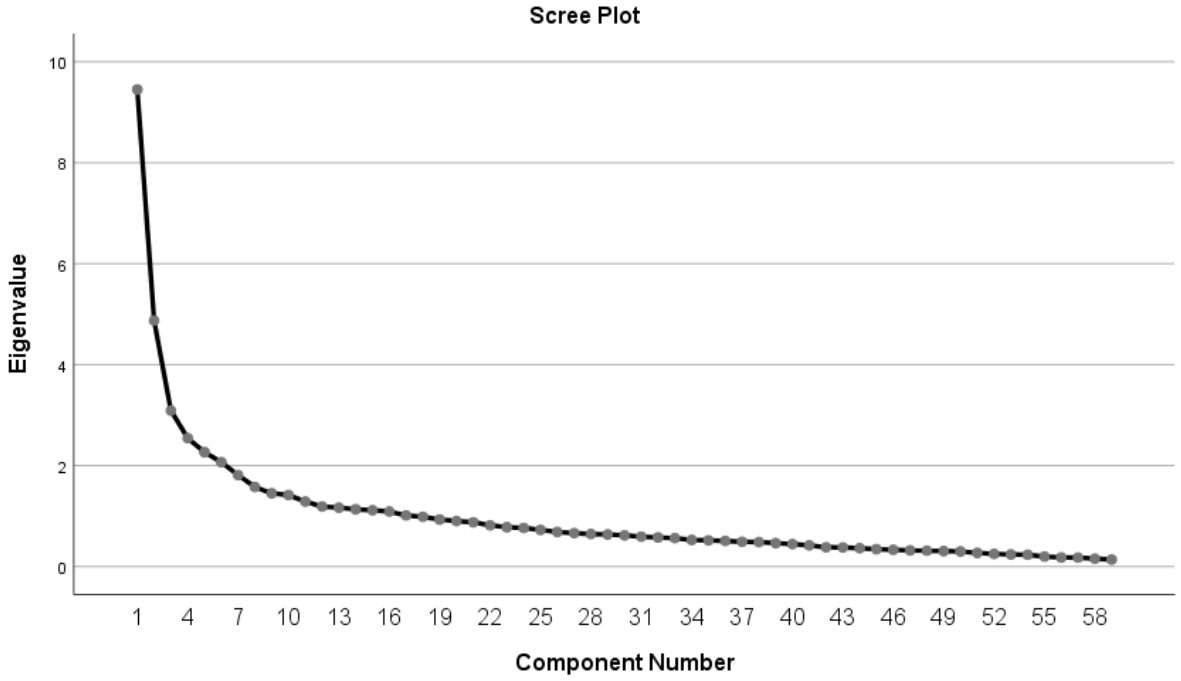

Figure 4: Scree plot for the factor analysis of the original game usage questionnaire

Nine factor solution (preferred): The total variance explained was 49%. The nine factors were interpreted as capturing (1) *story and game-mechanics*, (2) *seriousness and aggressive playstyle and tech-side of gaming*, (3) *focus on RL contacts*, (4) *expressing self and testing things and interacting with in-game contacts and creating RL things*, (5) a *focus on fun and positive emotions*, (6) *feeling stressed and angry and being engaged in ranked and player-vs-player activities and thinking about in-game interactions after playing*, (7) *priority of gaming*

and large time investment and collecting things in-game and not wanting to miss out and playing longer than intended and informing oneself about the game, (8*) interacting with randoms and feeling part of a community*, (9) and a combination of *feeling like having wasted time and in-game friends not being considered real and feeling alone while playing and playing without intention*. The component matrix for this solution can be found in Appendix I.

The 10- and 11-factor solutions had some factors that were ill-defined, had low loadings or few items, indicating that fewer factors may be more appropriate. The solutions with lower numbers of factors had an overall similar structure. The seven-, six-, and four- factor solutions had some factors that were unclear and difficult to interpret because of large numbers of content-wise different items combined on the same factors. Items also frequently had strong cross loadings and many factors had large numbers of generally low-loading items. Both, the eight-and nine-factor solutions were acceptable. The differences were that the nine-factor solution explained slightly more variance (54.5% vs 51.5%) and that in the eight-factor solution, the combination of the *player-vs-player* and *ranked* and *getting-angry* and *stressed* factor splits up and loads onto the seriousness factor and the negative factor. While the eight-factor solution might have been easier to interpret, because the player-vs-player and getting angry factor split up, some items in this solution had higher cross-loadings than in the nine-factor solution. Also, how exactly the items from the player-vs-player factor were loaded by the others in the eight-factor solution was dependent on the approach taken. For example, when using oblimin rotation those items were loaded by the *expressing*- and *negative combination*-factors, while when using varimax rotation they were loaded by the *seriousness*- and *expressing*-factors, slightly changing the interpretation of these factors. The interpretation of the factors in the nine-factor solution was independent of the approach taken. For these reasons the nine-factor solution was adopted.

6.3.3 Factor analysis of the adjusted game usage item-set.

After the initial analysis, the set of items included in the analysis was pruned. Items with poor loadings and those with significant cross-leadings were removed, as well as those that used categorical scales and were redundant when compared with similar items using ordinal scales. In the end, 47 items were kept. The structure and interpretations of factors in the analysis using only the reduced 47-item set did not differ from those of the initial instrument and therefore are not presented again. The scree plot of the item-adjusted questionnaire can be found in Appendix I.

The rotated component matrix for the final Nine-factor solution following the removal of extraneous items is displayed in Table 6. Values <0.3 are excluded. Components were labelled as follows:

1-story and involvement; 2-seriousness; 3-friends; 4-expressing; 5-positive experience; 6-competetive engagement; 7-priority; 8-community; 9-real activity.

A confirmatory factor analysis testing this nine-factor solution indicated significance of the model fit; $\chi^2(953)=2383$, $p<0.001$. The Root Mean Square Error of Approximation (RMSEA), a measure commonly used to determine the goodness of the fit of a model, indicated an acceptable fit with RMSEA=0.065; the generally accepted criterion is RMSEA<0.08 (Blunch, 2008). However, the Comparative Fit Index (CFI) was only 0.7; the generally accepted limit is CFI≥0.9 (Blunch, 2008). The discrepancy between the goodness of fit indices indicates that the model may be acceptable, but that it should be treated with caution and that the instrument should be re-evaluated. See section 4.3.3 for more information on confirmatory factor analysis and details on the measures presented here.

Cronbach's alpha statistics for the factor scales were: Expressing 0.71, Story and involvement 0.84, Seriousness 0.75 (the item describing own playstyle as active/aggressive was removed as it reduced alpha and had low factor loadings), Positive experience 0.75, Friends 0.81, Competitive Engagement 0.72, Priority 0.63, Real Activity 0.46, and Community 0.56. Values >0.7 imply that scales have acceptable internal consistency (Cramer & Howitt, 2004). Based on this evaluation the last three scales were identified as potentially being inconsistent.

Table 6

Factor loadings for exploratory factor analysis (principal component analysis with varimax rotation) of the item-adjusted game usage questionnaire.

	Component								
Items\Factors and eigenvalues	1 7.4	2 4.4	3 3.0	4 2.3	5 2.1	6 1.9	7 1.7	8 1.5	9 1.4
I have extensive knowledge about this game's: story	**0.86**								
I care about how things turn out when playing	**0.79**								
I think about the story/lore of the game	**0.74**								
If I start something in this game, I will complete it	**0.70**	0.31							
experiencing the story	**0.64**								
I have extensive knowledge about this game's: game-mechanics	**0.60**								
winning		**0.64**							
I think about why I win or lose in order to improve		**0.63**				0.31			
In this game I try-hard		**0.63**							
When I play I focus entirely on the game		**0.59**			0.33				
I engage in content that I find challenging		**0.57**							
making progress		**0.54**							
Overall, I would describe my playstyle as active/aggressive		**0.43**							
just doing something together with friends			**0.82**						
with RL-contacts			**0.80**						
not letting friends down			**0.68**						
achieving something as part of a group			**0.58**					0.38	
Of the times I play this game, I play: alone			**-0.50**					-0.47	
I talk with others about the game (in RL)			**0.48**			0.36			
chatting with others (non-friends)				**0.67**				0.35	
expressing myself				**0.66**					
testing or analysing game mechanics				**0.64**					
seeing or trying something new				**0.61**	0.31				
I actively participate in forums related to this game				**0.46**					
I create things related to this game (e.g. costumes, writing, artwork, ...)				**0.42**					
with in-game contacts			0.38	**0.40**					0.34

Table 6 (continued): *Factor loadings for item-adjusted game usage questionnaire*

Items\Factors and eigenvalues	1 7.4	2 4.4	3 3.0	4 2.3	5 2.1	6 1.9	7 1.7	8 1.5	9 1.4
When playing the game I have fun					**0.78**				
After playing the game I feel content					**0.77**				
just having fun					**0.66**				
When playing this game I get excited		0.33			**0.57**				
I engage in PvP activities/content						**0.71**			
I play modes/do activities that are ranked/rated						**0.67**			
When playing this game I feel stressed						**0.60**			
I follow the professional scene				0.30		**0.56**			
When playing this game I get mad						**0.46**			-0.31
Playing this game has a high priority for me in daily life							**0.78**		
The average time I spend playing this game per week is (<1, 1-5, 5-10, 10-20, 20-30, 30-40, >40)							**0.65**		
I do some activities in the game only because I feel I miss out if I don't							**0.50**		
I play this game longer than I had intended							**0.46**		
collecting something						-0.36	**0.45**		
with randoms								**0.70**	
I interact with other players I do not know using in-game or voice chat (saying more than "Hi" or "Thanks for group")								**0.65**	
Playing this game, I feel I am part of a community					0.32			**0.47**	
I consider friends I have only met in the game to be real friends									**0.59**
After playing the game I feel I have wasted my time									**-0.55**
When playing this game I feel alone									**-0.47**
just playing, doing whatever; no actual intention		-0.31							**-0.45**

Note. 1-story and involvement; 2-seriousness; 3-friends; 4-expressing; 5-positive experience; 6-competetive engagement; 7-priority; 8-community; 9-real activity. Values below 0.3 are suppressed.

6.4 Study 2 – Part 1 – Contribution to Study 2

6.4.1 Evaluation of participant feedback.

Fifty-five people provided some sort of feedback. The most common issue raised by participants (n=8) was that some items were perceived as not applicable or irrelevant to their game, but no "not applicable" option was provided. In response to this feedback the researcher added a general explanation to various items asking participants to choose "completely disagree" when they feel their game does not have a certain aspect. However, all items, were carefully reconsidered and some, such as an item about the knowledge of a game's lore, did get the requested "not applicable" option in the next version of the questionnaire.

Three participants commented on the selectable genres, arguing that the four genres offered – action, strategy, role playing, and simulation – were insufficient. Specifically, *shooters*, were missing. The selectable genres were intended to reflect those defined by Apperley (2006) and not popular genre terms. Apperley described genres based on how he assumed players generally interact with the games. The advantage of his categorisation is that there are far too many popular genres to include them all in the questionnaire, and that many of them, such as science-fiction, fantasy or horror, are essentially meaningless in the context of this study. Instead he proposed to distinguish *role playing*, *simulation*, *strategy*, and *action*. Role playing for him meant games in which the focus is on character development and players act through that character, in strategy games the play happens outside the game in the players' thoughts through organising and evaluating games' variables, in simulation games players act as themselves, and in action games played characters are essentially tools of the players through which they can interact with the virtual world. A limitation of this classification is that especially nowadays many games could fall into multiple of his genres depending on how they are played. However, in this categorisation, shooters fall into the action genre. This misunderstanding was addressed by providing examples of what the categories mean for participants.

Two participants asked about the inclusion of singleplayer games, or games without a focus on multiplayer aspects. These participants noted that the restriction to online multiplayer games may be very limiting, and that most of the items in the questionnaire also apply to singleplayer games. This had previously been considered by the researcher but rejected because the questionnaire had not been developed with that purpose in mind, posing a risk

to its validity. However, supported by this feedback, singleplayer games were included in the next version of the questionnaire. Items not applicable to singleplayer games were not shown to respondents indicating those as main game.

6.4.2 Implications of reported general gaming information.

The first salient result was that there are differences between the genre of games as perceived by players and their official genres. This is another argument that supports the observation that games can be used differently by players, to the point that they perceive and describe their genres differently (e.g., Flueggen, Doyle, & Veith, 2018). It also highlights a need for more detailed categorisations of games – for example, based on subjective perceptions or differences – in studies on the effect of games, as it seems that objective categorisations may not be generally valid (Kallio, Mäyrä, & Kaipainen, 2011). Apparently, that a game is developed and marketed for example as RPG does not mean that all players view it as such. The implications of a study which has – or has not – found differences between users of different genres – which usually are assigned by researchers and not participants – are questionable when not even participants agree amongst themselves on what genre a game belongs to.

Next, only 11% of players in this study simultaneously played several games without having a "main" game. This implied that the concept of main games could probably be used in this project without neglecting too many players. It also means more generally that most players do tend to focus on a limited number of games at any given time. Based on the interviews of study 1, this could be explained in terms of limited time availability, but also in terms of players only feeling like a specific kind of game at a given time. On the other hand, the data also indicate that roughly equal percentages of players mainly play one, two, and three games, meaning over 70% of players play more than one game at a time. This poses a potential risk to reliability: If players play more than one game as main game at a time, they will be influenced by more than one game, and the influence of one may add to or – more confoundingly – mask or counter the effects of another. This would make the game usage questionnaire results less meaningful for correctly correlating and interpreting changes in wellbeing. However, despite over 70% of players indicating that they played several games, 70% of players also indicated that the game they referred to was their clear main game over the past month. This indicates that participants having several games is not as much of an issue as feared, because many still seem to have one game that they identify as more important for them.

The next variable of general interest was how frequently players changed their main games. Responses indicated that less than 20% of players change their games weekly or have no main game, and that a substantial majority of players change their main game every few months. This provides information for the choice of a good timeframe to refer to in the study. Besides players playing several games at once, the most problematic case for participants would be if they had changed their main game during the timeframe covered by the questionnaire. In this case participants would likely be confused as to which game to refer to. More seriously, if game usage influenced wellbeing and the game of reference changed halfway through the timeframe, this would lead to unidentifiable averaged values in wellbeing. Knowing that a player's main game usually stays constant for at least a few months indicates that a month is a reasonable timeframe to refer to. It also indicates that iterating the study every three months is likely to see a change in games for many players, which allows a test of whether this change correlates with a change in game usage or wellbeing.

After completing the main part of the questionnaire players were asked if they believed that what they indicated in the questionnaire was representative of how they used games in general. Only 20% chose one of the disagree options, and 57% chose mostly or completely agree. While it is a contestable conclusion, this was interpreted as implying that the questionnaire for one main game can acceptably represent a player's game usage.

6.4.3 Implications of the factor analyses for the game usage framework.

Multiple factor analyses were conducted, and solutions tested, with the overall factor structure being stable across extraction algorithms and rotations. Interpretation was thus relatively independent of the specific factor analytic approach and reducing the numbers of factors extracted did not fundamentally change the overall factor structure: With each reduction one factor collapsed and its items loaded onto other factors – usually two – instead. This independence from the particular solution provides some support for the validity of the structure.

The nine factors are displayed with brief descriptions in Table 7, and the factor analysis leading to this solution can be found in Table 6. Overall, the final structure of the items is not too different from the structure based on the interviews, but their connections and underlying factors are.

Table 7

Nine aspects of game usage; based on principal component analysis of original questionnaire responses

Expressing Chatting, testing something new, creating something oneself	**Story and Involvement** Knowing and caring about the game/story, completing things, knowing game mechanics	**Seriousness** Trying to win, focussing, engaging in challenges, improving and progress
Positive experience Playing to (just) have fun, feeling content after playing	**Priority** The game being important, spending a lot of time on it, doing things to not miss out	**Friends** Game as normal space to play with friends from outside the game, playing for the group
Community Interacting with random players, not playing alone, feeling part of a community	**Real activity** Considering in-game contacts as "real" friends, game as good use of time	**Competitive Engagement** Engaging in and caring about competitive aspects

Factor 1 was labelled *story and involvement*. Adding involvement to the name emphasises caring about the story, seeing things through in the game, and knowing about things like game mechanics. While, at first, it was surprising to see these latter aspects together with story, it does make sense when redefining it as involvement in the game. Many players who are deeply involved in a game will know about most of that game's aspects, including its story and mechanics. *Seriousness* (factor 2), describes how engaged or focussed on doing well a person is while playing. A serious person is not necessarily good at or knowledgeable about a game, but they take whatever they do in the game seriously. The difference between involvement and seriousness in this context is that involvement describes caring about the game and its story more generally, while seriousness refers to the manner in which the game is played. *Friends* and *Priority* (factors 3 and 7) are self-explanatory. However, two new items, which were designed to load on priority, were added to the questionnaire for the next use: the number of days played per week and money spent, on average, per year. Number of days played per week was brought up in the feedback of one participant, who suggested it might be relevant to know if people play evenly throughout the week, or just intensely on days on which they have time. The response categories for the amount of money spent were informed by participants in the pilot study. It is important to point out that the priority factor included the intention of not wanting to miss out and collecting in-game things such as achievements. This makes sense when considering human motivation – if something has

a higher priority for a person, they are by definition motivated to pursue it. Factor 4 was labelled *expressing*. It includes various actions through which people can show who they are in a game, such as in interactions with others or by experimenting with the game. Factor 5 was labelled *positive experience*, which crucially includes both whether players perceive playing as fun or exciting and if it is their focus to have fun – as opposed, for example, to focussing on progressing through a game. Factor 6 – originally referred to as negative player-vs-player – was relabelled *competitive engagement*. This is because not all ranked or rated activities are necessarily player-vs-player and feeling stressed or angry can be unrelated to player-vs-player or ranked activities. Rather, it was re-interpreted as a personal sense of competitiveness eliciting feelings of stress or anger if things don't work out as planned. *Community* (factor 8) highlights that who they interact with in a game seems to be relevant to players. There was, in contrast to expectations based on other frameworks and the interviews, no general "social" factor comprising all items about playing with others. While the *friends* factor specifically included playing with contacts from outside the game, the *community* factor included playing and interacting with randoms and emphasised a preference for not playing alone, while the *expressing* factor includes interactions with in-game contacts. Lastly, the combination of negative items found in factor 9 was labelled as its positive opposite and named *real activity*. If playing is accepted as a real or normal activity in a player's life, in-game friends will be considered to be real friends, time spent on the game will be perceived as well used, and the "real" in-game interactions will prevent feelings of loneliness. On the other hand, a person who does not consider the game to be real might become more aware of being physically alone when surrounded by "virtual" people.

The structure revealed by the stepwise removal of factors described above implies a hierarchy of factors, from the most stable and general to the less stable and possibly sample dependent. Based on this interpretation, the core factors seem to describe (1) involvement in the game and its story and mechanics; (2) how serious a player is about a game and how focussed they are while playing – which includes the game affecting them and the kind of content they choose in a game; (3) to what degree they play the game as part of a group or community and hence who they interact with and how; and (4) to what degree they have fun and play the game to enjoy it. The most situational factors may be competitive engagement and real activity. But limiting the framework to the four core factors or eliminating the two situational factors would result in losing a lot of information and neglecting differences the full model provides and distinguishes. This is a question for

further empirical work. The results of study 3 will help to identify which of these factors are meaningful in a given context, rather than only considering whether they are statistically stable.

The results of the confirmatory factor analysis are ambiguous, with the χ^2-test and RMSEA showing good-to-acceptable results, and the CFI being lower than is usually accepted. The Cronbach alpha test identified the real activity, community, and priority scales as potentially problematic, but it should be kept in mind that Cronbach's alpha is, in part, a function of the number of items and those three scales have very few items. The real activity factor seems most problematic and was the second factor that collapsed (when going from eight to seven factors). It also had in average lower factor loadings (<0.6) than the others in the exploratory factor analysis. All of this indicates that adjusting this factor would be a promising start to improving the model. At this stage, however, these observations were only acknowledged and did not lead to further action: The values were acceptable and the factors were interpretable.

The use of varimax factor rotation, the fact that the factor structure was robust to choice of rotation (varimax or oblimin), and that correlations between factors in the oblimin rotation were low, means that the factors are mostly orthogonal, indicating they are independent from each other. On an interpretative level this implies that, players' game usage is very diverse as their scores on these factors apparently vary almost independently. A game can have a high priority, yet players do not have to be serious about it while playing, but can still be involved. Players can be experts about a game's mechanics, whether or not they have a positive experience while playing; their sense of community in the game is independent of whether they play with, or because of, friends, they can express themselves in the game while being engaged in competitive aspects or not, and they can be playing despite considering it to actually be a waste of time.

6.4.4 The revised Game Usage Framework in the context of study 2.

The main contribution of the pilot study was that while many items grouped similarly to what was expected, the implied underlying structure deviated significantly from the structure proposed based on the interviews. Instead of the original seven factors, nine better separable and more nuanced factors were indicated. Based on the qualitative feedback, the questionnaire was well received by those involved in the pilot. In addition to the quantitative pilot and qualitative support from the participants adding to the validity and robustness of

the framework, the new resulting modified model is empirically stronger. Overall, the questionnaire appears more appropriate for the intended purpose of describing and distinguishing between ways in which players use games than the original framework. However, it has some weaknesses, such as the problematic *real activity*- and *community*-scales, and the difficulty of interpreting the *competitive engagement*-factor. Furthermore, it was based on only one sample, half of which played two games that are not among the 10 most popular online games – Warframe and Monster Hunter World – reflecting that recruitment was biased towards those two forums.

6.5 Study 2 – Part 2 – Methods

6.5.1 Participants

The second sample of study 2 was part of the larger third study, which included another questionnaire in addition to the game usage questionnaire. In this subsection only the information relevant for Study 2 is presented.

Participants were recruited through several channels between December 2018 and September 2019. All players, of any video games, over the age of 12 years were invited to participate. The study was advertised widely in the researcher's networks, including participants of previous stages, facebook and the Gamesnetwork, an international e-mail list for researchers on games. Advertisements were also posted repeatedly on game specific forums – e.g. World of Warcraft, League of Legends, Path of Exile –, in various gaming subreddits – e.g. Counter Strike, Warframe, DotA2 – and on some general gaming forums – e.g. MMO-champion and GAMES FAQ. In addition, one post was *boosted* as a sponsored facebook advertisement. Physical advertisements were distributed at three universities in New Zealand and Germany and at a German high school. A generic version of the advertisements can be found in Appendix C; adjusted versions were used for the different situations – e.g. using a game-specific greeting or a different picture, and advertisements distributed in Germany were written in German. As a gratuity for participating, participants could choose to enter a draw for one of 20 vouchers worth NZD 50 (about USD 35) each.

In total, 1,099 people accessed the game usage questionnaire, of whom 770 completed it. Because demographic information was only collected in the other questionnaire used in this study, this information is only available for the 531 participants who completed both questionnaires. Of these, 71% identified as male, 26% as female, and 3% as gender-diverse.

The average age of participants was 24 years (SD=8, min=13, max=59). Twenty percent were school students, 1% in training of some form, 48% university students, 7% currently unemployed, 1% full-time parents, 21% employed, and 2% preferred to not provide that information. The most common countries in which participants had lived most during the six months before completing the questionnaires were New Zealand (300), the USA (55), Germany (54), Australia (20), Canada (16), and the United Kingdom (10). In total, people from 40 different countries participated in the study. 81% of participants reported to play their main game online. The most common games were World of Warcraft (70), League of Legends (63), Guild Wars 2 (36), Overwatch (26), Path of Exile (26), Counter Strike: Global Offensive (23), Fortnite (21), Warframe (20), Destiny 2 (16), DotA 2 (14), Apex Legends (13), Monster Hunter World (12), and Red Dead Redemption 2 (10). In terms of game types this means by far most common were MMORPGs, followed by FPS, closely followed by MOBAs, followed by ARPGs and Open World Action games. In total participants referenced over 150 different games as main game when counting only one game per series.

6.5.2 Instruments

The instrument used in this analysis was the result described in section 6.3.3, with some adjustments described in section 6.4 – mainly adding non-applicable options to certain items and adding two items addressing the number of days played per week and the amount of money spent on the game on average.

The first block of the questionnaire contained four questions regarding *general gaming information* – such as which game is referenced, which genre it could be described as, and whether it is played online. The next block contained 20 items on various aspects of game usage, separated into two sections using either a response scale from *Completely disagree*, over *Mostly disagree*, *Tentatively disagree*, *Tentatively agree*, and *Mostly agree* to *Completely agree* or from *Almost never* over *Rarely*, *Sometimes*, *Often*, and *Usually* to *Almost always*. The third block contained 19 items mainly focused on intentions while playing using the same *Almost never* to *Almost always* scale, as well as a few items on game related activities with a scale from *Very rarely*, over *Rarely*, *Occasionally*, *Sometimes*, and *Often*, to *Very often*, and a couple of items on durations. The fourth and final block was only for users of online games and contained 10 items mostly using the already mentioned scale from *Almost never* to *Almost always*. The full questionnaire is presented in Appendix H.

6.5.3 Procedure

The questionnaire was set up on the online survey platform Qualtrics. Digital advertisement posts contained the links as well as a link to the website that had been created for this study: https://game-usage.weebly.com. On this website, potential participants could find more information about the researcher, the research, and the links to the surveys. Physical advertisements contained only the link to the website and a QR-code to the questionnaires. Participants were asked to answer the questionnaire with regard to roughly the last month.

6.5.4 Analysis

The analysis conducted was identical to the one described in section 6.2.4

6.6 Study 2 – Part 2 – Results

This analysis involved data from differing numbers of participants. At the start, the data of 508 participants were used. Seven-hundred and seventy participants completed the Game Usage Questionnaire and 625 of those indicated they played their main game online. Due to an oversight, the last item of the questionnaire "*I consider friends I have only met in the game to be real friends"* provided participants with the additional response category "I do not have friends in-game". This meant the data for this item was not comparable for the 117 participants who had chosen that option and that response was recoded as *missing*. Missing data were excluded listwise, leading to a starting sample size of 508 for the following set of analyses. The core of the original instrument comprised 49 items. The KMO-score was 0.83 and Bartlett's test was significant; $\chi^2(1176)=8354$, $p<0.001$; both indicating the data is adequate for factor analysis. Eleven factors had an Eigenvalue greater than one and the scree-plot indicated a likely five- to nine-factor solution as shown in *Figure* 5.

In the nine-factor solution – the number of factors chosen in part 1 of study 2 – many items had loadings smaller than 0.4, and the ninth factor only had two associated items: "I follow the professional scene" and "I talk with others about the game in RL". The nine factors were interpreted as roughly resembling *Seriousness, Story, Friends, Negative emotions, Priority* plus *"*friends are real*", doing something new or experimenting or expressing oneself, interacting with randoms and engaging in PVP activities, positive emotions,* and *following the professional scene.* The full pattern matrix for this solution can be found in Appendix I.

This strongly resembled the structure identified in section 6.3, but some items loaded differently in ways that resulted in different interpretations of the associated factors.

Especially the factors originally labelled *competitive engagement* and *real activity* did not exist in that form. Because the results differed, and to ensure the final version of the Game Usage Framework has as robust a structure as possible, the data were subjected to a full series of factor analyses.

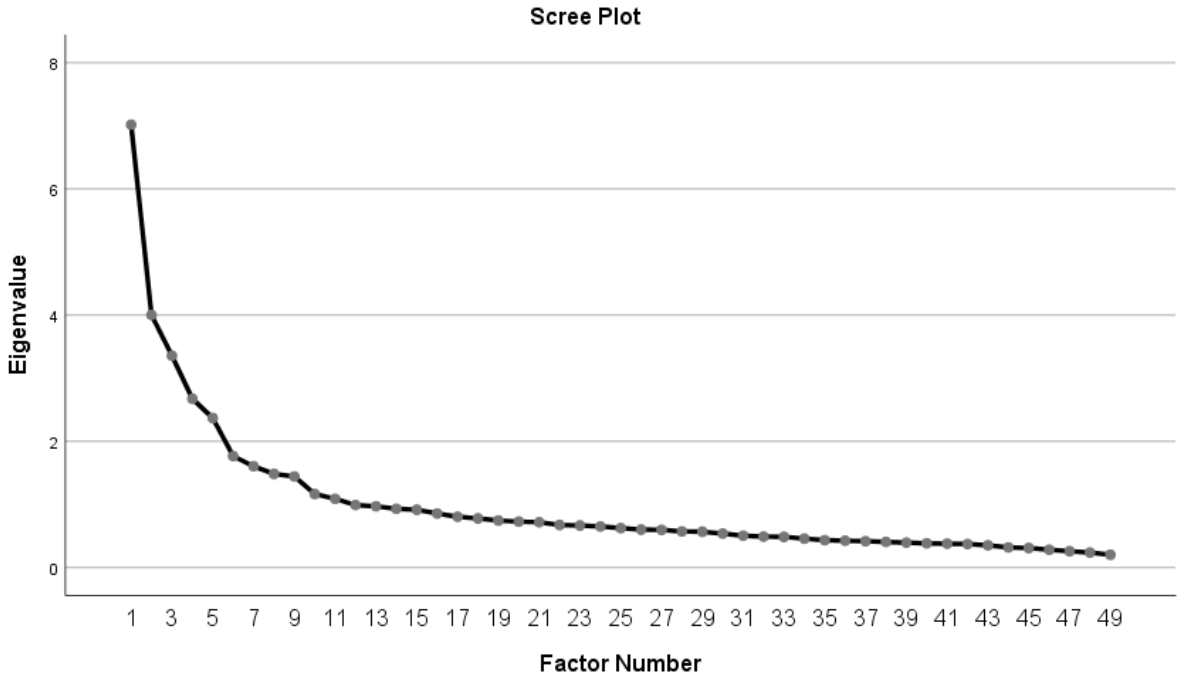

Figure 5: Scree plot for the factor analysis of the game usage questionnaire from longitudinal data

The data were analysed using all possible combinations of principle component analysis and principal axis factoring with varimax and oblimin rotations. Factor loadings smaller than 0.3 were suppressed. After each analysis, the weakest loading item that had a loading smaller than 0.4 was removed and the analysis was repeated. At each stage, four to nine factors were extracted, and the interpretations of the factors compared. At the end, formerly-excluded items were reincluded one-by-one to check if they now loaded differently than in the former solution. Because missing cases were excluded listwise, removal of the "real friends" item mentioned above meant an inclusion of the formerly excluded 117 participants leading to an increased sample size of 625. As this change in number of participants is problematic for a consistent analysis, analyses were also conducted that either entirely excluded those 117 participants or that excluded that item from the beginning.

Depending on which items were excluded first, factor loadings of remaining items changed, and in some cases, items were kept in one analysis that were removed in another. However,

the overall interpretations and structure of the factors were the same across all analyses, and the final sets of items were nearly identical, too. The most striking property of the structure was that for solutions with eight or fewer factors, reducing the number of factors did not change the remaining factors: rather than loading on different factors, the factor loadings of all items formerly associated with the removed factor became non-substantial. The only exception to this behaviour were the positive and negative emotions factors when going from eight to seven factors. Depending on the items removed thus far during the analysis, the factor loadings of the items associated with the positive emotions factor either became non-substantial or the items combined with the negative emotions factor. Because the ninth factor only loaded one clear item and because of the apparent stability of the structure of solutions with fewer than nine factors, subsequent analyses focussed on eight or fewer factors.

The eight factors identified were interpreted as Priority, Friends, Story, Negative Emotions, Experimenting, Seriousness, Social, and Positive Emotions. Factors are listed in order of stability: when reducing the number of factors, the latter factors collapsed first and the factor loadings of the associated items became non-substantial. The first four are always factors in the five-factor solution indicated by the scree-plot in Figure 5. But whether the fifth factor was experimenting, seriousness, or social depended on the order in which items were removed during the analysis. Interestingly, factor analyses including the users of offline games or with only the players of offline games reproduced a very similar overall structure minus the social factor. While the overall structure appears clear and stable, the choice of final items to be included in the questionnaire was not as clear. Different approaches to the analysis extracting eight factors – e.g. varimax vs oblimin rotation and removing certain items in different orders – concluded in four final sets of items, ranging from 23 items under oblimin rotation to 32 items under varimax rotation. These solutions were compared using confirmatory factor analysis. $\chi 2$-tests were significant for all solutions, RMSEAs ranged from 0.074 to 0.068, GFI-scores ranged from 0.83 to 0.90, and NFI-scores ranged from 0.71 to 0.82. The best solution was achieved with oblimin rotation with 23 final items; $\chi 2(202)=780,<0.001$; RMSEA=0.068; GFI=0.90; NFI=0.82. The scree plot and factor analysis for the final item-set are presented in Figure 6 andTable 9 Table 9.

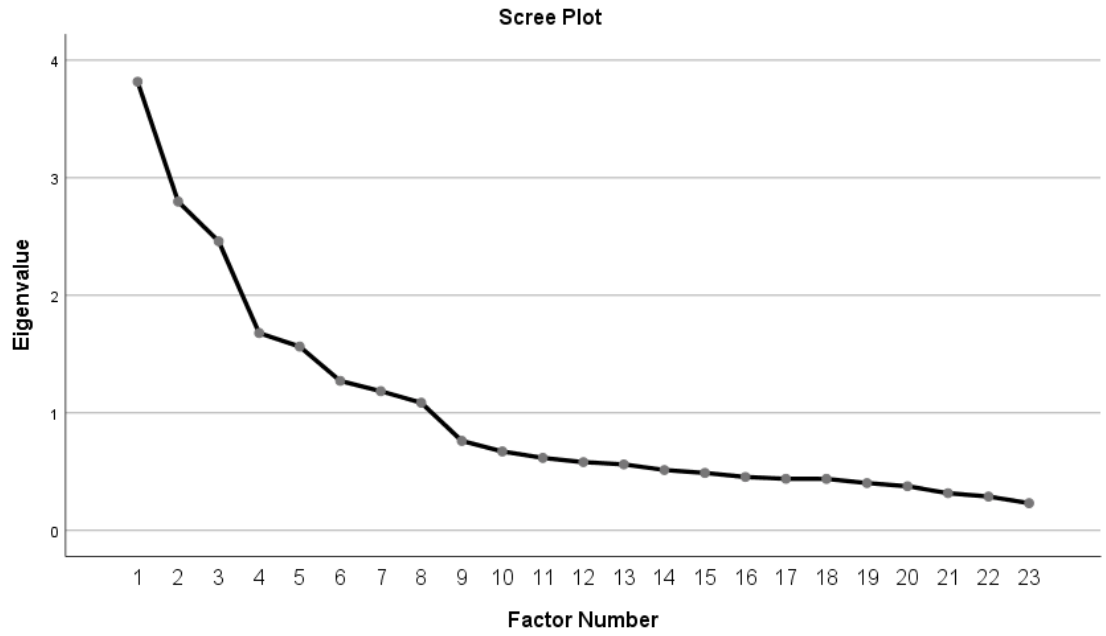

Figure 6: Scree plot of final game usage item set with longitudinal data

Factors were labelled as follows: 1-Priority, 2-Friends, 3-Positive Emotions, 4-Negative Emotions, 5-Seriousness, 6-Experimenting, 7-Social, and 8-Story.

Additional confirmatory factor analyses were conducted comparing the models with four to eight factors. The results are presented in Table 8. The greatest improvement in GFI is from the six to the five-factor solutions, with the five-factor solution also being the first that has a good NFI. However, all models are acceptable and since reducing the number of factors did not change the others, all eight factors were retained and evaluated in the subsequent analyses.

Table 8

Confirmatory factor analysis of different factor solutions for the final item set of the Game Usage Questionnaire

Solutions	χ^2	df	RMSEA	GFI	NFI
Eight factors	780	202	0.068	0.90	0.82
Seven factors (positive emotions removed)	563	149	0.067	0.91	0.85
Six factors (social removed)	446	120	0.066	0.925	0.87
Five factors (seriousness removed)	245	67	0.065	0.95	0.91
Four factors (experimenting removed)	178	48	0.066	0.96	0.93

Note. $p<0.01$ in all solutions

Table 9

Factor loadings for exploratory factor analysis (principal axis factoring with oblimin rotation) of final item-set of the final version of the game usage questionnaire.

	Factor							
	1	2	3	4	5	6	7	8
Items\Eigenvalues	3.8	2.8	2.5	1.7	1.6	1.3	1.2	1.1
Days a week	**0.85**							
Time per week	**0.80**							
Priority	**0.69**							
Doing something together with friends		**0.87**						
Play with RL contacts		**0.66**						
Play alone		**-0.64**						
Not letting friends down		**0.53**						
Have fun			**0.70**					
Just having fun			**0.62**					
Content			**0.52**					
Angry				**0.71**				
Stressed				**0.70**				
Try-hard					**0.62**			
Think why win or lose to improve					**0.57**			
Winning					**0.55**			
Making progress					**0.52**			
Trying something new						**0.73**		
Testing game mechanics						**0.70**		
Interact with others I do not know using text or voice-chat							**-0.80**	
Chatting with others (nonfriends)							**-0.58**	
Think about story lore								**-0.92**
Experiencing the story								**-0.78**
Knowledge of story								**-0.55**

Note. 1-Priority, 2-Friends, 3-Positive Emotions, 4-Negative Emotions, 5-Seriousness, 6-Experimenting, 7-Social, and 8-Story. Values <0.4 are suppressed.

6.7 Study 2 – Part 2 – Contribution to study 2

While showing a structure overall similar to the one found in the initial factor analysis, this second analysis of the Game Usage Questionnaire led to several adjustments. Based on the data collected here, an eight-factor solution is suggested as best suited to distinguish and describe how players use games. These eight factors were labelled *Priority, Friends, Story, Negative Emotions, Experimenting, Seriousness, Social*, and *Positive Emotions*. *Priority* describes how important playing the game is for players in their normal life and how much and how regularly they play, *Friends* describes if and how regularly they play with RL-friends, *Story* describes the extent of their involvement in and knowledge of the game's story, *Negative Emotions* refers to how frequently players get angry of feel stressed while playing, *Experimenting* describes if they tend to try new things and experiment in a game, *Seriousness* describes how hard they try to win and if it is important for them to improve in the game, *Social* refers to how much players tend to interact with others in the game who they do not know, and *Positive Emotions* describes if players have fun and play to have fun or feel content after playing. The individual factors and the overall structure were independent of the specific approach of the analysis, largely independent of the items included or excluded, and especially also independent of the number of factors extracted. This independence implies that the identified structure is stable and potentially generally applicable.

6.8 Summarised results of studies 1 and 2

This section serves as brief summary of studies 1 and 2, which focussed on the development of a framework and the construction of an instrument to describe and distinguish the ways in which players use games. The different structures indicated in studies 1 and 2 are presented in Table 10. The in-depth discussion and comparison of the framework with models from the literature are presented in the overall discussion of the project in section 8.1.

Table 10

Overview of game usage factors identified in studies 1 and 2

Based on interviews	**Adjusted in pilot**	**Adjusted with larger test**
In-game behaviour	Expressing	Experimenting
Choice of content and setting	Friends	Friends
Intention	Competitive engagement	Negative emotions
Subjective experience of gaming	Positive experience	Positive emotions
Allocation of RL resources	Priority	Priority
Involvement in/Attitude towards game/seriousness	Seriousness	Seriousness
Game related activities	Community	Social
	Story and involvement	Story
	Real activity	

Study 1 comprised a thematic analysis of interviews with players of different games. The resulting framework was intuitively plausible, but not all aspects were clearly differentiable or easily measurable. In the second study, a questionnaire was constructed based on that framework and piloted with a medium-scale sample. Subsequent factor analysis led to various changes and a reorientation of all aspects. While this framework was more easily measurable, two of its scales appeared to be problematic and one factor was difficult to interpret. This second version of the framework was then tested on a larger and more diverse sample. Exploratory factor analysis led to minor adjustments to the structure, and to removing half of the items. This final Game Usage Framework (GUF) has acceptable-to-good fit indices, easily interpretable factors, a robust structure, and a strong empirical base, making it appropriate for use in study 3 and a promising tool for investigating game usage and its influences more generally.

There are three specific suggestions for future verification of the framework. First, the positive emotions factor was the only one that, depending on the remaining items, broke down, with all of its items loading onto the negative emotions factor. In the present study it was retained as an independent factor because, in the final model, it did not break down

and instead the factor loadings of the associated items became non-significant when the number of factors was reduced. Second, with the full item set, the scree-plot would support up to nine factors. Depending on the approach to the analysis both items of that ninth factor – "playing with randoms" and "engaging in PvP activities" – are related to player-vs-player activities. It could be that there is a significant ninth player-vs-player-related factor but, in the present analysis, it broke down immediately. This, however, could be due to the specific items included in the questionnaire, which might not have been sufficient to support a player-vs-player factor. A core issue in this regard could have been the "playing with randoms" item. The term *randoms* was originally established in the context of automatic player-matching functions which were most prevalent in, but not exclusive to, player-vs-player focused activities and games. This makes this item difficult to interpret and explains its relation to player-vs-player, but also why it loads onto the social factor depending on the remaining items in the analysis. Third, the items for this questionnaire were originally developed for a different hypothesised structure and were based on the interviews in study 1. The final structure differs from the originally-hypothesised one, resulting in the items not all being ideal for measuring the factors identified here. A focus in future work should therefore be on developing items that better represent these factors, especially for those that currently only have two associated items.

In the bigger picture, the framework raises some important questions: Why do people play games differently? What does it say about them? And what might it mean for them? As already implied in regard to the PENS, different game usages might indicate that players are in different situations in life and that they – consciously or subconsciously – use potentially the same games to satisfy different needs. The need for autonomy might be linked to the game usage factors of experimenting, story or priority. The need for competence might be linked to positive experience, and seriousness. Relatedness might be linked to friends and social. While positive and negative emotions and might directly influence players' feeling of wellbeing, the other factors might do so indirectly by fulfilling the basic needs.

7 Study 3 – Longitudinal Study of Game Usage, Wellbeing, Personality and Needs

7.1 Study 3 – Introduction

The purpose of this study was to address the second main aim of the project: establishing relationships between the game usage and wellbeing of users of video games. The presentation of this study is split into four sections: confirming that the instruments work as intended, directly predicting game usage, directly predicting wellbeing, and testing for interactions between game usage, personality and wellbeing in the context of wellbeing. Data for this study was collected from participants who completed two questionnaires up to three times, at least three months apart each. One questionnaire comprised the final Game Usage Instrument developed during Study 2. The other questionnaire comprised three extant instruments measuring personality, needs, and wellbeing.

Two major contributions of this stage are identifying game usage factors that are most relevant for predicting overall positive and negative wellbeing, and finding evidence for interactions between game usage, needs and wellbeing that should be further investigated and considered in research on effects of playing video games.

7.2 Study 3 – Methods

7.2.1 Participants.

From the pool of the participants described in 6.5.1 – recruited through various online forums and physical advertisements at universities in New Zealand and Germany, those were included in this study who had completed all questionnaires. They were invited to participate again every three months, to a maximum of three times. The draw for gratuities was repeated three times – in February, May, and September 2019 – for everyone who had completed both questionnaires in the time since the last draw. Reminder e-mails were sent out in the month before each draw to all previous participants who had provided their e-mail address for this purpose. A discussion of general issues with recruiting encountered in this study and lessons learned for future studies are presented in Appendix J.

Time 1

These participants are identical to the ones described in section 6.5.1.

Time 2

In total, 136 people accessed the game usage questionnaire a second time, of whom 130 completed it. One-hundred and four people accessed the wellbeing questionnaire a second time, all of whom completed it. One-hundred people completed both questionnaires a second time.

Of these, 63% identified as male, 33% as female, and 4% as gender-diverse. The average age of participants participating twice was 25 years (SD=8, min=16, max=50). Six percent were school students, 1% in training of some form (e.g. apprenticeship), 64% university students, 5% currently unemployed, 21% employed, and 3% preferred to not provide that information. The most common countries in which participants had lived most during the six months before completing the questionnaires were New Zealand (63) and Germany (11). In total, people from 18 different countries participated twice. Eighty-one percent of participants reported to play their main game online. The most common games were World of Warcraft (8), Overwatch (5), and Minecraft (5). Participants referenced 64 different games as main game when counting only one game per series.

Time 3

Forty people accessed the game usage questionnaire a third time, of which 32 completed it. Twenty-eight people accessed the wellbeing questionnaire a third time, all of which completed it. Twenty-five people completed both questionnaires a third time.

Because this number was too low for reliable analyses no data from time 3 was used.

7.2.2 Instruments.

The variables of interest in this study were game usage, personality, basic psychological needs and wellbeing. The instruments chosen to measure these constructs are the final version of the Game Usage Questionnaire developed in Study 2, the "Big Five Inventory-2 short form" (Soto & John, 2017b), the Basic Psychological Need Satisfaction and Frustration Scale (Chen *et al.*, 2014), and the "WHO-5 Well-Being Index" (WHO-5; e.g. (Topp *et al.*, 2015). All instruments were used as suggested in the relevant publications, except for the WHO-5. Usually, the scale of the WHO-5 is presented as going from left to right from "All

of the time" to "At no time". In this study the order was reversed to be in-line with the other instruments so as to decrease the likelihood of participants getting confused. All used questionnaires can be found in Appendix K.

Game Usage Questionnaire

This was the final questionnaire adjusted in study 2. It consists of 23 items measuring eight factors: *Priority, Friends, Positive Emotions, Negative Emotions, Seriousness, Experimenting, Social,* and *Story*. All items use a 6-point Likert-scale for frequency or agreement. Detailed psychometrics for this questionnaire, which can be found in section 6.6, indicate that the instrument and its underlying model are acceptable-to-good. The full questionnaire is presented in Appendix H.

Big Five Inventory-2-short form

The Big Five Inventory-2 short form (BFI-2-s) consists of 30 items and was developed based on the Big Five Inventory-2 with 60 items (Soto & John, 2017b). These 30 items are associated with 15 different *facets* that are organised around five different factors, or *domains*. It uses a 5-point Likert-scale ranging from *Disagree strongly*, over *Disagree* a *little* and *Neutral*; *no opinion* over *Agree a little* to *Agree strongly*. Half of the items for each factor are reversely scored. Exploratory factor analysis on the data from an internet sample of 2,000 participants extracting five factors with varimax rotation, produced the hypothesised structure (Soto & John, 2017b). All items loaded substantially (>0.3) on their associated factor, there were barely any substantial cross-loadings, and factor loadings ranged from 0.39 to 0.78. Overall, factor loadings were predominantly in the range of 0.5-0.7, indicating a moderate-to-good definition of the factors (Raykov & Marcoulides, 2010). Cronbach alpha varied from 0.73 to 0.84 with an average of 0.77, indicating acceptable internal consistency. Finally, a study by Soto and John (2017b) showed that the factors from the 30-item version were very highly correlated with the original 60-item instrument, with shared variances between 94% and 97%. This indicates the results of the tests of validity conducted for the original instrument – e.g. confirming the factor structure – should still apply.

Basic Psychological Need Satisfaction and Frustration Scale

The Basic Psychological Need Satisfaction and Frustration Scale was developed and tested by Chen *et al.* (2014). It comprises 24 items, four of which are associated with each of six factors: Autonomy satisfaction and frustration, Competence satisfaction and frustration,

and Relatedness satisfactions and frustration. It uses a five-point Likert-scale ranging from *Completely untrue* to *Completely true* without descriptions for intermediate values. Chen *et al.* (2014) developed the scale drawing on a sample of 1,051 university students distributed almost equally over four different countries (USA, China, Belgium and Peru). They used exploratory and confirmatory factor analyses. Factor loadings of the items were significant, items loaded almost only on the main associated factors, and all items' loadings ranged from 0.6 to 0.8, with most being around 0.7, implying a good definition of the factors. Results of a confirmatory factor analysis indicated a good fit with CFI=0.95, RMSEA=0.04, and $\chi^2(231)=442$, $p<0.001$. Cronbach's Alphas ranged from 0.71 for relatedness frustration to 0.81 for competence satisfaction.

WHO-5

The WHO-5 has exhibited adequate internal consistency in numerous studies and has been shown to be a reliable predictor of scores of various negative and positive wellbeing outcomes (Topp *et al.*, 2015). It comprises five items and uses a 6-point scale ranging from *All of the time* to *Most of the time, More than half the time*, *Less than half the time*, and *Some of the time*, to *At no time*. As an example, Krieger *et al.* (2014) found an average Cronbach's alpha of 0.9 – which indicates high internal consistency – a good fit for a one-factor model using confirmatory factor analysis, and that the shared variance with the Becks Depression Inventory-II was significant and high with $r^2=0.71$. Another comprehensive analyses was conducted by Bech *et al.* (2003) in a study involving 9,500 participants. They found a Loevinger coefficient of 0.56 – which indicates homogeneity and unidimensionality – a Spearman correlation coefficient with the Mental Health Scale of 0.84 – indicating a high correlation – and reasonable sensitivity despite the brevity of the instrument. This is important for the present study because of the requirement to be able to distinguish between participants' wellbeing.

The Ryff scale was also considered for use in the present study, as was the idea of developing a new questionnaire for eudaimonic wellbeing, drawing on some widely-used – albeit contested – instruments. Aims were to establish overlaps between different operationalisations and to identify common core categories of wellbeing. A pilot was conducted, using an instrument based on the Ryff scale, but also including items from the PERMA-profiler (Butler & Kern, 2016), EPOCH (Kern *et al.*, 2016), and the QEWB (Waterman *et al.*, 2010). The results of an exploratory factor analysis were in line with several

other studies, and did not clearly replicate the six wellbeing dimensions suggested by Ryff (e.g. Abbott *et al.*, 2006; Burns & Machin, 2008; Springer, Hauser, & Freese, 2006). Additionally, the factor analysis did not clearly indicate a strong or easily-interpretable alternative structure, meaning substantially more work would have been required. Due to the limited number of participants (n=101), however, the pilot data were not reliable enough to do a major rework of the instrument. Therefore, bearing in mind the time-constraints of the overall project, the WHO-5 was chosen as suitable alternative.

7.2.3 Procedure.

Two questionnaires were set up on the online survey platform Qualtrics, one containing the Game Usage Questionnaire and questions on game-demographics, the other containing the Big Five Inventory-2-short form, Basic Psychological Need Satisfaction and Frustration Scale, WHO-5, and general items on demographics. Each questionnaire had its own link. Digital advertisement posts contained those links, as well as a link to the website that had been created for this study: https://game-usage.weebly.com. On this website, potential participants could find more information about the researcher, the research, and the links to the surveys. Physical advertisements contained only the link to the website and a QR-code to the questionnaires. After clicking on the links, participants were forwarded to the respective survey on Qualtrics which started with a prompt to enter a de-identifier. If none was entered, participants were forwarded to a general information form about the study and participation. Participants were asked to answer all questionnaires with regard to roughly the last month. This timeframe was chosen to be long enough to be representative of and influential on participants, short enough that participants would be unlikely to have experienced too many significant changes, and recent enough for participants to remember what they were doing and how they were feeling. An important choice had to be made regarding the Basic Psychological Need Satisfaction and Frustration Scale and the WHO-5: whether participants were supposed to complete them with regards to their "normal" lives, their in-game experiences, or their life overall. This question arises because of the focus on the influence of game usage on participants' wellbeing and the assumption, that players' experiences in-game and outside the game might differ significantly. It was decided that the general wellbeing instrument – the WHO-5 – was to be answered in regard to participants' overall lives. If the influence of game usage on wellbeing was to be tested, it made no sense to ask about in-game experiences here and, because the items of the WHO-5 refer to very general aspects of wellbeing, it would be difficult to separate in-game wellbeing and

wellbeing outside the game. The Basic Psychological Need Satisfaction and Frustration Scale was to refer to participants' experiences outside of games. The wording of the items enables participants to easily separate outside the game and in-game experiences. Mainly, however, this instrument was intended to gather information about participant's situations outside of games, which were hypothesised to interact with game usage.

Participants could complete the questionnaires in one or multiple sessions. At the end of the first questionnaire – they could start with either – they were given a randomly generated six-digit code as a de-identifier which they were asked to provide at the start of the second survey and when participating a second or third time. Providing a de-identifier at the beginning of a questionnaire led to the general information section being skipped, and not providing a de-identifier when participating the second or third time led participants being sent to the questionnaires for first-participation instead.

At the end of the questionnaires, participants were offered an opportunity to enter their e-mail address for the purpose of being sent their de-identifier and reminders to participate again before an upcoming draw. Participants also were shown their scores compared to others' average scores for the Big Five personality domains, the WHO-5 scores, and the aspects of game usage. It was emphasised that the wellbeing scores should only be seen as indicative and not as diagnostic, and that, if a person felt their score to be low, they could consider talking about it with someone they trust. They were also offered means to contact the researcher, who would then try to find someone to talk to together with them; no participant used this option. An automatic assessment of their needs was not provided because it was seen as too prone to misinterpretation. At the very end participants were shown the link to the other questionnaire and reminded that they could enter the draw after having completed both questionnaires. They were further reminded that they could participate again after three months.

About one month before – and again two weeks before – each subsequent draw, all participants who had previously provided their e-mail address received a reminder e-mail with the links to the surveys for participating again.

When participating again, participants were not shown the personality- and demographics-sections of the wellbeing-themed questionnaire, because personality has been shown to be stable over time after adolescence (e.g., Borghuis *et al.*, 2017). Instead, participants were asked after each questionnaire if they felt their game usage or wellbeing, respectively, had

changed since participating the previous time. If they chose *yes*, they were shown an additional one-page block with about 15 yes/no questions that represented areas of life that might have changed and could be related to a change in game usage or wellbeing. This block was also intended to pick up any significant changes in demographics. At the bottom of that page were three free-text boxes, which participants could use to specify the answers indicated in the list or other factors that were either game usage related, real life related, or not directly related to either but potentially related to their wellbeing. These additional blocks can be found in Appendix H.

7.2.4 Analysis.

The focus of the analysis was on addressing the central questions of the project and testing the hypotheses posited in section 3.6. The analysis was split into four sub-sections. First, the instruments were verified. Then the extent to which game usage and wellbeing can be predicted[2] from the respective other constructs was investigated. Finally, interactions between the constructs in the prediction of wellbeing were examined.

Verifying the instruments

The primary tools were exploratory and subsequent confirmatory factor analysis using SPSS and AMOS (Spicer, 2005). Exploratory factor analysis was used to determine the most likely number of factors underlying the data and to investigate the extent to which items load as suggested in the literature. If the exploratory factor analyses indicated alternative models, confirmatory factor analysis was used to identify which had the best model fit. Exploratory factor analysis was chosen over confirmatory factor analysis for verifying the models because the former can identify alternative models, while the latter only indicates whether hypothesised models fit the data. Model fit was examined using χ^2 tests, the Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), and Root Mean Square Error Approximation (RMSEA; see section 4.3.3 for more details on the fit indices). For these analyses, only the Time 1 data were used, because data of Times 2 and 3 are not statistically independent. This means they include the same participants, whose response patterns are likely to be similar across times, skewing the results if included multiple times in the same analysis (Spicer, 2005).

[2] As brief clarification, the word "predict" is here used in statistical sense, meaning that the *value* of one variable can be predicted to from another; this does not necessarily imply a causal relationship

Predicting game usage

Only data from participants who had completed both questionnaires were used in these analyses. In an initial analysis, direct correlations between each game usage factor and all other measures were established for a basic overview of relationships between the variables. Following this, hierarchical linear regression was conducted. All game usage factors were included – in separate analyses – as dependent variables, and all personality, needs, and wellbeing factors as independent variables. Personality factors were entered first, needs second, and wellbeing third. Under this approach, when entering a variable leads to the contribution of another originally significant variable becoming non-significant, a mediating effect of one variable on the other is implied. Non-significant factors were removed one by one to find the main relevant variables for each factor. Additionally, the change of the total variance explained when entering a variable last represents that variable's unique contribution to the overall model.

The longitudinal analysis was used to further investigate the relationships between the constructs, and also to test the temporal stability of the factors. For these analyses the data of all participants who had completed both questionnaires twice were included. Data for Time 3 could not be used because the sample was too small for results to be reliable, and it could not be combined with the second participation data because statistical independence would be violated (Spicer, 2005). The first step of analysing the longitudinal data was simple linear regression between the same variables at the different time points. This was done to determine the relative stability of each factor. The next step was to analyse correlations between changes in the variables using simple and hierarchical linear regression. Finding that variables do not only have a significant correlation at one point in time, but also tend to change together over time, strengthens – although, it does not formally establish – claims of causal relationships between the variables. If a correlation at one point in time is significant on the basis of a type 1 error, it is unlikely to observe a similar correlation for the changes of the variables. Furthermore, if an observed high correlation was due to an unobserved variable affecting both observed variables, they could still change independently if the unobserved variable does not change, while if there was a direct relationship the change in one variable would lead to the change in the other.

Predicting wellbeing

This analysis was identical to the analysis for predicting game usage, but with wellbeing as dependent variable.

Testing for interactions between the constructs

The aim of these analyses was to test for any interactions between the constructs which may improve their mutual association with wellbeing. It was, for example, hypothesised that social game play may be associated with higher wellbeing for users with low relatedness satisfaction but not for those with high relatedness satisfaction. First, the sample was split into groups based on whether their wellbeing was substantially higher or lower than predicted by regression models on the basis of participants' need satisfactions and frustrations. The game usage scores of these groups were compared using ANCOVAs with personality factors and the other needs as covariates. ANCOVAs were conducted to investigate whether differences in wellbeing between the groups were significant when associations with the other constructs were controlled. If a group with higher-than-expected wellbeing had a significantly different game usage score in any factor than the group with lower-than-expected wellbeing and this difference was not evident in the simple correlations conducted earlier, an interaction between game usage and that need in the context of wellbeing would be indicated.

In another analysis, cluster analysis using K-means clustering was used to group participants according to their personality factors and needs. These clusters were then compared on their game usage scores using ANOVAs. Complex patterns – meaning those where multiple of the personality or needs scores and multiple of the game usage scores differed from the average – were broken down according to correlations from the previous steps. For example, if a cluster was high on two needs and two game usage scores, a possibility that this could be explained in terms of associations already observed between one of the needs and one of the game usage factors was explored. Unexplained observations were noted as new tentative associations. This step was used for adjusting and developing hypotheses about specific interactions between needs, wellbeing, and game usage. In another cluster analysis participants were clustered according to their game usage. An attempt was made to predict the general patterns of wellbeing and needs of the clusters from their game usage. These predictions were then compared with the observed patterns of need satisfaction and wellbeing of the groups. This was done to test the previously-developed hypotheses about

associations between factors, and to test whether the individual associations can be combined linearly. The latter would mean that, as assumed in the previous step, complex patterns can be represented as a sum of individual associations, without them significantly affecting each other. This would not be the case if, for example, high autonomy satisfaction was associated with low priority, but high autonomy satisfaction in the presence of high competence satisfaction was associated with high priority.

In a third step, using the longitudinal data, the sample was split into three groups based on whether their wellbeing increased, decreased, or stayed the same across time – as defined by the difference in wellbeing being <0.3SD – and the analyses were repeated. This was done to test whether game usage and needs interact in association with wellbeing. Based on the theory discussed in section 3.6, it was hypothesised that there would be positive interactions between game usage and needs in the group whose wellbeing increased, negative interactions in the group whose wellbeing decreased, and trends with no effect on wellbeing in the group whose wellbeing stays the same. Positive and negative interactions here refer to interactions that are associated with improved wellbeing.

Hypotheses:

A general hypothesis, which has been well researched, is that needs satisfaction and frustration are linked to wellbeing (e.g. Church *et al.*, 2012; Milyavskaya & Koestner, 2011). Therefore, participants with high needs satisfactions and low needs frustrations were predicted to experience high wellbeing, and vice versa. Similarly, it is expected that personality is influential on wellbeing, mainly through extraversion and negative emotionality (Anglim & Grant, 2014).

The main hypotheses derive from the basis for the Game Usage & Wellbeing Theory posited in section 3.6. If a person's needs are satisfied, their wellbeing is likely to be high, independent of game usage. Likely, game usage will overall be lower. The first part of this hypothesis is based on wellbeing being primarily impacted by needs satisfaction, with the influence of game usage being secondary. The second part stems from the role needs satisfaction is assumed to play as motivation for game usage. If needs are satisfied, a powerful motivation is missing, which may, on average, lead to less game usage. The possibility that need satisfaction derives from game usage is excluded in this study, because the needs instrument specifically asked participants to only consider need satisfaction outside of games.

If needs are unsatisfied or frustrated, a player with game usage that provides satisfaction of those needs will exhibit higher wellbeing than they would if they did not play the game. Players with game usage that thwarts those needs further will exhibit lower wellbeing than they would without playing. Both will likely show overall high game usage. These hypotheses follow from the wellbeing provided by need satisfaction according to Basic Psychological Needs Theory and are based on the hypothesis that game usage can satisfy and frustrate needs. The second part follows from need satisfaction being hypothesised to motivate game usage.

In longitudinal scenarios nine hypotheses result from the before mentioned hypotheses, which are presented in Table 11. Needs "improving" in this context means they overall are more satisfied or less frustrated. The cells in the matrix refer to expected changes in wellbeing. The hypotheses in Table 11 are based on combinations of the aspects of the theory, particularly the assumption of a match between game usage and needs with influence on wellbeing. The first and third row mainly reflect that need satisfaction is hypothesised to be associated with wellbeing; if need satisfaction increases or decreases so will wellbeing. The second row mainly reflects that game usage is hypothesised to be able to compensate for or enhance the experience of low need satisfaction out of games; the differentiations within each row stem from interactions between these hypotheses. If game usage changes in a way that better matches current need satisfaction, wellbeing is hypothesised to increase or at least decrease less strongly, while if game usage changes in a way that counters need satisfaction, wellbeing is hypothesised to decrease or at least not increase as strongly. In all cases, personality is expected to influence the game usage required for a mis/match between game usage and needs. All of these hypotheses are temporal extensions of the former two hypotheses.

The model depicted in *Figure 2* assumes a directional relationship, with wellbeing as the outcome and game usage as the input, while needs are assumed to be fixed variables. The latter means the satisfaction of a person's needs outside games is assumed to not be influenced by their wellbeing or them playing games. Whether this is the case or not, and whether people can truly differentiate between needs being satisfied by playing games and other aspects of life, is disputable. Notwithstanding, it also is possible that a person's wellbeing changes for reasons other than a change of the satisfactions and frustrations of needs, in which case game usage would become an outcome variable. In that case the theory does not make a clear prediction, but it would be expected that an increase in wellbeing may

lead to an overall decrease in game usage, while a decrease in wellbeing might lead to an overall increase in game usage. This assumption is based on low wellbeing potentially having a motivational effect to play games as distraction from life (Bargeron & Hormes, 2017).

Table 11

Hypothesised changes of wellbeing depending on changes in needs and game usage as hypothesised in the developed Game Usage and Wellbeing theory

Needs\Game Usage	Matching change	No change	Mismatching change
Improve	Increase	Increase	Slight increase to slight decrease
No change	Increase	No change	Decrease
Worsen	Slight decrease to slight increase	Decrease	Strong decrease

Comparing online and offline players and different age groups

As a final analysis, online and offline players and different age groups (≤18 vs >18 years of age) were compared to test if there were significant differences that would imply, for example, that they should be considered separately in studies on the effects of games. For this purpose, the hierarchical linear regression conducted before were repeated for the different groups. Additionally, the groups' means were compared using t-tests.

7.3 Study 3 – Results

7.3.1 Verification of used instruments.

All instruments were tested using exploratory factor analysis to ensure that they work as intended for the present sample. Analyses were primarily conducted using SPSS deploying principle axis factoring with oblimin rotation. However, principle component analysis and varimax rotations were also used to test if solutions are independent of the specific approach. An instrument was treated as verified if the factor structure that was found to be the most adequate solution in this study matched the one suggested in the literature. A particular aim of this analysis was to test and adapt the game usage framework and questionnaire.

7.3.1.1 Analysis of the World Health Organisation wellbeing questionnaire.

This analysis involved the data of 575 participants. The instrument consisted of five items. The KMO-score was 0.82 and Bartlett's test was significant; $\chi^2(10)=980$, $p<0.001$; both indicating the data is adequate for factor analysis. Only one factor had an Eigenvalue greater than one, implying a one-factor solution. This is in line with what has been proposed in the literature.

7.3.1.2 Analysis of the Big Five Inventory-2-short form.

This analysis involved the data of 575 participants. The instrument consisted of 30 items. The KMO-score was 0.82 and Bartlett's test was significant; $\chi^2(435)=5146$, $p<0.001$; both indicating the data is adequate for factor analysis. Seven factors had an Eigenvalue greater than 1, with the scree-plot indicating a five-to-six factor solution. In the seven-factor solution the seventh factor was empty and in the six-factor solution the sixth factor was almost empty, only loading one item. The five-factor solution reproduced the structure suggested in the literature. No items showed significant cross-loadings and all items had loadings>0.3, most >0.4.

7.3.1.3 Analysis of the Basic Psychological Need Satisfaction and Frustration Scale.

This analysis involved the data of 575 participants. The instrument consisted of 30 items. The KMO-score was 0.92 and Bartlett's test was significant; $\chi^2(276)=7949$, $p<0.000$; both indicating the data is well suited for factor analysis. Five factors have an Eigenvalue greater than one and the scree-plot indicated a four- or five-factor solution. The scree plot is displayed in *Figure 7*.

In the five-factor solution, all eight competence-related items were loaded by a single factor, while for the autonomy and relatedness items – as suggested in the literature – four items each were loaded by separate satisfaction and frustration factors. In this solution there were some cross-loadings between 0.3 and 0.4, between the related satisfaction and frustration factors, but all items were clearly loaded by a main factor with loadings >0.5. Forcing a six-factor solution reproduced the structure suggested in the literature, but this structure cannot be supported due to the sixth factor having an Eigenvalue of only 0.7, meaning it explains less variance than an individual item would if all items were uncorrelated. The four-factor solution is more complex: there are significant cross-loadings, but overall it mainly indicates three factors – one each for autonomy, relatedness and competence – with the autonomy-related item "*I feel my choices express who I really am*" being loaded by its own

factor. The results for the four-factor solution differ when using varimax rotation instead, as here the autonomy-related items load clearly onto separate satisfaction and frustration factors.

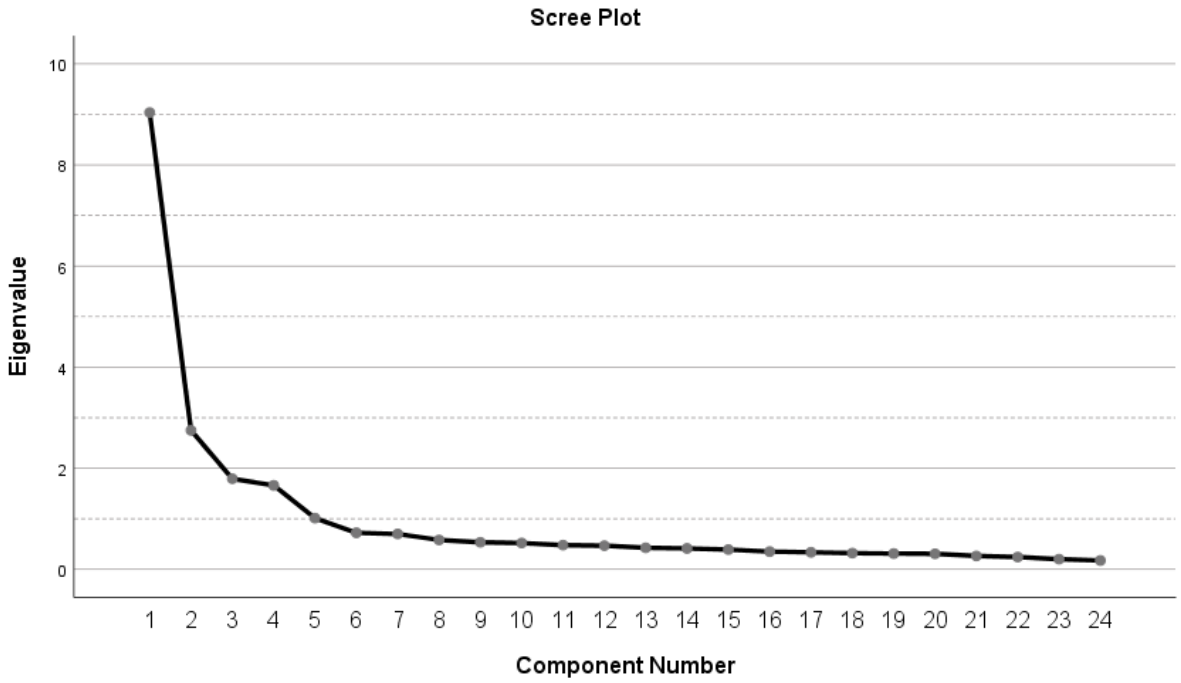

Figure 7: Scree plot for the factor analysis of the basic psychological needs satisfaction and frustration scale

To better inform the choice of a solution, confirmatory factor analysis was conducted comparing solutions as follows:

Three-factor solution – one autonomy, one relatedness, and one competence factor: CFI=0.8, RMSEA=0.1;

Four-factor solution – two autonomy factors, one relatedness and one competence factor: CFI=0.84, RMSEA=0.1;

Five-factor solution – two autonomy and relatedness factors, one competence factor: CFI=0.89, RMSEA=0.08;

Six-factor solution – two autonomy, relatedness and competence factors: CFI=0.94, RMSEA=0.06.

Based on the results of the CFA – going from three to six factors – the five-factor solution is the first acceptable one, and the six-factor solution suits the data best, based on both goodness-of-fit indices. As mentioned before, though, the six-factor solution cannot be

supported based on the EFA. Therefore, the five-factor solution with one overall competence satisfaction factor was chosen for the subsequent analyses in this study.

7.3.1.4 Analysis of the Game Usage Questionnaire.

The results of this analysis were described and discussed in detail in sections 6.6 and 6.7.

7.3.1.5 Summary and discussion of verifications of instruments.

Factor analyses showed that the World Health Organisation wellbeing questionnaire and the Big Five Inventory-2 short form questionnaires can be used as proposed in the literature.

Analysis of the Basic Psychological Needs Satisfaction and Frustration Scale, on the other hand, revealed an issue, in that the proposed six-factor structure cannot be supported. Instead, a five-factor solution with all competence items loading on the same factor seemed more plausible and was used in the analyses of the present study. Besides this observation suggesting that further analysis of the instrument is advisable, it highlights an issue with the current approach to the development and testing of instruments in this field and possibly the social sciences more generally. The BPNSFS was developed from a larger instrument with 42 items, but after the questionnaire was adjusted and its size reduced to 24 items based on *confirmatory* factor analyses, no *exploratory* factor analyses was conducted (Chen *et al.*, 2014). Further analyses verifying the instrument with other samples also only used CFAs (Heissel *et al.*, 2018; Liga *et al.*, 2018). These compared three- and six-factor models and found the best fit for the six-factor model. However, whether the data might indicate a different model altogether – for example, a four- or five- factor model, which is indicated by the exploratory factor analysis in the present study – was not considered in either of those studies. It is therefore suggested that exploratory factor analyses be used more routinely in instrument development and verification.

7.3.2 Preparing the data for analysis.

Using a single-parameter graded response model, scores for all measures were calibrated to measurement scales with interval properties (Samejima, 2016). For this the package *ltm* (Rizopoulos, 2006) for the statistics software "R" was used. Details of this approach are explained in section 4.3.4. These scale locations, henceforth called *IRT-scores*, were used for the further analysis. A key advantage of IRT-scores over normal factor scores is that they are interval data rather than ordinal data. This becomes especially influential in the longitudinal data, where differences within participants can be estimated more accurately. As last step of

data preparation, the scores for all factors of all measures were standardised by subtracting the respective mean of a factor from the respective scores of all participants and then dividing the resulting score by the respective factor's standard deviation. This means the average of all measures is zero and all scores and results presented – except for correlation coefficients and covariances – are in units of standard deviations, a property that is helpful when comparing different measures.

7.3.3 Predicting game usage.

One key variable that was expected to influence game usage and its correlations with the other measures was whether participants played games online or offline. A set of t-tests comparing the game usage scores of the 430 online players and 100 offline players who had completed all questionnaires revealed various significant differences. Therefore, analyses were conducted separately for users playing their main games online and offline. The results reported in the next sections only consider the data provided by the online players. Details of the differences and a comparison of the analyses for both groups are provided in section 7.3.7.

The first step of the analysis was to investigate correlations between the IRT-scores associated with each factor derived from each instrument. The full correlation matrices can be found in Appendix L. All correlation coefficients were ≤0.3, and there are several significant correlations in the range from 0.15 to 0.3. Especially seriousness and social showed multiple significant correlations with the other factors. The highest correlation was between seriousness and priority with r=0.3. While these correlations were significant, they suggest that the factors are largely distinct, as they share at most 10% of variance.

Simple correlations between game usage and the other measures

Synopsis: The purpose of this analysis was to gain an overview of the relationships of the game usage factors with all other measures to inform subsequent analyses. Key findings were that (1) all correlations are weak, and (2) the most substantial associations involve the positive and negative emotions in-game factors.

Table 12 shows correlations between the individual game usage factors and personality, wellbeing, and needs. Only values statistically significant at p≤0.05 are displayed here. The full table can be found in Appendix L.

Table 12

Correlations of game usage factors with personality traits, needs, and wellbeing for online players

	Experi-menting	Friends	Negative Emotions	Positive Emotions	Priority	Serious-ness	Social	Story
Openness	.14	-.10			-.11			.15
Conscien-tiousness			-.12			.10		
Extraversion		.13			-.26			
Agree-ableness			-.16	.11				.11
Negative Emotionality	.11		.26	-.18				
WHO-5		.13	-.10	.27	-.12		.10	
Autonomy satisfaction			-.12	.28		.13		
Autonomy frustration	.13		.19	-.13				
Relatedness satisfaction		.22	-.11	.17	-.14			
Relatedness frustration	.12	-.11	.25	-.20				
Competence satisfaction			-.17			.15		

Note. Only values significant at p≤0.05 are displayed.

The game usage factors that are most strongly correlated with other factors are negative- and positive emotions. Some of the most striking observations are that negative emotions in the game mainly correlate with negative factors of the participants' real-lives, such as autonomy frustration, relatedness frustration and the personality trait negative emotionality, while positive emotions correlate most strongly with overall wellbeing and autonomy satisfaction. As participants were asked explicitly to complete the needs questionnaire in respect to activities outside games – and to ignore needs satisfaction and frustration derived from games – these correlations may indicate that a person's situation outside the game influences how they experience games. In that regard it is not surprising that negative emotionality is correlated with negative emotions, because people with high negative emotionality tend to experience situations more negatively in general. The results here imply that this may also be valid in the context of computer games.

The game usage factor *friends* was correlated positively with relatedness satisfaction. This observation makes sense if a person's situation outside the game influences their game

usage: a person with higher relatedness satisfaction will likely have more or closer friends with whom they could play than a person with lower satisfaction. The negative correlation between extraversion and priority indicates that, for extraverts, playing games is less important, which supports a stereotype of gamers being more introverted. Looking at the correlations between game usage factors and personality on the facet level, friends is correlated to *sociability* – a facet of extraversion – with r=0.21, which helps explain its correlation with relatedness satisfaction. Negative emotions is correlated negatively with *respectfulness* – a facet of agreeableness – (r=-0.22) and positively with *anxiety* (r=0.24) and *emotional volatility* – both facets of negative emotionality – (r=0.26), which could mean that people in online games who are less respectful and more emotionally unstable tend to have more unfriendly experiences than others, possibly because of upsetting other players. *Positive emotions* is correlated negatively with *depression* – the third facet of negative emotionality – with r=-0.23, again emphasising that people who tend to experience things negatively in general also do so in games. Priority is correlated negatively with all three facets of extraversion, *sociability*, *assertiveness*, and *energy level* (r=-0.2), essentially implying that people higher in extraversion tend to prefer other things over gaming. Considering the overall aim of this project to understand the relationship between game usage and wellbeing, it is important to note that of the eight game usage factors, only the *positive emotions* factor is more-or-less substantially correlated with wellbeing; and even this factor only shares 7% of variance with wellbeing.

Multiple linear regression between game usage and other measures

Synopsis: The purpose of this analysis was to determine to what extent game usage factors could be predicted from needs, personality and wellbeing. Key findings were that (1) overall only small proportions of variance in game usage were accounted for by the other measures, (2) the association with personality often was accounted for by the association with needs, and (3) highest combined associations were with positive and negative emotions in-game.

The next step in predicting game usage was to enter the different variables into multiple linear regression models with the game usage factors as dependent variables. For each game usage factor, the five personality traits were added first. In a second step the five needs-factors were entered, and, finally, wellbeing was included. In Table 13 the significant independent variables and the corresponding total shared variances are presented. In cases in which values for the third step are not displayed, wellbeing was not significantly

associated with the respective game usage factor. Advantages of this approach over simple correlations is that it can identify and account for an overlap of the independent variables and show mediating effects. Therefore, it can determine the significant predictor variables and how well they, when combined, predict the variable of interest.

Table 13

Significant predictors of game usage factors in multiple linear regression for online players

Dependent variable	Predictor variables	Total r^2 and unique contributions
Experimenting	1. Openness	.02
	2. Openness + autonomy frustration	.04 (.02|.02)
Friends	1. Openness + extraversion	.04 (.02|.02)
	2. Openness + relatedness satisfaction	.07 (.02|.05)
Negative emotions	1. -Agreeableness + negative emotionality	.08 (.02|.06)
	2. -Agreeableness + negative emotionality + relatedness frustration	.10 (.01|.03|.02)
Positive emotions	1. -Negative emotionality	.03
	2. Autonomy satisfaction	.08
	3. Autonomy satisfaction + wellbeing	.10 (.03|0.2)
Priority	1. -Extraversion	.07
	2. -Extraversion	.07
Seriousness	1. –	.0
	2. Competence	.02
Social	1. –	.0
	2. Competence	.01
Story	1. Openness	.02

Note. Values in the parentheses in the rightmost column show the unique proportions of variance in the dependent variable accounted for by each predictor variable.

Game usage factors were poorly predicted by needs, personality, and wellbeing. In particular, in experimenting, seriousness, social and story less than 5% of variance was explained, even when considering all basic psychological needs-, personality-, and wellbeing-factors; in the others at most 10% of variance was explained. Except for the

negative emotions- and priority- factors, peoples' needs – as indicators of their general situations outside the game – seem to be more relevant to their game usage than their personalities. For friends, the contribution of extraversion is completely mediated by relatedness satisfaction and for positive emotions the effect of negative emotionality is mediated by autonomy satisfaction. Regarding the exceptions, negative emotions in online games seem to be most strongly predicted by people being low on agreeableness – perhaps they tend to get into arguments or to get upset at others' actions in games if they do not align with their own intentions –, high on negative emotionality – meaning they tend to experience situations negatively in general –, and them having high relatedness frustration – indicating they experience negative social interactions in outside the game. Priority seems to be influenced mainly by a persons' level of energy and tendency to engage in social interactions. Positive emotions was on par with negative emotions in having the highest shared variance with the other measures. Based on its correlation with autonomy satisfaction and wellbeing, and considering the correlation between these two variables, which is discussed in the next section, it could be that positive emotions in a game reflect a person's wellbeing, meaning that people who have high wellbeing may be more likely to experience playing games positively and to have fun.

In summary, game usage factors are weakly correlated with needs, personality, and wellbeing. The factors correlated most strongly are positive and negative emotions, which possibly reflect peoples' wellbeing and their tendency to experience negative mental states.

Longitudinal data

Synopsis: The purpose of these analyses was to establish the stability of game usage factors over time and to determine if the previous point-in-time correlations are supported by longitudinal correlations. Key findings were that (1) most game usage factors are moderately stable across time but participants overall played less and less seriously, and (2) the only point-in-time correlation supported was the association of positive emotions in-game with wellbeing.

One hundred participants completed both questionnaires twice. In Table 14, correlation coefficients of participants' scores are Time 1 and 2 are presented. Only correlation coefficients significant at $p<0.05$ are shown. The full t-test results for all factors can be found in Appendix L.

Table 14

Correlations of game usage scores between Time 1 and Time 2

	Experi-menting	Friends	Negative Emotions	Positive Emotions	Priority	Seri-ousness	Social	Story
r	.33	.65	.57	.58	.51	.62	.39	.66

Note. All values shown are significant at p≤0.05.

Game usage factors were quite stable over three months, while experimenting and social varied more substantially. Negative emotions, priority and seriousness are the only game usage factors that changed systematically, all decreasing. The average negative emotions score decreased by 0.22 SD; $t(99)=-2.54$, p=0.01; the average priority score decreased by 0.3 SD; $t(99)=-3.17$, p≤0.01; and the average seriousness score decreased by 0.25 SD; $t(99)=-3.15$, p≤0.01.

Table 15 shows the correlations between changes of the game usage factors with changes of the needs and wellbeing. Only correlation coefficient statistically significant at p<0.05 are shown. The full table can be found in Appendix L.

Table 15

Correlations between changes in game usage factors from Time 1 to Time 2 with changes in needs and in wellbeing

Game Usage factors	Wellbeing	Relatedness satisfaction	Relatedness frustration
Positive emotions	.25		
Seriousness			.22
Social		-.25	

Note. All values displayed are significant at p≤0.05. Blank cells are non-significant.

Changes in wellbeing and positive emotions are correlated about as strongly as wellbeing and positive emotions were correlated at Time 1 (r=0.27), providing support for there being a persistent relationship between these variables. The correlation of positive emotions with relatedness satisfaction is likely connected to the relationship between relatedness satisfaction and wellbeing. That changes in relatedness satisfaction are negatively correlated with social scores indicates that people who have less meaningful contacts in life play more socially, and vice versa. The final significant correlation was between relatedness frustration

and seriousness. The correlation reported here could imply that people tend to take games more seriously when they feel rejected by others, suggesting, for example, people might take games more seriously to distract from breakups or similar scenarios.

Summary of results

Overall, game usage was found to be barely predicted by personality, needs, or wellbeing, with the predictor variables combined accounting for at most 10% of the variance in a game usage factor. Except for predicting *negative emotions* in-game, personality was found to not be a substantial predictor variable. The strongest predictable factors were *friends*, mainly from relatedness satisfaction, *negative emotions* in-game, mainly from negative emotionality and relatedness frustration, and *positive emotions* in-game, from wellbeing and autonomy satisfaction. The only one of these correlations that was supported by correlations between changes of the variables was that between *positive emotions* in-game and wellbeing.

This emphasises that the overall relationships between game usage, personality, needs and wellbeing are not strong enough to support general predictions, and that there are other unobserved variables that are more influential on game usage than the constructs considered here.

7.3.4 Predicting wellbeing.

The first step of the analysis of wellbeing was to investigate the correlations between the factors within each construct. The correlation matrices can be found in Appendix L.

All needs were significantly correlated with each other and with wellbeing. The average correlation was r=0.45, with the highest correlation being between autonomy satisfaction and competence (r=0.55). These correlations indicate substantial associations between the factors, while also suggesting that each factor has a unique aspect and contribution.

All five personality factors were significantly correlated with each other. The average correlation was r=0.30, with the highest correlation being between extraversion and negative emotionality (r=-0.39). These correlations are moderate, showing that personality factors are mostly independent but correlated, and some share up 15% of variance.

All in all, this implied overlaps had to be taken into consideration in multiple regression, especially for the needs.

Simple correlations between wellbeing and the other measures

Synopsis: The purpose of this analysis was to gain an overview of the relationships between wellbeing and the other measures to inform subsequent analyses. Key findings were that (1) wellbeing was only weakly associated with game usage factors, (2) wellbeing was substantially associated with needs and personality, and (3) needs and personality were substantially associated with each other.

As reminder, Table 16 shows the correlations between game usage factors and wellbeing. The only substantial correlation was found between wellbeing and positive emotions.

Table 16

Correlation coefficients between game usage factors and wellbeing for online players

	Experimenting	Friends	Negative Emotions	Positive Emotions	Priority	Seriousness	Social	Story
WHO-5		.13	-.10	.27	-.12		.10	

Note. Only correlations significant at p≤0.05 are displayed.

Table 17 and Table 18 show correlations of wellbeing with personality and needs, respectively. The personality factors correlated most highly with wellbeing are extraversion and negative emotionality, while the correlation with openness is non-significant. All needs are substantially correlated with wellbeing, as expected, satisfactions are correlated with wellbeing positively, while frustrations are correlated with wellbeing negatively. Important to note is that the correlations between wellbeing with needs and personality are significantly higher than those with game usage.

Table 17

Correlation coefficients between personality traits and wellbeing for online players

	Openness	Conscientiousness	Extraversion	Agreeableness	Negative emotionality
WHO-5		.31	.46	.23	-.60

Note. Only correlations significant at p≤0.05 are displayed

Table 18

Correlation coefficients between needs and wellbeing for online players

	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence
WHO-5	.57	-.43	.43	-.45	.53

Note. All correlations are significant at p≤0.01.

Table 19 shows correlations of needs with personality. Correlations between personality traits and most needs are weak. Exceptions include most correlations with negative emotionality and most with competence. This implies that, in predicting wellbeing in multiple linear regression, considerable overlap of variance had to be expected. An important observation was again the apparent role of negative emotionality in peoples' positive and negative perceptions of situations.

Table 19

Correlation coefficients between needs and personality traits for online players

Personality traits	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence
Openness	.14		.18		.14
Conscientiousness	.27	-.22	.14	-.19	.41
Extraversion	.33	-.25	.29	-.30	.48
Agreeableness	.21	-.15	.30	-.21	.10
Negative Emotionality	-.42	.45	-.24	.46	-.60

Note. Only correlations significant at p≤0.05 are displayed.

Multiple linear regression between wellbeing and other measures

Synopsis: The purpose of this analysis was to determine to what extent the variance in wellbeing was accounted for by the other measures. Key findings were that (1) wellbeing was only weakly associated with game usage, (2) wellbeing was highly associated with needs and personality, (3) a major proportion of the variance in wellbeing was accounted for jointly by needs and personality, and (4) the association between game usage and wellbeing was accounted for by needs and personality.

Wellbeing was first modelled with game usage factors, personality traits and facets, and needs separately. Then, combinations of these variables were entered into the same multiple regression model. In each analysis, first all variables were included, before the least

significant variable was removed and the regression repeated, until only significant variables remained. Once a final set of model variables had been established, unique variances were determined for each by entering them into the regression last and noting Δr^2. Variables associated with less than 1% unique variance were removed. The shared and unique variances for all multiple regressions are presented in *Figure 8*.

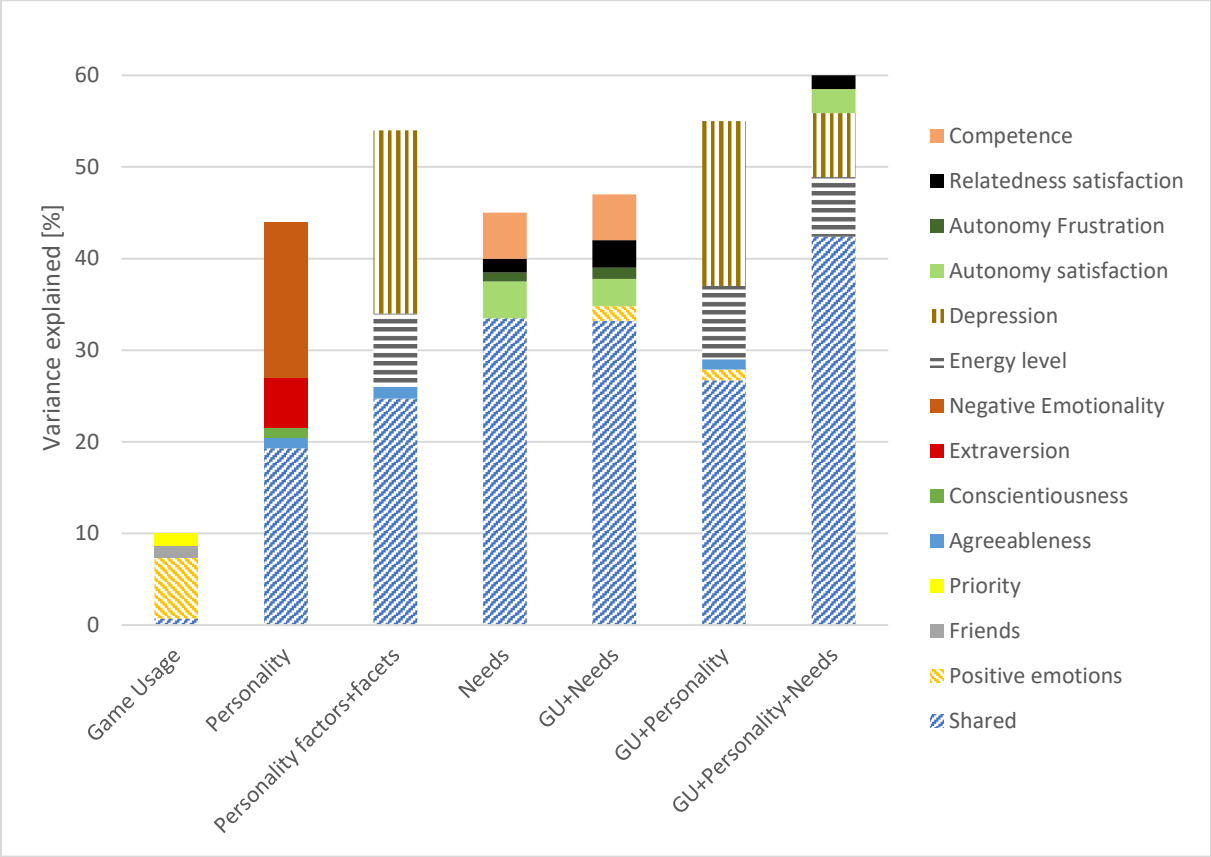

Figure 8: Multiple regression of wellbeing. This graph shows the significant predictors of wellbeing in multiple regression of wellbeing. Shared and unique contributions are colour-coded. Regressions are split by game usage factors, personality traits and facets, and needs, and combinations thereof.

Figure 8 shows: The left four bars show the contributions – unique and shared between at least two – of the significant variables in multiple regression of wellbeing from game usage (first bar, main factor is positive emotions), personality factors (second bar, main factors are shared and negative emotionality), personality facets (third bar, main factors are shared and depression), and needs (fourth bar, main factors is shared, followed by autonomy satisfaction and competence satisfaction). The remaining three bars show the contributions when combining game usage and needs (fifth bar, main factors is shared, followed by autonomy satisfaction and competence satisfaction and positive emotions), game usage and personality (sixth bar, main factor is shared, followed by depression, energy level and

positive emotions), and all thee constructs (seventh bar, main factor is shared, followed by depression, energy level, and autonomy and relatedness satisfaction).

This analysis has several implications. First, wellbeing can be substantially predicted by personality and needs, which jointly account for almost 60% of its total variance. Next, and possibly most importantly in the context of this study, game usage does not account for a substantial amount of wellbeing variance in addition to that associated with personality and needs. The only game usage factor accounting for significant unique variance was positive emotions, which was nonetheless just 0.5% of total variance. Considered independently though, game usage accounts for almost 10% of total variance in wellbeing, most of which is shared with the positive emotions factor. When combining game usage with only personality *or* needs, positive emotions has a significant unique contribution. That the association between *positive emotions* in-game and wellbeing is completely accounted for by the associations of wellbeing with personality and needs – two measures that are firmly based outside of games – provides further support for the claim that *positive emotions* in-game reflect wellbeing, rather than it influencing wellbeing.

Priority represents how much time a person spends on a game, but also how important it is to them. It has often been used as a main variable in investigations of the effects of games under the labels of intensity, frequency, or engagement. In the present study, this factor was not a significant predictor of wellbeing. Considered separately, it shares less than 2% of variance with wellbeing, indicating a very weak relationship. Nonetheless, the correlation is significant and negative. This implies that people for whom the game is less important and who play less tend to be more well, or that for people who are more well, games tend to be less important. The role of friends in the regression is mediated through a mutual correlation with relatedness satisfaction.

Including the personality facets in the regression accounted for most of the variance associated with personality traits, and only left agreeableness, energy level, anxiety and depression as significant predictors – although anxiety uniquely accounted for less than 1% of total variance. Wellbeing in this study was measured using the WHO-5, which comprises five items that focus on feeling "cheerful and in good spirits", "calm and relaxed", "active and vigorous", "fresh and rested", and as if "life is filled with things that interest me". This fifth item is very similar to an item used to determine autonomy satisfaction, and the first four items are very similar to the meaning of the personality facets of depression and energy level.

The biggest difference between these items is that the personality questionnaire refers to a person in general, while the WHO-5 only asks about a recent timeframe – in the case of the present study the past month. Thus, the high correlations between these measures might not actually be due to a high correlation between two independent constructs, but rather, due to these instruments essentially measuring the *same* construct, which is likely to be more wellbeing- than personality-related. If so, using the personality factors instead of the facets might produce more meaningful results, as the other facets of those factors do not have that same wellbeing-like wording.

Longitudinal data

Synopsis: The purpose of this analysis was to evaluate the stability of the needs and wellbeing, and to determine if the previous point-in-time correlations were supported by longitudinal data. Key findings were that (1) needs and wellbeing were moderately stable but participants seemed to overall experience stronger constraints in life, (2) the point-in-time correlations between wellbeing and needs as well as the weak association between wellbeing and positive emotions in-game were supported, and (3) most of the association of the change in wellbeing with the change in positive emotions was accounted for by the change in needs.

One hundred participants completed both questionnaires twice. In Table 20, correlation coefficients of participants' scores in the factors at Time 1 and 2 are presented. Only correlations significant at $p<0.05$ are shown.

Table 20

Correlations and differences of means of wellbeing and needs between time 1 and time 2

	WHO-5	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence
r	.50	.64	.44	.63	.56	.65

Note. Only values significant at $p\leq0.05$ are displayed.

All needs and wellbeing were moderately correlated, and autonomy frustration was the least stable variable; furthermore, autonomy satisfaction decreased and frustration increased on average; $\Delta=-0.26$, $t(99)=-2.85$, $p=0.01$ and $\Delta=0.23$, $t(99)=2.27$, $p=0.03$, respectively. This may indicate a general change in time-constraints affecting a major part of the sample due to work or school. Based on the qualitative information provided, that a major part of the

sample were students, and on the time points of participation, a potential explanation is that many students were on break or at the beginning of the semester during Time 1 but back to studying or preparing for exams during Time 2. The full t-tests for all variables can be found in Appendix L.

Simple correlations

Correlations between changes in wellbeing scores and changes in game usage factors are shown in the first column of Table 15. As reminder, only the change in positive emotions was significantly correlated with the change in wellbeing (r=0.25*). The corresponding correlations with changes in needs are presented in Table 21.

Table 21

Correlations of changes in wellbeing between time 1 and time 2 with changes in needs

	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence
WHO-5	.34	-.23	.34	-.38	.36

Note. All correlations were significant at p≤0.05.

Overall, correlations with changes in needs were substantial, significant and in the expected directions. They were not as strong as the correlations at Time 1, which were between r=0.45 and r=0.58 (see Table 18). Care must be taken not to over-interpret these results, because individual needs can change independently and counter each other's effects, possibly weakening correlations between individual needs and wellbeing, without implying that the correlation between wellbeing and needs is actually weaker.

Multiple regression

Multiple linear regressions showed that the change in wellbeing was associated with 30% of the variance (adjusted r^2) of the change in needs. The significantly-associated needs are autonomy, relatedness and competence satisfaction, and relatedness frustration. This was lower than the variances explained by needs at Times 1 or 2 – which were 45% and 52%, respectively – but higher than the variance explained by changes of individual needs. This implies that changes in needs interact with each other and partly counter or amplify one-another's effects. It also shows that the change in needs is less strongly correlated with the change in wellbeing than would be expected based on the point-in-time correlations between these variables at Times 1 or 2.

In the analysis predicting change in wellbeing from change in game usage, the only significant factor was positive emotions with r^2=0.06. Combining needs and game usage yields adjusted r^2=0.32, with autonomy and competence satisfactions, relatedness frustration, and positive emotions being significantly associated with change in wellbeing.

Summary results regarding the prediction of wellbeing

Wellbeing could only be weakly predicted by game usage, mainly through positive emotions. Personality factors and needs each predicted wellbeing substantially, with the largest part of the explained variance being shared. The contribution of game usage – or rather *positive emotions* in-game – was entirely mediated by the variance shared by needs and personality, further indicating that *positive emotions* in-game possibly reflects wellbeing, rather than influencing it. The longitudinal data fully supports the observations made based on the cross-sectional data.

7.3.5 Interactions between game usage, personality, needs, and wellbeing.

One of the hypotheses of this study was that game usage may affect players differently depending on their situations in life, operationalised as needs. An inference from this hypothesis was that correlations would differ for different groups of players, and that overall correlations between the measures would be weak. The interaction analyses presented here used a split-sample approach rather than calculating moderation terms by multiplying variables with potential moderators. The different groups were then compared using t-tests and conducting ANCOVAS with personality factors and needs as covariates. Moderation terms of game usage factors with needs and personality were also tested in regressions but turned out to be non-significant in all cases.

Sample-split by expected wellbeing

Synopsis: The purpose of this analysis was to determine if interactions between game usage and needs are evident that may be associated with higher or lower than expected wellbeing. Key findings were that (1) players with higher wellbeing than expected based on their relatedness frustration showed higher social game usage, and (2) players with higher wellbeing than expected based on their competence satisfaction had higher positive emotions in-game.

Groups were split using two approaches. The first was to determine the *expected wellbeing* of all participants based on each need using simple linear regression. Then, the sample was

split into two groups: one with wellbeing at least 0.5 standard deviations higher than the value predicted from their needs score, and one with wellbeing at least 0.5 standard deviations lower. An example of this sample-split is shown in Figure 9 for wellbeing values predicted from participants' autonomy satisfaction scores. Participants above the green (upper) line were compared with those below the red (lower) line on all game usage factors with the other needs and personality factors as covariates. This split was repeated based on all needs. The other plots can be found in Appendix M. This sample split resulted in groups ranging from 120 to 137 participants.

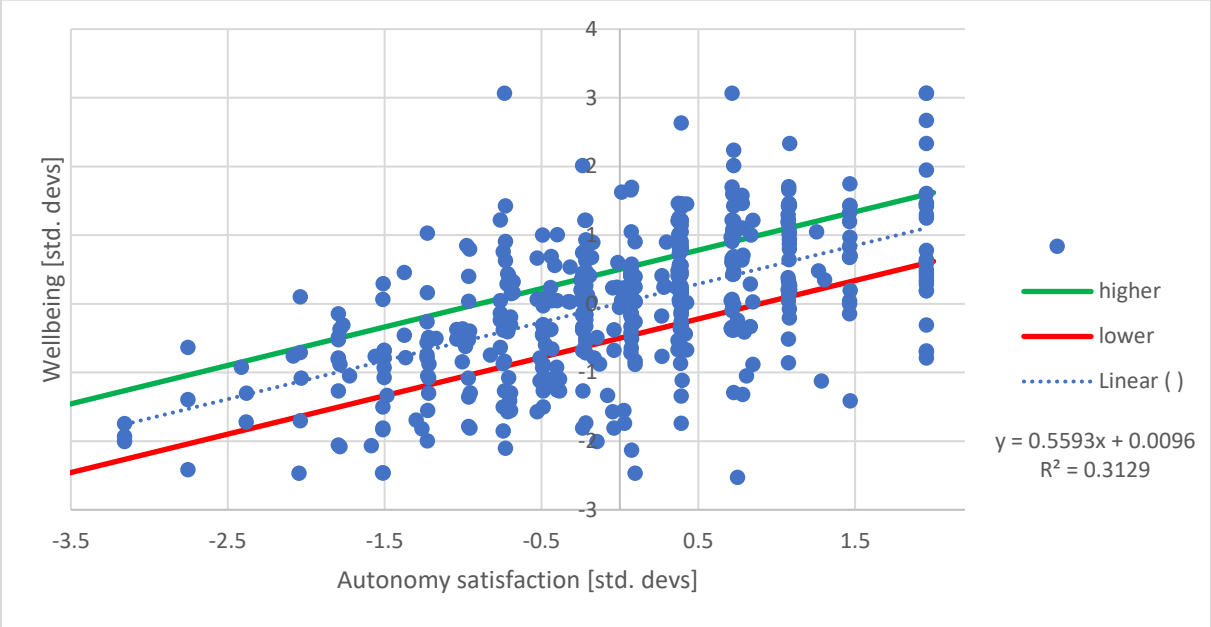

Figure 9: Example of sample split based on autonomy satisfaction

In Table 22 the differences between the groups that are statistically significant at p=0.05 are shown. The results of the corresponding ANCOVAs and the full table of differences are listed in Appendix L. The values are the differences between mean game usage scores for the participants whose wellbeing was higher than expected, compared with those for whom it was lower predicted from the needs listed in the left-most column. Scores are standardised, meaning a difference of 0.30 indicates that the game usage-score of the higher-wellbeing group was 0.30 standard deviations higher than the lower-wellbeing group.

Table 22

Differences of means of game usage scores between participants whose wellbeing was higher and lower than expected based on each need, when controlling for all other needs. Positive values indicate people with higher wellbeing had higher scores in the respective game usage factor. Values displayed are standardised scale locations.

Needs	Positive emotions	Priority	Social
Autonomy frustration	0.61		
Relatedness satisfaction	0.57		
Relatedness frustration	0.56	-0.30	0.26
Competence satisfaction	0.69		

Note. Only values significant at p≤0.05 are displayed.

Subsequent ANCOVAs showed that the differences in means for positive emotions and priority became non-significant in all cases except for competence satisfaction, when wellbeing was entered as additional covariate. This means that the observation, that *positive emotion* scores for players' whose wellbeing was higher than expected based on the needs, was accounted for by the association between *positive emotions* and wellbeing, the latter of which differs between the groups by default. Likewise, the association between wellbeing and priority also accounted for the finding that priority scores were lower for people with higher wellbeing than would be expected based on their needs.

Therefore, the only significant relationships in this analysis were *social*-scores being higher for people whose wellbeing was higher than expected based on their relatedness frustration, and *positive emotion*-scores being higher for people whose wellbeing was higher than would be expected based on their competence satisfaction. This indicates an interaction between the respective three variables each. The nature of these interactions – which variable is the condition, which is the cause and which is the effect – is not known: It could be that (1) for people with a given level of wellbeing, those with higher relatedness frustration tend to play more socially than those with lower relatedness frustration; or that (2) for people with a given level of relatedness frustration those with higher wellbeing tend to play more socially; or that (3) for people with a given level of relatedness frustration those who play more socially tend to have higher wellbeing. The third option, however, would be favoured by

Self-Determination Theory. This interpretation would imply that playing games more socially might help to compensate for the frustration of relatedness needs outside the game.

Likewise, the connection between *positive emotions* in-game and competence satisfaction could imply that positive experiences in games can compensate for low competence satisfaction.

Sample-split through clustering

Synopsis: The purpose of this analysis was to examine if there are subgroups in the sample, described by specific patterns of needs or game usage, for which additional associations between game usage, needs and wellbeing are evident, and if players' needs can be predicted from their game usage. Key findings were that (1) few new associations emerged, but (2) many of the previously identified associations were further supported, (3) some game usage factors appeared to be associated only with a need's satisfaction but not its frustration or vice versa, and (4) average needs satisfaction was associated with a variety of game usages, making predictions difficult.

A second approach taken to splitting the sample, was k-means clustering. K-means clustering is a procedure for elucidating structure in large multivariate data sets. The general approach is to randomly assume the locations of a number, *k*, of cluster-centres, called *means*, and to assign each data point to the nearest mean. Then the centres of all data points belonging to a cluster become the new means. The process is iterated until the centres stop moving. Participants were clustered based on their personality traits, based on their needs and wellbeing, and based on their game usage. For this analysis all 531 participants who completed both questionnaires were included because it was assumed that, if there were significant difference between online and offline players, these would show in the clustering. The criterion for deciding on the number of clusters was that the largest number of clusters was selected for which the smallest distance between two clusters was at least 2 units and the smallest cluster had at least around 50 participants. After establishing the clusters based on personality or on needs and wellbeing, the average game usage scores associated with each cluster were compared. For clusters established based on game usage scores, the pattern of needs and wellbeing scores were predicted and then compared with the observed averages.

Clustering by personality traits resulted in two clusters: one with low negative emotionality and one with high negative emotionality. People with low negative emotionality

experimented less, experienced less negative and more positive emotion while playing, and the game had lower priority. All of these observations are consistent with a link between negative emotionality and wellbeing, and are in line with the other findings of the present study: On average, the lower people's negative emotionality, the higher their wellbeing, and people with higher wellbeing tend to have more positive and fewer negative emotions in-game and games are possibly a lower priority for them. The link with experimenting is a new finding and could imply that people who tend to experience situations more negatively also tend to try more things in games. Or, the effect of negative emotionality might be mediated by low needs satisfaction – all needs satisfactions were strongly correlated with negative emotionality –, which would suggest that people attempt to compensate for a lack of need satisfaction by experimenting more in games.

Two solutions for clustering by needs and wellbeing were considered. The first comprises two clusters, one with overall high needs satisfaction, low frustration and high wellbeing, and the other with low satisfactions, high frustrations and low wellbeing. Significant differences in game usage for these clusters were that people with high needs satisfactions had lower *negative* and higher *positive emotions* in-games scores, and played more seriously. The former is possibly linked to the higher wellbeing, while the latter is a new finding.

The second needs and wellbeing-based solution comprised seven clusters, which are displayed in Table 23. Values presented in the upper part of the table are the means of the cluster centres for each need and wellbeing. Values in the lower part of the table are the means of the game usage factors for the people in each cluster. Only means that differ significantly from the average of the sample at $p \leq 0.05$ are presented. The tables for the corresponding two ANOVAs are presented in Appendix L.

Table 23

Results of clustering based on needs and wellbeing. Displayed are the averages of needs and wellbeing for each cluster in the upper part of the table, and the averages of the game usage factors for each cluster in the lower part. Values are in units of standard deviations.

Needs	1 (n=69)	2 (n=123)	3 (n=40)	4 (n=125)	5 (n=59)	6 (n=46)	7 (n=69)
Autonomy satisfaction	-0.66	0.32		0.85	-1.54	0.54	-0.59
Autonomy frustration	0.85	-0.37	0.82	-0.85	0.9	-0.4	0.37
Relatedness satisfaction		0.68	-0.32	0.71	-1.46	-1.09	-0.29
Relatedness frustration		-0.58	1.35	-0.77	1.65		0.20
Competence satisfaction	-1.16			0.89	-1.35	0.76	
WHO	-0.88	0.28		1.02	-1.28		-0.31
Game Usage							
Experimenting			0.55				
Friends		0.26			-0.36	-0.28	
Negative emotions			0.55	-0.33	0.32		
Positive emotions	-0.26	0.34		0.17	-0.57		
Priority						0.3	
Seriousness			0.35		-0.36	0.44	
Social							
Story							

Note. Only differences significant at p≤0.05 are displayed.

Cluster 1 had low autonomy and competence satisfaction, high autonomy frustration and low wellbeing. Essentially these were people who felt constrained and is if they cannot do the task they are confronted with; possibly they felt depressed. People in this cluster had low *positive emotions* scores in-game. This suggests that people with low satisfactions, high frustrations and low wellbeing tend to also have low *positive emotions scores* in-game, in addition to having them outside of games.

In contrast, Cluster 2 had high autonomy satisfaction and low frustration, high relatedness satisfaction and low frustration, and high wellbeing. These were people who felt in control of their lives and happy with their relationships. Accordingly, they have high *friends* scores and high *positive emotions* scores in-game. This shows an association between high

relatedness satisfaction and low frustration and playing with friends and between high needs satisfactions and wellbeing and high *positive emotions* scores in-game.

Cluster 3 is odd, as people in it had high autonomy and relatedness frustration and low relatedness satisfaction, but normal wellbeing. Possibly, these people felt constrained in life and unhappy with their social situation, but had something that prevented them from experiencing low wellbeing. People in this cluster had high *experimenting* scores, high *negative emotions* scores in-game, and high *seriousness* scores. This might link *experimenting*, *negative emotions* in-game and *seriousness* with high needs frustrations. This cluster is peculiar in that its members have average satisfactions and high frustrations, yet average wellbeing. This might emphasise a difference between needs satisfactions and frustration for predicting wellbeing, and might link the game usage factors of *negative emotions* in-game and *experimenting* specifically to the frustration of needs. It also could be a tentative indication of effective compensation, meaning that the high *experimenting* and seriousness scores might compensate for the high frustrations and thereby maintain average wellbeing. The observations from this cluster also imply that high negative emotions might primarily be linked to needs frustrations rather than to negative wellbeing, which matches its non-significant correlation with wellbeing found the previous analysis.

Cluster 4 had high satisfactions, low frustrations, and high wellbeing. These were people that all around felt they had everything they need. People in this cluster had low *negative emotions* scores in-game and high *positive emotions* scores in-game; the rest of their game usage was average. This supports the hypotheses that high needs satisfactions and wellbeing are linked to low *negative emotions* in-game and high *positive emotions* in-game. It could also support the hypotheses that *positive* and *negative emotions* in-game largely reflect how players feel outside the game. The rest of the game usage of people who feel well all around seems to differ widely and must therefore be determined by some other variables.

Cluster 5 was the opposite of cluster 4, having low satisfactions, high frustrations, and low wellbeing. People in this cluster felt similar to those in Cluster 1, just worse. People in this cluster had low *friends* scores, high *negative emotions* scores in-game, low *positive emotions* scores in-game, and low *seriousness*. This supports links between low satisfactions and high frustrations with high *negative emotions* in-game and low *positive emotions* in-game. It also supports the claim that low *friends* scores are linked to low relatedness satisfaction. The association between high frustrations and low *seriousness* is contradictory to the association

between high frustrations and high *seriousness* hypothesised earlier. A possible solution is to again distinguish between satisfactions and frustrations and hypothesise high *seriousness* to be associated with average to high satisfactions, and low *seriousness* with high frustrations.

Cluster 6 had high autonomy satisfaction and low frustration, low relatedness satisfaction, and high competence satisfaction. This cluster therefore was similar to cluster 4, just with low relatedness satisfaction. People in this cluster had low *friends* scores, high *priority* scores, and high *seriousness* scores. This cluster provides support for the link between low relatedness satisfaction and low *friends* scores. It also is in line with the adjusted hypothesis about high *seriousness* scores being associated with high autonomy and competence needs satisfactions and low frustrations. In addition, this cluster indicates a relationship of high *priority* scores with either high need satisfactions or low relatedness satisfaction. Since the first option contradicts how priority has appeared in the analyses so far, it the second option is deemed more likely. This could indicate that these people attempt to distract themselves from having few good friends. Or, they might have few good friends because the game is too important for them, but then again, their priority is not that much higher than the average.

Cluster 7 had low autonomy and relatedness satisfactions and high frustrations, and low wellbeing; however, except for the low autonomy satisfaction, all of these are close to the average. Essentially these are similar to cluster 5, just not as extreme. People in this cluster had average game usage scores. Two potential observations of this cluster are that low deviations of needs are not necessarily associated with deviations in game usage scores, and that, in the case of normal game usage, needs are associated with wellbeing the same as would be expected without any game usage.

While there were several indications for interactions between game usage factors and needs that had not been observed in the previous analysis, the only interaction with potential link to wellbeing was that between *experimenting* and autonomy or relatedness frustration.

Clustering by game usage resulted in nine clusters which are displayed in Table 24. Values presented in the upper part of the table are the means of the cluster centres for each game usage factor. Values in the lower part of the table are the means of the needs and wellbeing for the people in each cluster. Only means that differ significantly from the average of the sample at $p \leq 0.05$ are presented. The tables for the corresponding two ANOVAs are presented in Appendix L. Because psychological needs satisfaction outside the game was

assumed to not be influenced by game usage, this analysis was used to test if a person's situation outside the game could be inferred from their game usage. The predictions made here were based on the patterns found in the clustering by needs.

Based on the previous analyses, the following associations were hypothesised:

- high experimenting may be linked to high autonomy or relatedness frustrations
- high friends may be linked to high relatedness satisfaction and low frustration
- high negative emotions may be linked to low satisfaction or high frustrations
- high positive emotions may be linked to high satisfactions or high wellbeing
- high priority may be linked to high satisfactions or high relatedness frustration
- high seriousness may be linked to high autonomy and competence satisfactions
- based on the other analysis on interactions, high social may be linked to high relatedness frustration in the context of higher than expected wellbeing

Table 24

Results of clustering based on game usage. Displayed are the averages of the game usage factors for each cluster in the upper part of the table, and the averages of the needs and wellbeing for each cluster in the lower part. Values are in units of standard deviations.

Game Usage	1 (n=75)	2 (n=56)	3 (n=55)	4 (n=67)	5 (n=47)	6 (n=45)	7 (n=60)	8 (n=73)	9 (n=53)
Experimenting			0.64	-0.47	-0.60		0.89	0.56	
Friends	-1.01	0.30	0.66	0.49	0.29	-1.13	-0.46	0.66	
Negative Emotions		1.42	0.67	-0.43		-1.18	0.40	-0.21	-0.72
Positive Emotions	-0.93	-1.15	0.46	0.35		0.75	0.74	0.40	-0.30
Priority	-0.70		1.06	-0.91	0.54		0.24	-0.38	0.95
Seriousness	-0.83		1.17	-0.48	1.29	-0.44	-0.32		-0.37
Social	-0.89	0.25	1.27	-0.61	0.48	-0.79	-0.81	0.82	0.49
Story		-0.60	0.36	-0.91	-0.82	0.90	0.77	0.45	
Needs									
Autonomy satisfaction	-0.30	-0.54		0.30		0.36			
Autonomy frustration	0.28	0.31	0.32	-0.41	-0.37	-0.36			
Relatedness satisfaction	-0.24			0.33					-0.26
Relatedness frustration	0.29	0.42		-0.39		-0.50			
Competence satisfaction		-0.32			0.35	0.31			
Wellbeing	-0.37	-0.35		0.30		0.34			

Note. Only values significant at p≤0.05 are displayed.

Cluster 1 can almost be described as disengaged players, having low scores on all game usage factors except for *negative emotions* scores in-game, *experimenting* and *story*. Based on low *friends* scores low relatedness satisfaction or high frustrations were expected, based on low *positive emotions* scores in-game low wellbeing was expected, based on low *priority* scores high relatedness frustration was expected – high satisfactions were deemed unlikely due to the rest of the pattern –, based on low *seriousness* scores low autonomy and competence satisfactions were expected, and based on low *social* scores – contradicting low *friends* scores – low relatedness frustration was expected. People in this cluster had low satisfactions, high frustrations, and low wellbeing, matching almost all expectations. An exception was the expected association between low *social* scores and low relatedness frustration. However, that association assumes a compensation and therefore higher wellbeing, which was not the case in this cluster. This cluster indicates that people being disengaged in a game might hint at them being in a poor situation in life.

Cluster 2 had high *friends scores*, *negative emotions* scores in-game and *social* scores, and low *positive emotions* scores and *story* scores. These players played to play with friends or other players, but did not really enjoy or care about the game; possibly playing video games was not even their preferred activity. These people were expected, and found, to have overall low satisfactions, high frustrations, and low wellbeing. This cluster again potentially emphasises the difference between satisfactions and frustrations, in that the high *friends* score may reflect average relatedness satisfaction, and the high *social* score may reflect high relatedness frustration.

Cluster 3 was high on all game usage scores. These players were engaged in all aspects of the game. Based on high *experimenting* scores one would expect high autonomy frustration, based on high *friends* scores average to high relatedness satisfaction, based on high *negative emotions* scores in-game high frustrations, based on high *positive emotions* scores in-game high wellbeing, based on high *priority* scores high relatedness frustration, based on high *seriousness* scores average to high satisfactions, and based on high *social* scores high relatedness frustration. It was found that only autonomy frustration was high while the rest was average, matching some of the expectations, but also not being completely in line with others. This implies that average needs scores may be associated with breadth of game usage scores.

Cluster 4 had low scores in all game usage factors, except for *positive emotions* scores in-game and *friends* scores. Similar to cluster 2, these players were not really engaged in the game and possibly mainly play to play with friends. In contrast to cluster 2, however, they have a good time while playing. High *friends* scores were expected to be associated with high relatedness satisfaction and high *positive emotions* scores in-game with high wellbeing. Based on the other scores being low, generally high satisfactions and low frustrations were expected. All the assumptions made based on game usage were confirmed.

Cluster 5 had low *experimenting* scores, high *friends* scores, high *priority* scores, *seriousness* scores and *social* scores, and low *story* scores. These players possibly are similar to cluster 4 in that they play to play with others, but they also care about the game themselves. Based on low *experimenting* scores low autonomy frustration was expected, based on high *friends* scores at least average relatedness satisfaction, based on high *priority* scores high satisfactions or high relatedness frustration were expected, based on high *seriousness* scores high satisfactions were expected, and based on high *social* scores high relatedness frustration. People in this cluster had low autonomy frustration and high competence satisfaction, matching expectations. However, relatedness frustration was expected to be high, which was not the case, and again wellbeing was average. This possibly emphasises that average needs may be associated with a breadth of game usage factors, and that the association between social and relatedness frustration might only be found in the context of higher wellbeing. Finally, based on clusters 4 and 5, low *story* scores might be linked with high autonomy and competence satisfactions and low frustrations.

Cluster 6 appeared strange, because it had low *friends* scores, *negative emotions* scores in-game, *social* scores and *seriousness* scores, but high *positive emotions* scores in-game and *story* scores. Based on the low *negative emotions* scores in-game and high *positive emotions* scores in-game high wellbeing needs satisfactions were expected. No further predictions were made because of the contradicting observations (e.g. very low *friends* scores and *social* scores, high *positive emotions* scores in-game and low *seriousness*). These oddities together with the high *story* score indicated this cluster might contain a large number of offline players, who, based on experience, often are more interested in a game's story and for whom playing together with friends or playing socially does not reflect their needs. People in this cluster had, as expected, overall higher satisfactions and lower frustrations as well as high wellbeing and no peculiarities in their relatedness satisfaction or frustration. A subsequent

check of their general gaming information showed that 57% of the participants in this cluster were offline players, explaining the oddity of friends and social scores.

Clusters 7 and 8 differed from the total average on almost all game usage factors and showed multiple contradictions, such as low *friends* scores and *social* scores or high *friends* scores and *social* scores, or high *negative emotions* scores in-game and *positive emotions* scores in-game. For neither cluster any significant need or wellbeing score was found. This would be expected if the hypothesised opposite associations between game usage and needs cancelled each other. But it, again, possibly indicates that players with average needs scores can differ significantly in game usage, making predictions unreliable.

Cluster 9 had low *negative emotions* scores in-game and *positive emotions* scores in-game, high *priority* scores, low *seriousness* scores, and high *social* scores. These players possibly do not care about actually playing the game, but rather just spend their time online chatting. Low *positive emotions* scores in-game indicate low wellbeing and low satisfactions, low *seriousness* scores also indicate low satisfactions, and high *social* scores indicates high relatedness frustration or low satisfaction, if wellbeing was average-to-high. People in this cluster had low relatedness satisfaction, the other needs and wellbeing were average, matching all expectations.

Summary

The analyses in this subsection have shown some patterns and interactions between game usage, needs and wellbeing that were not seen in the previous regression analyses. That some of these interactions emerged repeatedly strengthens the indication that there might be underlying causal relationships. However, it also became clear that average levels of need satisfaction may be associated with a wide range of game usages, making it very difficult to predict needs from game usage. This was also reflected in the generally weak correlations reported earlier.

Common patterns are associations between high seriousness and high needs satisfactions, between experimenting and story and low autonomy satisfaction, between high friends and average-to-high relatedness satisfaction, and between high positive emotions and high wellbeing. Negative emotions showed no reliable patterns. The associations of priority are not fully understood, mainly because it was only significant when other game usage factors, were, too. Finally, the associations of social game usage indicate an interaction between game usage and needs, but only in the context of higher wellbeing.

Longitudinal data

Synopsis: The purpose of this analysis was to determine if the point-in-time interactions between game usage, wellbeing and needs were supported by longitudinal data. Key findings were that (1) associations between game usage and needs varied substantially between the participants whose wellbeing increased, decreased, or only changed a little, (2) for the participants' whose wellbeing increased social game usage was associated negatively with relatedness satisfaction, (3) for the same participants story involvement was associated with autonomy frustration, (4) for the participants whose wellbeing decreased no associations between game usage and needs were evident, and (5) multiple of the associations described in previous analyses were supported by substantial associations between game usage and needs for the participants whose wellbeing only changed a little.

For this analysis, participants in the longitudinal study were split into three groups: one comprising those whose wellbeing increased by at least 0.30 standard deviations (n=28), one comprising those whose wellbeing decreased by at least 0.30 standard deviations (n=36), and one comprising those whose wellbeing changed by less than 0.30 standard deviations (n=36). A difference of 0.30 standard deviations was used because an average difference of 0.30 to the original group was roughly the limit for significance at $p<0.05$ and led to almost even numbers across the three groups. The purpose of this analysis was to investigate if the longitudinal data supports the interactions already observed, or indicates further interactions between game usage, needs, and wellbeing. Specifically, it is intended to identify correlations between game usage and needs that may be beneficial or detrimental for – or appear to not affect – wellbeing. Although the numbers of participants in these groups were low, the analysis nonetheless identified tendencies and interactions of interest for further research. However, these results, should be treated with caution.

In Table 25, adjusted r^2-values of multiple regressions with the changes of game usage factors as dependent variables and changes of needs as independent variables are displayed together with the predicting variables significant at $p\leq0.05$ for each wellbeing group.

Table 25

Variance in changes of game usage factors between Time 1 and Time 2 accounted for by changes in needs based on multiple regression for participants grouped by whether their wellbeing increased, stayed the same, or decreased

Variable	Δ(wellbeing)>0.3	Δ(wellbeing)≈0
Δ Experimenting		15% (relatedness satisfaction)
Δ Friends		13% (relatedness satisfaction)
Δ Priority		9% (autonomy frustration)
Δ Seriousness		10% (autonomy satisfaction)
Δ Social	19% (- relatedness satisfaction)	30% (autonomy frustration)
Δ Story	9% (autonomy frustration)	

Note. Only shared variances for independent variables significant at p≤0.05 are displayed.

A core assumption for the interpretations of this analysis is that changes in needs are independent variables, while wellbeing and game usage could both be independent or dependent variables. In other words, it is assumed that the satisfaction of needs outside of games cannot be influenced by game usage or wellbeing. On the other hand, game usage could influence wellbeing and wellbeing could influence game usage, and both could be influenced by need satisfaction. That needs outside of games cannot be influenced by game usage follows from the differentiation of needs satisfaction from outside the game and game-related contexts in the questionnaire. Whether players can clearly differentiate these influences is debatable, however. For example, playing games with a friend may be an important part of that relationship and therefore influence relatedness satisfaction outside the game. Wellbeing is assumed to be a consequence of the satisfaction of the basic needs, but – akin to the personality trait of negative emotionality – a person who is more well overall may tend to experience needs as satisfied more readily.

A salient observation is that the significant relationships between game usage and needs tend to differ between wellbeing groups. The strongest example of this were *social* scores. The game usage factor social was found to be negatively associated with relatedness satisfaction, but only for those whose wellbeing increased. That this correlation was absent for the other groups could imply an effective compensation mechanism: If players respond to their relatedness satisfaction decreasing by increasing their social game usage, this may improve their wellbeing. The other explanation would be that, if players' wellbeing increases

while their relatedness satisfaction decreases, they tend to increase their social game usage. As there is no logical reason for the limitation to situations in which relatedness satisfaction decreases in the latter explanation, the former explanation is preferred. This observation in the longitudinal data is in line with the interaction analysis on the cross-sectional data, only that there social was associated with an increase in relatedness frustration. However, for those whose wellbeing stayed the same, social was also correlated positively with autonomy frustration. This could be interpreted as an ineffective attempt at compensating for a reduction in autonomy. Autonomy frustration can be understood, for example, as constraints outside the game, such as having deadlines at work or a strict timetable. Apparently, a significant number of people tend to react to an increase in constraints outside the game with more social interactions in games, but this does not seem to influence their sense of wellbeing, *or* it effectively counteracts the effects of increased needs frustration. Since autonomy frustration was not one of the significant predictor variables in the multiple regression for the change of wellbeing, however, the latter was assumed to be unlikely.

Experimenting was correlated with relatedness satisfaction for those whose wellbeing stayed the same. A possible explanation for this is that better or more social contacts, especially if they also play games, inspire players to be more open and experiment more in games.

Friends was correlated with relatedness satisfaction for those whose wellbeing stayed the same. This matches the cross-sectional data and provides further support for the claim that friends-oriented gaming mainly reflects players' relationships with their contacts from outside the game.

Priority was associated with autonomy frustration for those whose wellbeing stayed the same. This indicates a common tendency that, when players feel more constrained in their real-lives, gaming becomes more important for them, possibly in an attempt to balance out the additional outer restrictions. However, this does not appear to be effective – or detrimental – as this correlation was only observed for those whose wellbeing stayed the same. Another explanation is that gaming does not necessarily become more important, but that due to the increased constraints other activities become more difficult to pursue, while gaming can be adjusted to fit into almost any schedule.

Seriousness was correlated with autonomy satisfaction for those whose wellbeing stayed the same. This indicates that players tend to take games more seriously as they have less constraints, but that doing so is not associated with increased wellbeing. This tendency

could be explained in terms of *mental capacity*, meaning that in order to take games seriously players need to be in a good headspace, while if they feel too constrained they rather play more relaxed.

Finally, story was correlated with autonomy frustration for those whose wellbeing increased. This could imply that people can compensate for an increase in autonomy frustration by being more engaged in a game's story and possibly experience virtual autonomy.

Surprisingly, for the group whose wellbeing decreased, no significant correlations were found. This means that for those players there were no obvious patterns, which could imply that, at least for these participants, there were no common negative interactions between game usage and needs.

Overall, this analysis has reproduced some patterns that had already been identified in the previous analyses, thus providing further support for them reflecting underlying relationships. It also provided some additional support for claiming that the different game usage factors likely interact with the needs and do so differently in different situations. One of the key observations is, that the correlations here are substantially stronger than in the direct multiple regressions conducted for the longitudinal data. Game usage and needs seem to change wildly for players, but when considering their wellbeing, patterns become clearer. This is a further indicator for interactions between the measures: apparently, players' needs do not strongly motivate certain game usages, but different ways of dealing with changes of their needs are associated with different outcomes for their wellbeing. An interesting example are the ways players react to increased autonomy frustration. It seems to be a common tendency that players prioritise the game more, or play more socially, but neither was associated with an increase in wellbeing. However, among those whose wellbeing increased, increased autonomy frustration was associated with increased story. This example also serves to emphasise the importance of distinguishing game usage: just increasing priority in general in response to increased autonomy frustration was not associated with increased wellbeing, but focusing more on story, was.

There is a very important issue, however, with the interpretation of the data of the group whose wellbeing stayed the same, and that is "what if…"? It is not known whether those participants' wellbeing would have changed differently with different game usage. It could, for example, be, that priority is an effective compensation for increased autonomy

frustration and those players' wellbeing would have decreased otherwise, or that seriousness as response to increased autonomy satisfaction is detrimental and those players' wellbeing would have increased otherwise.

Summary

The analysis of longitudinal interactions provided further support for several of the patterns already observed, and additionally offered indications of their role in the context of wellbeing. The only significant association found in all of the interaction analyses was between social and high relatedness frustration or low relatedness satisfaction. Another relationship found in the cross-sectional and longitudinal interaction analyses, with a potential association with wellbeing, was between story and autonomy frustration. Other relationships found consistently, but without link to wellbeing, were relatedness satisfaction and friends, priority and autonomy frustration, seriousness and autonomy satisfaction, and social and autonomy frustration. The association between high competence satisfaction and higher than expected positive emotions, seen in the first interaction analysis, did not emerge again.

7.3.6 Explanations of observations from qualitative data

After participants had completed the questionnaires a second time, they were asked to indicate whether they believed their game usage or wellbeing had changed, and to indicate possible explanations for the changes. The hypotheses developed based on the observations could thus be evaluated based on the information provided by participants.

Change in game usage

Of the 100 participants who completed both questionnaires twice, 72% indicated their game usage had changed. This would be equivalent to considering differences in individual game usage factors of up to one standard deviation as no change, which seems unreasonable as a difference in one standard deviation is very substantial. It, therefore, probably instead implies that moderate changes that only happen in individual game usage factors are not perceived by participants as significant overall changes.

Of the participants who indicated their game usage had changed, 90% indicated this change was influenced by at least one aspect outside the game, mostly (60%) by either a change in their situation at work/school or a change in their general situation in life. These were often specified as having less time due to constraints outside the game. Other common reasons

were health changes (24%) – including worsening or improving mental health issues that impact how they experience the game – and changes in the environment outside the game (24%).

These data provide support for claims of causal relationships between changes in a person's situation outside the game and their game usage and support some of the hypotheses posited to explain observed correlations. Examples of free-texts provided by participants included their mental wellbeing influencing how they experience games, or them consciously seeking positive social interactions in a game to compensate for a lack of social interactions outside the game.

Seventy-four percent of the participants who had indicated their game usage had changed, indicated that this was influenced by in-game aspects. The largest contributors here were a change of games (54%) – often described as a loss of interest in a game – and because they tried something new or different in a game (39%). Less frequent reasons were because they learned something new they had not known before in the game (20%) or because of people related to a game and in-game friends (20%).

These data highlight three main points. First, one of the biggest contributors to a change of game usage – besides changing the game played – was that doing or learning something different can change game usage, emphasising the diversity within games. Second, the social aspects of games seem to be important for understanding changes of game usage, but not as frequent as other reasons. Lastly and most importantly, more people indicated the change of game usage was due to reasons outside the game than due to game-related reasons.

Change in wellbeing

Forty-nine percent of participants indicated their wellbeing changed. This matches the quantitative data if a of up to 0.5 standard deviations is seen as no change, which seems like a rather wide but still reasonable criterion for change.

Ninety-six percent of those who indicated their wellbeing had changed, indicated that aspects outside the game were influential. Most mentioned were changes in their situation at school or work or changes in their general situation in life (70%) – often specified as stress and sometimes as mental health issues. Next common reasons were changes in health or because of their family (35%).

These proportions match the proportions of reasons for changes in game usage well, indicating it is likely that the same factors that led to changes in game usage and wellbeing. This is further supported by some of the participants having explicitly noted the same reason in the free-text boxes at the end of both questionnaires.

Forty-three percent of those who indicated their wellbeing had changed, indicated that aspects of their game usage were influential. Most commonly mentioned as relevant were changes in general game usage or changes in their situations within the game (35%), followed by people related to the game (22%).

Substantially fewer participants indicated that changes in game usage were significant for wellbeing than those that indicated in-game reasons as significant for changes in game usage. This likely implies that not all aspects that influence changes in game usage also influence changes in wellbeing, while changes in wellbeing seem to be associated with changes in game usage. Together these observations confirm that one of the most influential factors through which game usage influences wellbeing is through its social aspects, and that many of the other factors mainly reflect or accompany changes in a person's situation or wellbeing.

7.3.7 Comparing online and offline players, and age groups.

The last part of the analysis was to investigate whether relationships between game usage, needs, personality and wellbeing differed between online and offline players, or between adolescents and older participants.

Comparing online with offline players

Conducting the simple correlations and multiple linear regressions with the full sample – meaning combining the data for online and offline players – showed very similar results overall. This is in part expected because offline players only constituted 19% of the total sample, but the overall observations also are similar for just the offline players. That being said, there are noteworthy differences. The first analysis in this context was to compare the scores of online and offline players for all measures. For comparisons of the game usage scores sample sizes were n=625 and n=145, respectively, and for comparisons involving the personality, needs and wellbeing data sample sizes were n=431 and n=100.

Differences in the means between game usage scores of online and offline players are displayed in Table 26. Online players had higher scores on most game usage factors except

for the *positive emotions* scores in-game and the *story* score, for which their scores were lower. As *social* scores were entirely measured through items relating to online interactions, offline players by default did not have *social* scores. That offline players generally had higher *story* scores was to be expected as many singleplayer games have a greater focus on the story. That offline players have higher *positive emotion* scores is interesting; this might be due to them having more control over their gaming experience as it does not depend on other players. Furthermore, winning or losing in singleplayer games usually depends on oneself, not on how good the enemy is, making it a more consistent experience.

Table 26

ANOVA on the difference of the means of game usage factors for online and offline players

	Experimenting	Friends	Negative emotions	Positive emotions	Priority	Seriousness	Story
Mean online	0.04	**0.23**	0.03	**-0.05**	**0.12**	**0.09**	**-0.08**
Mean offline	-0.15	**-0.97**	-0.14	**0.22**	**-0.53**	**-0.40**	**0.37**
Difference in means	0.19	**1.20**	0.17	**-0.27**	**0.65**	**0.49**	**-0.45**
df	530	**530**	530	**530**	**530**	**530**	**530**
F	2.82	**149**	2.28	**5.88**	**35.2**	**20.0**	**17.1**
Significance	0.09	**0.00**	0.13	**0.02**	**0.00**	**0.00**	**0.00**

Note. Differences significant at p≤0.05 are displayed in **bold**.

Regarding personality traits, online players had lower conscientiousness scores (-0.24) and almost significantly lower agreeableness and negative emotionality scores (-0.19, p=0.08). Players in both groups did not differ significantly in age.

Online and offline players did not differ significantly in any need or wellbeing, the closest to significant was autonomy satisfaction (-0.13, p=0.24).

Regarding simple correlations between the measures – only mentioning differences in r>0.1 – differences were, that friends was correlated with openness (r=-0.2) but not with relatedness satisfaction. Negative emotions was more strongly correlated with negative emotionality (r=0.37 vs r=0.26), and it was correlated negatively with wellbeing and with all needs satisfactions and positively with the frustrations, while for online players it was only correlated with autonomy and relatedness frustration. Priority was not correlated negatively

with extraversion. Seriousness was correlated with conscientiousness and autonomy satisfaction, and negatively with autonomy and relatedness frustration.

This implies that, for offline players, some aspects of game usage related differently to needs, personality and wellbeing than for online players. Unsurprisingly, the connections between friends and relatedness satisfaction and between priority and extraversion, which were evident for online players, were absent for offline players. The stronger associations between the *negative emotions* game usage factor and negative aspects in the situations of players outside the game are interesting; for online players only the respective associations with positive emotions and positive aspects of situations outside the game were observed. A connection between seriousness and needs satisfactions and frustrations was also found. This was not apparent in the simple correlations for online players, but was implied in the interaction-focused analyses. Both of these last two observations suggest a stronger connection between people's experiences in games and their situations outside the game for offline players than for online players.

Multiple linear regression showed that negative emotions could be better predicted for offline players than for online players, with $r^2=0.17$ from agreeableness, negative emotionality and competence, while for online players shared variance was $r^2=0.10$. Most other game usage factors had similarly low shared variances for both offline and online players.

However, relationships with wellbeing revealed a slightly different picture. For online players 10% of variance in wellbeing was associated with a combination of positive emotions, friends, and negative priority. For offline players, 18% of variance in wellbeing was associated with a combination of positive emotions, negative emotions, and seriousness. The factors that were significant for the offline players more reflect how they are feeling than what they are doing in the game. This implies again that how they experience games is more strongly linked to their situations outside the game for offline players than for online players. An intuitive explanation for this is that the experiences in online games depend on more variables than in offline games, most noteworthy being the actions of other players.

Interestingly, though, correlations between personality, needs and wellbeing were higher for offline players than for online players, too. A comparison of the predictions of wellbeing from the different measures for online and offline players is presented in Table 27. In all

cases, wellbeing can be predicted substantially better for offline players than for online players. Including game usage factors in multiple regressions with needs or personality improves the variance explained by 1% with the only significant factor being positive emotions, as was also observed for online players. In the regression that included personality facets and needs, positive emotions became non-significant when autonomy satisfaction and relatedness satisfaction were entered, implying again that the correlation between positive emotions and wellbeing is likely to be largely due to positive emotions in the game reflecting the situations of the players outside of the game. The specific variables included in the final wellbeing regression for offline players were energy level, depression, relatedness satisfaction, and competence or autonomy satisfaction; including either or both led to r^2=0.69.

Table 27

Comparison of variance in wellbeing explained for online and offline players by game usage, personality, and needs

Predicting variables	Online players	Offline players
Game usage	10%	18%
Personality (traits)	44%	49%
Personality (facets)	54%	62%
Needs	45%	52%
Personality (facets) + needs	59%	69%

Why wellbeing can be predicted better for offline than for online players, especially considering that they do not differ significantly in personality traits or facets, is not clear. Possibly, for people who tend to play online games there are additional confounding variables not observed here which weaken the correlation between wellbeing, needs and personality.

There are three core results from this analysis. Online and offline players differ significantly in game usage but only barely in personality and not in needs or wellbeing. The variables significant for predicting game usage and wellbeing are slightly different for offline gamers than for online gamers. The relationship between game usage, needs and personality with wellbeing is stronger for offline players than for online players.

Overall, the relationships are very similar, and when accounting for the other measures, game usage is not a substantial predictor for wellbeing in either group. When only regarding game usage, it predicts a substantial part of wellbeing, 18%, but this seems to be by wellbeing being reflected in the game usage rather than the game usage influencing wellbeing. While priority was negatively correlated with wellbeing for online players, it is not so for offline players, which is an interesting observation of its own. Together, these results indicate that there seem to be differences in the role of game usage factors for online and offline players, indicating they should be considered independently in analyses.

Comparing adolescents with older participants

This analysis investigated for any significant differences between adolescents and older participants. For this purpose, the sample was split into two groups, one with participants 19 years of age or older (n=382), and one with participants 18 years of age or younger (n=149).

In the following, only differences significant at $p \leq 0.05$ are presented. The full results of the corresponding ANOVAs can be found in Appendix L. Adolescents focused more on friends (0.27), almost had higher positive (0.18, p=0.06) and negative (0.19, p=0.06) emotion scores, and played more socially (0.29); they did not differ in the choice of online over offline games. They had lower openness (-0.28) and conscientiousness (-0.25) scores, and more relatedness frustration (0.21).

Wellbeing could overall be predicted slightly better for adolescents than for older participants with $r^2=0.53$ from personality, $r^2=0.52$ from needs, and $r^2=0.62$ from both combined. Including game usage improved the correlation to $r^2=0.63$. An interesting observation was that while personality was equally predictive for adolescents, needs explained 7% more variance for them than for older participants. However, the total variance in wellbeing accounted for by personality and needs was only 4% higher, meaning that personality and wellbeing shared more variance for adolescents.

Predicting game usage from needs and personality did not differ substantially between adolescents and older players, except for priority, which shared 13% variance with negative extraversion and negative openness for adolescents, as opposed to only 8% for older participants, meaning the stereotypical link between playing video games and being introverted is stronger of adolescents.

While some values were different, relationships between games usage, needs and wellbeing did not seem to be substantially different for adolescents and older participants. Confirming this on a more detailed level with the more complex analyses used on the rest of the sample was not possible in the present study because any form of sample splitting would have meant working with numbers too small for results to be reliable. Adolescents could not be considered explicitly in the longitudinal analysis because only 15 of those participating at least twice were under 19 years of age.

7.4 Summary of Study 3

The main aim of this study was to explore and specify relationships between game usage, personality, psychological needs, and wellbeing. Results were split into three parts: predicting game usage, predicting wellbeing, and testing for interactions between the measures in the context of wellbeing. Multiple analyses were conducted on the cross-sectional and the longitudinal data: simple correlations to establish overall statistical relationships, hierarchical regression to determine the shared and unique contributions of the individual factors, and different approaches to analysing interactions between game usage, needs, and wellbeing. This subsection mainly serves as a summary of the diverse findings of the present study. A more in-depth discussion of the results and their meanings is presented in the discussion of the overall project in section 8.2.

The first main result was that game usage factors were weakly associated with needs, personality, and wellbeing. Particularly, personality factors were not significant predictors in most cases, their contribution often being mediated by needs. An exception to this was the *negative emotions* in-game factor, which was mainly associated with negative emotionality. Besides *negative emotions* in-game, the only other substantial association was between *positive emotions* in-game and wellbeing and needs satisfaction.

The second main result was that wellbeing was only weakly associated with game usage – mainly through the positive emotions factor – while it was substantially associated with both needs and personality. Moreover, in multiple regression analyses needs and personality accounted for the contribution of game usage – more specifically of the positive emotions factor – meaning game usage did not substantially predict wellbeing in that model.

The third main result was that indicators for interactions between needs and game usage in the context of wellbeing were found. In these more specific analyses, several associations

were uncovered consistently, some of which had not been found in the analyses of the overall sample. Most noteworthy was the relationship between social and low relatedness satisfaction or high relatedness frustration. This association was not seen in the overall sample, but emerged for both, people whose wellbeing was higher than expected based on their relatedness frustration and for those whose wellbeing increased from time one to time two. Two other associations found consistently throughout this analysis were between friends and relatedness satisfaction and between positive emotions and wellbeing or high needs satisfactions. These, however, did not seem to interact with wellbeing, but rather to reflect participants' needs satisfaction or wellbeing. Similarly, associations between priority and autonomy frustration and between seriousness and autonomy satisfaction were found, but only for those whose wellbeing stayed the same. This indicates that it may be a common tendency for people to react to increased autonomy frustration with increased priority or that people with higher autonomy satisfaction feel more like taking games seriously, but both players whose wellbeing improved or decreased reacted differently in those situations. For example, for players' whose wellbeing increased, increased autonomy frustration was associated with increased story instead of priority. Negative emotions and experimenting did not reliably show any interactions.

As further results, the comparison of age groups showed that game usage overall has similar associations for adolescents and older players, though adolescents appear to have a stronger focus on playing socially and with friends. A comparison of online and offline players, on the other hand, showed some significant differences, especially regarding the strength of the association between negative emotions and needs as well as wellbeing, the factors associated with high wellbeing, and the roles of priority and seriousness. For offline players priority was not linked to their needs or wellbeing while seriousness was, while for online players both were reversed. No obvious links to specific genres have been found in the present study, and the overall relationships identified, appear to be independent of genre. However, some games will naturally lend themselves to certain game usages, which in turn is relevant for the interactions between needs and game usage.

An important limitation of the last stage of the present project was a lack of participants in the longitudinal part of the study. While over 500 people had completed both questionnaires initially, only 100 completed both a second time. There are several issues which may have contributed to that, including participants forgetting their de-identifiers and not contacting the researcher, and the instruments being split over two short questionnaires instead of one

longer one – requiring participants to open a second link after finishing the first questionnaire. This low number for second participation makes the results less robust and prohibited the use of the more detailed analyses and sample-splits. Furthermore, with over 100 games being mentioned as main game and having rather few participants per game, it was not possible to reliably compare participants of different games. Finally, the verification of the instruments revealed that – as discussed in more detail in section 7.3.1.3 – the structure of the Basic Psychological Need Satisfaction and Frustration scale used in the present study is contestable.

8 General Discussion and Conclusion

The present project consisted of three studies to address two broad aims. The first was to develop a framework for game usage that describes and distinguishes different ways in which games are used. The second was to investigate relationships between game usage and wellbeing, and any influence of personality and the satisfaction of basic psychological needs on these relationships.

8.1 Studies 1 and 2 – The Game Usage Framework

The first aim of the project – developing a game usage framework and questionnaire – was focus of studies 1 and 2. A preliminary framework was developed based on interviews with users of video games. This was adjusted based on a medium-scale quantitative pilot study, and then again based on responses of a large sample. The final eight factors are displayed in Table 28 and discussed afterwards.

Table 28

Final set of game usage factors identified in the project

Experimenting	Positive emotions	Social
Friends	Priority	Story
Negative emotions	Seriousness	

For many players, *experimenting* seems to be an integral part of gaming. It describes actions that are aimed at trying and testing things in games. It is assumed that this factor may also include exploration for the sake of exploring – as opposed to exploring because a game requires it. Experimenting is considered in some form in all popular models that describe aspects of game usage. In the GMM (Gamer Motivation Model) by Yee and Ducheneaut (2016) it is a theme within the *creativity*-motivation, in the PENS (Rigby & Ryan, 2007) it is addressed through the *autonomy* factor, and in the GEQ (Johnson, Gardner, & Perry, 2018) it is represented through a diffuse factor that comprises *story, exploration, and engagement*.

Friends describes playing to do something together with contacts from outside the game and having a clear focus on a shared experience while playing – as opposed, to, for example, technically playing on the same team, but not actually caring about what and how they are doing. This factor is not explicitly mentioned in any of the other frameworks. It is partly

addressed through the *relatedness* factor in the PENS and possibly addressed through the *social* factor in the GMM, but in both cases only indirectly through questions about social interactions, that do not differentiate the kind of interaction or who this interaction is with. The present study, though, suggests that players do differentiate between playing with *others* and playing with *friends* in a way that affects their game experience.

Negative emotions in-game describes players getting angry or feeling stressed in a game. This factor possibly also comprises a variety of other negative feelings not included in the current questionnaire. The differentiation of negative emotions from other factors, such as *seriousness*, and statements from the interviews, imply a semi-active component of players letting a game affect them negatively, while others in similar situations may not experience negative emotions. This factor emerged as *negativity* in the GEQ, but is not directly addressed in the other models. If it is related to the frustration of competence, autonomy or relatedness, it is, however, indirectly covered through those factors in the PENS. Especially in the context of the modern video game culture, where many forums of online games are flooded with angry or upset posts, this factor may have a higher relevance than it is afforded by the extant models.

Positive emotions in-game describes experiencing feelings such as having fun or feeling content, but also whether having fun is a conscious intention while gaming – as opposed to seeing it as a consequence of winning, for example. As with *negative emotions* in-game, an active component of playing to have fun and experiencing a game positively is implied, independent of what is happening in that game. Similar to negative emotions, this factor is not represented in other models, apart from the GEQ in which it is labelled *positive feelings*. The GMM focuses on motivations for gaming, which explains why negative emotions are not considered, but that experiencing positive emotions is hardly addressed in the GMM is surprising – closest is the *excitement* theme within the *action* motivation. This possibly reflects the approach to developing the framework, in which fun is seen more as a consequence than a motivation, the same view that guided the development of the PENS. However, based on the present study, having fun and experiencing positive emotions may be a variable of and motivation for gaming rather than just one of its possible outcomes.

Priority describes the frequency and duration of play, as well as how important gaming is to players. Its meaning therefore goes beyond temporal engagement, which is the only variable considered in many studies on the effect of gaming (Blake & Klimmt, 2012). Neither aspect

of priority is considered by any of the common models, though it is addressed as *intensity* in the less popular but very informative model developed by Kallio, Mäyrä, and Kaipainen (2011). Participants in the interviews viewed this generally as one of the most important factors for distinguishing the ways in which people use games.

Seriousness describes various aspects that relate to how seriously a player takes a game, such as whether they care about winning – or making progress –, try hard to do so, and think about their gaming in order to improve. It is important to recognise that seriousness and priority seem to be separate factors: just that playing a game is important to a player does not mean they are serious about winning, and that someone tries hard to win when they play does not mean they play a lot. Aspects of this factor are addressed in the *mastery* and *achievement* motivations of the GMM, in which they consider practicing, difficulty, thinking ahead, completion, and being powerful. However, reflecting the intention of the model, these themes describe specific aspects players may look for in a game. The GMM does not consider the more general characteristics of players, which are probably associated with those aspects and independent of specific games. It is likely that a serious player will engage in challenges in a game and will play to practice – aspects addressed by the motivations for playing that game in the GMM – but this player will also take non-challenging situations and games seriously and may therefore turn a "non-challenging" game into a hardcore experience, as seen for example in speed-run communities that focus on finding the fastest ways to complete games – an aspect not considered in the GMM.

Social describes interacting with players who are not friends and playing specifically to interact with others. This factor is separate from the previously discussed *Friends*-factor. It is addressed by the GMM, and, indirectly, also by the PENS. This factor played a major role in the relationships between game usage and wellbeing and is therefore discussed further in relation to study 3.

Story describes the extent to which players are engaged in a game's story – online, by experiencing it, as well as offline, by thinking about it. Though it is an integral part in the design-process of many games, players differ significantly in how much, or even whether, they engage with it – from skipping it and only noticing what they can't avoid, to reading up more on the background of in-game events after playing. This factor was considered in all extant models, either directly as *story* or indirectly through aspects of *immersion*.

Overall, the present study has identified all factors used in extant operationalisations of game usage, but it is more comprehensive, organises these aspects differently based on data from users, and has identified some additional, potentially relevant, aspects. It is important to point out that all of these frameworks have significant similarities, despite having been developed at different times, using different approaches and with different aims in mind. The PENS focuses on need satisfaction as more suitable variable to explain players' experiences than fun; the GMM focuses on different motivations that may contribute to players preferring certain games; and the GEQ focuses on players' experiences in games. The new Game Usage Framework (GUF) focuses on players' game-related behaviour and experiences to explain the influence of games. Even the oldest categorisation, the aspects of Bartle's Taxonomy (Bartle, 1996), can be identified in the new framework: his socialisers are represented in friends and social, his explorers in experimenting and story, and his achievers in seriousness. His killers are partly seen in seriousness, but an explicit player-vs-player-focussed factor was not salient in the analyses leading to the GUF. In summary, the structure of the GUF and the extant models support each other – despite having been developed independently – in that most of the new game usage factors appear – to some degree – in at least one of the other models. That these independent studies with different foci and approaches found similar factors, strengthens their claim that the found factors represent an underlying common structure. However, the new framework provides a basis for potentially relevant differentiations within these factors that the other models do not consider. Moreover, it has a strong structure connecting these different factors. The GUF, therefore, though developed as an independent model, unifies most of the aspects of the common extant models into a single, more comprehensive, framework, as called for in the conclusions of many papers (e.g., Denisova, Nordin, & Cairns, 2016; Hamari & Keronen, 2017).

The GUF has two key characteristics that further support its use in this field of study. First, it was based and developed on an entirely empirical basis, rather than relying on the preconceptions of the researcher. This provides a strong groundwork for further, empirically informed, adjustments, to ensure that the framework represents factors that are *relevant* to gamers and for research on the effects of games. Second, it appears to be game- and game-type independent – at least in respect to online games – in that all factors identified describe characteristics of the players, not the games themselves. Furthermore, the factors are potentially relevant to almost any game, and even if a factor does not apply in a given game,

this implies that its players likely have a low score in that factor because they choose to play a game where that factor is unimportant. With some adjustments to the social factor it may even be valid for use with singleplayer games.

Together, this makes this framework a promising new tool to distinguish and describe how players use games and to understand their different experiences. Using this framework may help to enhance the comparability and robustness of research findings, and to better understand games and players.

There are two uncertainties remaining regarding this framework. First, there are indicators that the positive and negative emotion factors might represent an underlying general emotions factor. But indications for combining both factors were tied to the specific items in the questionnaire, and the subsequent analysis in study 3 revealed that these factors have different relationships with the other constructs. The data available therefore suggest that these factors, in fact, reflect separate constructs. The other uncertainty concerns the potential for an additional player-vs-player focused factor, which would better represent Bartle's (1996) fourth type. Such a factor would have been supported by the interviews and tentatively also by the quantitative tests in study 2. However, because this factor only had few, and unclear, associated items, it was not clear that it is stable enough to be included in the framework. Nonetheless, the factor structure adopted for the framework in this study needs to be confirmed or modified following further research.

A specific focus of future studies should thus be on the questionnaire. The current version is not suitable to determine a social game usage score for offline players. Furthermore, some of the items associated with other factors are not well suited to measure the associated constructs, largely because the items were developed for an earlier version of the framework. Revision of the questionnaire based on the new structure, with special focus on the factors that currently only load two items, would be a priority. In this process, relabelling the positive and negative emotions factors to better reflect their active aspects could be considered, as well as probing for a player-vs-player focused factor.

8.2 Study 3 – Relationships between Game Usage and Wellbeing

The second broad aim of the project – investigating the relationship between game usage and wellbeing while considering personality and needs – was addressed in study 3, which was a longitudinal study in which participants repeatedly completed instruments measuring

game usage, wellbeing, needs, and personality. There was a variety of findings, which fall into four categories: the prediction of game usage, the prediction of wellbeing, interactions between needs and game usage in the context of wellbeing, and differences between players of online and offline games.

While there are some significant correlations, game usage was only weakly associated with personality, needs, and wellbeing. This is in line with the results of Braun *et al.* (2016), who found significant but weak correlations between personality and aspects of game usage. These weak correlations suggest that there are possibly a multitude of other variables that influence game usage, from social to financial to the knowledge and general interests of players. Even so, it is noteworthy, that in many cases the association between needs and game usage were more substantial than those between personality and game usage, and that in some cases – for example between friends and extraversion, needs mediated the association between personality and game usage. This implies that needs, as a proxy for players' situations outside of games, are more influential on their game usage than personality as a proxy for internal characteristics. An exception to this is the *negative emotions* in-game factor, which was predicted equally by needs and personality, mainly through the negative emotionality factor. The only game usage factor that could consistently be predicted more substantially was positive emotions, which was mainly associated with wellbeing and autonomy satisfaction. The various relationships and mediating effects between game usage and wellbeing throughout the analysis suggest that positive emotions in the game do not influence players' wellbeing, but more likely reflect it. Similarly, negative emotions seem to reflect need frustrations and players' tendencies to experience situations negatively. In this regard, friends seem to reflect players' relatedness satisfaction – which makes sense because playing with friends implies that one has friends to play with. Less clear but sometimes hypothesised (e.g., Bargeron & Hormes, 2017), priority seems to be negatively associated with players' wellbeing – or, more specifically, positively with their autonomy frustration. This means that it appears to be a common tendency for players to react to an increase in constraints outside of games by playing more, or at least, for gaming to become more important. Another possible explanation is that gaming only becomes more important in relative terms because the increase in constraints outside the game prevents player from engaging in other activities. However, this relationship was only found inconsistently, implying that it may depend on specific circumstances. Overall, the low correlations are an important result, because they indicate, that – against expectations –

needs, personality, and wellbeing do not – at least not directly – predict game usage. This is in line with observations that some players do not adjust their game usage despite it possibly affecting them negatively and raises questions as to what the more influential factors are.

Regarding the prediction of wellbeing there were two key results in regression analysis with wellbeing as dependent variable. First, wellbeing was highly associated with needs and personality. Combining these revealed considerable shared variance, but also substantial individual contributions. This effect, and the magnitude of the association, is in line with several other studies (Anglim & Grant, 2014; Harris *et al.*, 2017; Joshanloo, Rastegar, & Bakhshi, 2012; Marrero, Rey, & Hernandez-Cabrera, 2016). Second and more relevant for the present project, even when all game usage factors were combined, hardly any association with wellbeing was evident, with the most substantial contributor being *positive emotions* in-game. Moreover, the association between positive emotions and wellbeing was completely accounted for by needs and wellbeing. This is a strong indicator that the usage of video games does not contribute substantially to broader wellbeing, and that the small associations of game usage with wellbeing that have been reported in fact are attributable to the situations of players outside the games. This is a major new contribution to this field of research, as the nature of the interactions between wellbeing and game usage in some studies was highly contestable due to a lack of indicators (e.g., Lemmens, Valkenburg, & Peter, 2011; Lobel *et al.*, 2017). While the present study provides strong indicators, these are not sufficient to formally establish any causal relationships; for this an experimental study would be required. However, the finding that there were no substantial relationships between game usage and wellbeing is relativised in the following paragraph.

Splitting the sample using different approaches and testing for interactions between game usage and need satisfaction in the context of wellbeing revealed further relationships. Possibly the most important and consistently-found interactions were the positive association of social game usage with relatedness frustration and the negative association with relatedness satisfaction, which were only observed in the context of higher-than-expected or increasing wellbeing. This suggests that the social experiences players make online can effectively – meaning with influence on psychological wellbeing – compensate for low relatedness satisfaction or high frustration in their real lives. That this relationship was not found for the overall sample implies that the wellbeing of players with high relatedness satisfaction does not profit from playing socially, possibly because they already experience sufficient relatedness satisfaction. This observation is further evidence

contributing to the understanding of the effects of game usage, and matches the findings of Kowert and Oldmeadow (2015). Two other associations that hinted at effective compensation, although not consistently, were between *story* and autonomy frustration and between experimenting and autonomy frustration. These associations imply that engaging more with a game's story, or experimenting more in it, might compensate for a lack of perceived autonomy outside of games. Possibly the sense of being immersed in a game and experiencing virtual freedom can carry over into other aspects of life and thereby – in line with SDT (Ryan & Deci, 2017) – improve wellbeing.

The association between autonomy frustration and *story* is also interesting in differentiation to the association between autonomy frustration and *priority*: the former relationship was found to be associated with wellbeing, while the latter was not. This implies simply playing the game more when constraints outside the game increase was not relevant for wellbeing, but being more engaged in the story, was. It therefore highlights that for the effects of games it is more important how players use games, than how much they do so.

Regarding interactions, it was found that seriousness may be positively associated with autonomy and competence satisfaction, meaning that players with higher satisfactions tend to play more seriously. An explanation for this was indicated by some of the participants in the interviews; when they felt better about themselves and they had more energy to focus on games, while when they felt exhausted they tended to be less engaged in the game. A final interaction to be discussed is the association between autonomy frustration and *social* game usage. It appears as if players tend to engage in more in-game social interactions when they experience higher autonomy frustration. One possible explanation for this is that, due to increased constraints, players have less time to engage in social interactions with other people outside of games and therefore feel more like interactions with others in-game. Another possible explanation is that – in line with many observations from virtual environments – people use game spaces to share and discuss frustration with like-minded people. Most of those cases, however, were not associated with changes in wellbeing. A caveat about the previous interpretations is that it is not known how players would have been had they played differently, or not at all. It could be that some of the interactions of game usage described here, in fact encompass effective processes for improving or maintaining wellbeing and that players' wellbeing would have been lower without them.

Regarding different age groups, the present study found that adolescents played games more socially and were more friend focussed and emotionally influenced than older players. As social interactions with peers are of crucial importance for wellbeing, especially in adolescence, this could explain the results of Kowert *et al.* (2015) showing a link between wellbeing and game usage was only present for adolescents, and the results of Dolatabadi *et al.* (2013) that adolescents who played video games tended to have higher wellbeing than non-players. But besides these descriptive differences, the relationships between game usage and wellbeing seemed to be the same for adolescents and older players. It has to be noted, however, that the present study only had a relatively small number of participants under the age of 19 years (n=149) and these results therefore have to be regarded cautiously. Regarding a comparison of online and offline players, differences in the relationship between game usage and wellbeing have been found. Key differences were that, for online players the significant variables for predicting wellbeing were *positive emotions* in-game, *friends*, and *priority*, whereas for offline players they were *positive emotions* in-game, *negative emotions* in-game, and *seriousness*. The correlations for offline players were also generally stronger. This implies that, overall, the relationship between players' situations outside of games and their in-game experiences are stronger for offline players than for online players, possibly because they are more in control of their gaming experience because it is not inevitably influenced by other players. An implication of these differences is that online and offline players should be considered separately in future research.

In summary, significant interactions were found between game usage and players' basic psychological needs in the context of wellbeing, considering which led to more and stronger correlations than were found in direct correlations. Overall correlations with other measures – such as wellbeing, needs and personality – were weak. They were found to range from r=0.1 to r=0.4 in most cases, which is roughly the same magnitude found in other studies using other instruments (e.g., Kardefelt-Winther, 2014; Lee & Leeson, 2015; Vella, Johnson, & Hides, 2015). Possibly, these correlations – which have been replicated across multiple independent studies with different instruments – are not due to inadequate instruments or sampling issues, but accurately reflect the relationships between game usage and wellbeing: significant, but overall minor, and strongly tied into players' situations outside the game.

The Game Usage & Wellbeing Theory developed in section 3.6 was partly supported. The main hypotheses based on that theory were that psychological needs and personality would predict players' game usage, that a match or mis-match between game usage and needs

would have a substantial influence on wellbeing, and that personality moderates the relationships between game usage, needs, and wellbeing. Against the theory, game usage was not associated substantially with needs or personality. However, both psychological needs and personality were substantially associated with wellbeing, overlapping considerably. Personality dimensions overall did not make a significant contribution to modelling game usage, except for the prediction of *negative emotions* in-game through the negative emotionality factor. Generally, only weak but bidirectional links between game usage and wellbeing were evident, while, in line with the theory, in specific combinations that implied a compensation for players' situations outside of games, game usage and needs were linked to greater increases and decreases in wellbeing. These interactions are depicted in *Figure 10*.

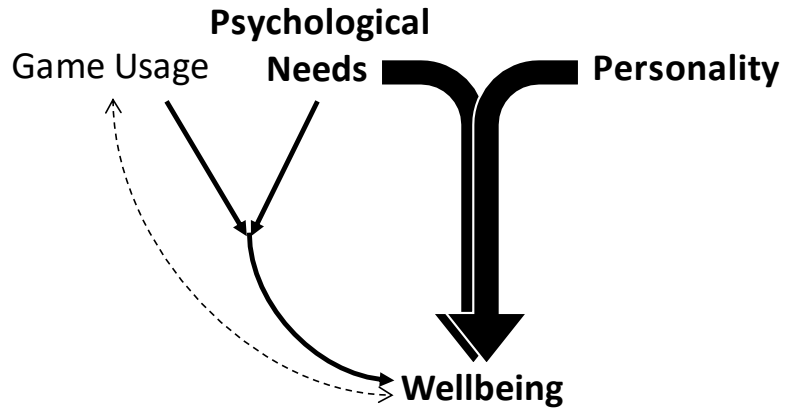

Figure 10: Schematic depiction of the interactions found in the present study. The width of the arrows indicates the strength of the relationships.

A substantive limitation of the present study – besides it not being experimental – is the low number of participants in the longitudinal part of the study. This not only makes the overall results less robust, but also prevented the use of some more detailed analyses at Time 2. Nonetheless, the main results of the study were based on multiple different analyses and were confirmed in the longitudinal data, as well as by the interviews in study 1, providing some support for the results and interpretations. A tentative argument could be made that, with the rather small sample sizes for some of the analyses in study 3 and accordingly large standard errors, a 95% alpha criterion may be too conservative: when including some of the barely non-significant differences (e.g. at p=0.1), several of the interactions now only found in some of the analyses are observed more frequently. The present study is explorative in nature and prefers type-I mistakes – rejecting the null-hypothesis when it is true – over type-II mistakes – accepting the null-hypothesis when it is false. In other words, in this

exploratory study – which by its nature aims to contribute specific suggestions for future research – it is assumed to be better to report potentially non-significant observations for further investigation, than to not report potentially significant observations, which therefore will not be studied further. However, the more adequate solution to this issue is attaining larger samples and thereby increasing the statistical power of the analyses.

The present results and interpretations have two implications for our general understanding of the usage of video games and its effects. The first is based on game usage not being substantially predicted by needs or wellbeing and on the direct correlations between game usage and wellbeing being weak, yet there being substantial correlations in the interaction analyses. This implies that personality, needs and wellbeing do not strongly motivate specific game usages. Another explanation for the weak correlations – especially over time – is that players may react differently to given circumstances. When, for example, constraints outside the game increase, some will play less to have more time for other activities, others may play more in an attempt to compensate for the feeling of having less autonomy, and others again may not change. This last explanation would also explain why, in the analyses using sample-splits, more and stronger relationships were found. Moreover, it appears as if although needs do not strongly motivate certain game usages, specific *combinations* of needs and game usage are supportive of wellbeing. This supports an argument that it is important to consider players' situations outside of games when evaluating their interactions with, and influences of, games (e.g., Kallio, Mäyrä, & Kaipainen, 2011; Ryan & Deci, 2017). Gaming inevitably is part of a wider context, and this context can influence the meaning of gaming for players (Oswald, Prorock, & Murphy, 2014). This is of particular importance for understanding the effect of games on wellbeing, and for using games to foster wellbeing. Based on this finding, it cannot be assumed that players will automatically adopt beneficial game usage, even when presented with a game designed to support them. Instead, they have to be aware of their own situation first – something, that for many people only happens afterwards – and then have to be made aware of a beneficial way in which to use games.

A second implication stems from aspects of game usage apparently reflecting aspects of players' "real-lives" and builds on the first implication. Playing with a focus on friends reflects satisfaction with relationships outside the game and, possibly, is just a virtual extension of these. Positive emotions in-game reflect players' wellbeing and negative emotions in-game reflect a tendency to experience situations negatively, as they would in

other areas of life. Seriousness probably reflects players' mental capacity, and priority and experimenting may reflect players' autonomy frustration, which is also observed in other areas of life (Ryan & Deci, 2017). Furthermore, virtual social interactions, for example, can contribute to wellbeing by providing social contact, and experiencing virtual manifestation of choice may compensate for restrictions outside the game. If players' "real-lives" and "virtual-lives" are connected this strongly and if the mental effects of virtual interactions are similar to interactions outside the game, it is questionable whether the differentiation into real-life and virtual-life makes sense from an empirical standpoint. Rather, it seems that gaming is simply another *normal* part of players' lives, except that restrictions of physical distance don't apply, because – unlike soccer, rugby, or a table-top games – players can play together from anywhere on the globe. This apparent lack of difference between real-life and virtual-life should not automatically be understood in terms of blurred lines between physical and in-game actions, however. It does not mean that because players go haywire in an action game they will also do so in their physical environment; this is an issue on which the present research is silent. That the observed effects seem to be independent of games in the present study, though, suggests that *specific* activities in games do not matter much – which may be different for players with psychological disorders. This implication instead means that the mental satisfaction – or frustration – players experience from these actions likely is similar to what they would experience from similar physical actions. But, in games, players can engage in activities that they may not be able to in their physical settings and can do so without the fear of physical or legal consequences. The level of similarity between the mental effects of actions in games and of actions in physical settings would be an interesting focus for a future experimental study, especially considering the quickly improving virtual reality systems.

Lastly, many studies to date that have aimed to connect game usage and wellbeing have focused on the social aspects of gaming (e.g., Kowert & Oldmeadow, 2015; Lobel *et al.*, 2017). In light of the present study that approach is supported. However, it is also suggested that there may be further promising aspects that should be evaluated, such as story and, potentially, also experimenting and seriousness. Priority, on the other hand, has been, again, found to not be as relevant.

Being aware of and consciously using the relationships observed in this research may help users of games play in more wellbeing-wise beneficial ways, or at least to understand their gaming better. It may also support the development of games for people with high

frustrations of specific needs and may similarly help to prevent unintended side-effects of game-based interventions or educational games.

8.3 Conclusions

The overarching intention of the present thesis was to contribute to our understanding of how playing games relates to the wellbeing of users. For this purpose, an exploratory sequential project with two aims was designed. The first was to develop a framework for describing and distinguishing game usage of participants. This was approached through three studies, the first using in-depth interviews, the second being a medium-scale quantitative pilot, and the third being a larger-scale longitudinal survey. The second aim was to investigate the relationship between the game usage and wellbeing of video game users. It was approached in the third, survey-based, study, through the addition of instruments measuring personality, basic psychological need satisfaction, and eudaimonic wellbeing.

An empirically based framework comprising eight aspects of game usage – *experimenting, friends, negative emotions, positive emotions, priority, seriousness, social,* and *story* – was developed. This framework is an important contribution; it is a comprehensive model, unifying and expanding on the aspects of the most common extant models. It may help researchers in the wider field of game studies to interpret and compare their results more meaningfully, which may lead to a better understanding of games, gaming, and its influences on gamers. Furthermore, its strong empirical base makes it a robust starting point for further research and adjustments to ensure it represents all relevant aspects of game usage.

Using the newly developed framework, the investigation of relationships between game usage and wellbeing showed that game usage cannot strongly be predicted from psychological needs, personality or wellbeing. Furthermore, the weak associations between game usage and wellbeing can be attributed to players' personalities and needs satisfaction. Finally, there are several substantial interactions between game usage and needs in the context of wellbeing. The most important interaction is that players engaging in social interactions in games appears to be able to compensate for the experience of frustration of relatedness in their lives, increasing wellbeing. The results partly support the developed Game Usage & Wellbeing theory which provides a framework for investigating and explaining the effects gaming has on wellbeing.

The main limitation of the present project is the number of participants, especially in the further timepoints of the longitudinal stage. Additionally, the game usage framework used in the longitudinal study needs to be confirmed with more diverse samples. Specific suggestions are to re-evaluate the differentiation between the positive and negative emotions factors, to probe for a player-vs-player oriented factor, and to develop new, more focussed items, for all factors. The specific interactions implied in the present study should be tested in other more focussed studies. A suggestion for further studies is to get game publishers involved for a large-scale representative verification. This was not attempted in the present study because of potential skews of the questionnaire and to avoid potential conflicts of interest, but now that the questionnaire has been developed and pre-tested it could be a useful option.

Despite the limitations of the studies involved in the present project, there is one clear key message: When evaluating the effects of game usage, consideration has to be given to how players use games and to the context in which they are using them. Different combinations of these factors have been connected with different wellbeing outcomes reported by players. One of the main contributions of the present study is that it provides indications that specify the nature of relationships between game usage, needs, and wellbeing, some of which have been hypothesised by other researchers without the data to support their claims. However, clearing up whether the found associations in fact represent direct causal relationships, which would be one of the most important contributions to this field, will require experimental studies.

It seems as if gaming is a normal part of players' lives, and that needs do not strongly motivate specific game usages. Even so, certain combinations of need satisfaction and game usage are associated with greater wellbeing. For game users, as well as other people concerned with gaming, being aware of these interactions may help them make more informed decisions to the benefit of their wellbeing.

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Appendices

Appendix A: Overview of all methods and how they were deployed

Mixed Methods Approach: The mixed methods approach used in the present study followed an exploratory sequential design. First interviews were conducted. The aim of these was to explore in what ways players use games and to summarise these in a set of game-independent categories. Within these categories, sub-themes were developed that specified different aspects of each category and reflected the respective codes more directly. Each sub-theme was then framed with as few quotes as comprehensively as possible. These were the basis for the questionnaire constructed afterwards. This questionnaire was used to further explore the categories identified in the interviews, to see how common each is, and especially to statistically investigate the structure of these sub-themes. This in the end led to a new interpretation of some of the sub-themes and resulted in the game usage framework used in the final analysis, which investigated the relationships between game usage, personality, needs, and wellbeing.

Semi-structured, in-depth Interviews: *Semi-structured* means that the interviewer had a general guide he followed, but that the order of items on that guide was not fixed and that is was more about covering the topics of each point the guide, rather than asking specific questions. *In-depth* means that the interview went beyond asking for descriptions and rather aimed to understand participants' viewpoints by asking follow-up questions and encouraging them to present their experiences and opinions in detail. Together, this combination allowed to get insights into participants' thinking and find out what they believe is important, while also allowing for some comparability across interviews by making sure all topics from the interview guide were covered. The interview guide is presented in Appendix B. However, being the nature of semi-structured interviews, giving a step-by-step guide is not possible because the development of each interview depends on the participant's responses.

Thematic analysis: The analysis method for the interviews was thematic analysis, following the six steps suggested by Braun and Clarke (2006). For this analysis an in-depth step-by-step guide is presented in the main body of the thesis in section 5.2.5, because – as is the case with most qualitative methods – knowing the specifics of the analysis-process is crucial for understanding and evaluating the results.

General statistics: The first step of each quantitative analysis was to analyse the distributions of all responses to each item. For this, the percentage of participants who had chosen each response category was regarded for each item to get a feeling for the participants and the items. In some cases, this statistic was compared across items on a descriptive level, for example the percentages of participants playing only one clear main game and the percentage who considered their responses to be representative of their gaming in general.

Exploratory factor analysis: Exploratory factor analysis was used to investigate potential structures underlying participants' response patterns in the questionnaires. It was conducted using the software "SPSS". For each analysis, both principal component analysis and principal axis factoring with varimax and oblimin rotation were used and the results compared. The general procedure was to conduct an analysis on the full item-set and to then compare the solutions for the different numbers of extracted factors indicated by the scree-plot, both on a qualitative-interpretative level as well as on a statistical level. Factor loadings<0.3 were suppressed. In each analysis items were removed one-by-one, starting with the items that showed no substantial loadings on any factor in multiple of the analyses extracting different factor numbers. Afterwards, another reason items were removed was if they had substantial loadings on multiple factors. After each item was removed, the analysis was repeated. This process was conducted for each analysis-approach separately. This process was stopped when each item had a substantial loading on one factor. Solutions within each approach but with different numbers of factors were compared based on their interpretability, before the remaining "best" solutions were compared across approaches. This process additionally considered the results of confirmatory factor analysis of each solution.

Confirmatory factor analysis: The aim of the confirmatory factor analyses was to compare the different possible solutions statistically. These were conducted using the "lavaan"- package in the software "R". The competing models suggested by the exploratory factor analyses were specified independently with the responses for all items involved in each model imported into the software, and several goodness-of-fit measures were considered, including χ^2, RMSEA, GFI and NFI.

Item Response Theory – Graded response model: This technique was used to calibrate more accurate scale locations for all variables and therefore more accurate estimates of participants' scores for each factor. For this analysis the package *ltm* for R was used. The responses for all items associated with a factor were imported in a single file – with one column per item – and the *grm*-function with the option *constrained* was run. Next, the IRT scale locations were read out with the function *factor.scores.grm* and applied to the data with the option *resp.patterns = imported_data* (imported_data being replaced by the name of the respective data frame). Finally, these scores were written into a new table, the column titled z1 containing the IRT scores.

Standardising variables: Participants' scores in all measures used in the final analyses in section 7 were standardised by subtracting each measure's mean from each participant's value and dividing the resulting values by the standard deviation for that measure.

Simple linear regression: To conduct simple linear regressions, the "regression" function in the software SPSS was used. In each case, the variable mentioned first in the respective text in the thesis was entered into the model as independent variable with the other variable being entered as dependent variable – since the outcome of interest is the correlation coefficient, r, the order of variables in the model does not matter. The outcomes considered were the standardised slope coefficient, β, and, more importantly, the significance, p, and the correlation coefficient.

Hierarchical regression: These analyses also used the regression function of SPSS. The key difference is that all variables that by theory were assumed to potentially be related to the respective "dependent" variables were included as independent variables and added one-by-one in individual steps. The analysis was then repeated with the independent variables being rotated each time. Only those variables that provided statistically significant contributions when added last were kept and the change in the adjusted r^2-value when a variable was added last was the unique contribution of that variable.

Standardised-Interaction-analysis: This analysis also uses multiple linear regression. It includes the two variables which are assumed might interact and an additional variable which is calculated as the product of the two standardised variables being analysed. If this *interaction-term* is significant in the multiple regression and explains additional variance (=contributes a substantial change in the adjusted r^2) a direct interaction between the two initial variables can be concluded.

AN(C)OVA: ANOVAs and ANCOVAs were conducted using the "Univariate" "General linear model function" of SPSS – either with or without specifying covariates. ANOVAs were used to test if samples differed on a set of measures, while ANCOVAs were used to test if accounting for differences in one variable accounted for the differences observed in the variable of interest. In both cases the variable of interest, for example the social gaming scores, was entered as "dependent variable" and the "fixed factor" was a dummy variable splitting the sample into the groups being compared, for example the participants whose wellbeing was higher and lower than expected. The main value of interest in this analysis is the significance together with the difference of the means of the groups.

k-means clustering: This was used as an approach to splitting the sample into smaller groups that could then be compared on the different measures with ANOVAS. It was conducted using the respective function for classifying groups in SPSS. All measures to be considered at once were added as variables at the same time. The cluster analysis was repeated with different numbers of clusters; as solution the largest number of clusters was selected for which the smallest distance between two clusters was at least 2 units and the smallest cluster had at least around 50 participants. Besides providing the cluster-centres for each cluster (the average score for each measure within each cluster), this analysis also assigned each participant to one of the clusters, allowing for subsequent comparisons of the participants in the clusters on the measures not included in the clustering process.

t-test: To compare the means of two samples, for example a game usage score at Time 1 and Time 2, t-tests were used. These were conducted using the respective function among the "compare means" options of SPSS. For these analyses the measure of interest was entered as "Test variable" and a different variable was used to split the larger sample into the two groups. Depending on the specific use, either an independent samples t-test was used (e.g. to compare online and offline players) or a paired t-test (e.g. to compare the values of the sample at Time 1 or Time 2). The main value of interest in this analysis is the significance together with the difference of the means of the groups.

Appendix B: Interview guide

Interview guideline

Prompts for part 1:

Why and when did you start playing this game?

Do you always play the same way?

Do you have a main character/race/account?

What do you enjoy most in this game?

Do you come up with your own challenges?

Do you rather play alone/with RL-friends/with in-game friends/with family?

Do you play with fix groups (if at all), or do you change groups regularly?

How do you go about planning gaming sessions?

Describe one of your most memorable experiences in this game.

Describe a "typical" gaming session.

Is how you play influenced by your RL? If yes, please explain.

Does that/how you play the game influence your RL? If yes, please explain.

What different activities do you do in this game?

What game related activities do you do outside the game itself?

How important would you say community aspects of the games are? And why?

Do you use the forums and other online-content frequently? If yes, how and why?

Do you think a lot about the game (while not playing)? What do you think about?

Have you created game-related content? What was it?

Please brainstorm: Name different aspects that would in your eyes be required to describe how you use the game.

Prompts for part 2:

How is how you use this game related to how you use other games? Do you see patterns (in your own or others' stories)?

E.g., do you use this game differently or the same way as other games? Do you choose this game for specific purposes/in specific situations and other games in other cases?

Appendix C: Study advertisements

Advertisement in fora for participation in interviews

LFM: Discussions about how we use games for research project

Hi everyone!

I am looking for participants for group discussions about how we as players use multiplayer online computer games (like [using either game of current forum or list of games appropriate to individual forum; WoW, DIII, SCII, LoL, DotA2, HotS, GW, CS: GO, GW2] and others). Anyone who regularly plays a Multiplayer-Online-Game, is over 16 years of age (consent to participate in research reasons),and can speak English fluently is welcome to participate.

Currently, in the media as well as in research, games are portrayed in non-representative one-dimensional ways as if all games are the same, all players are the same, and all players play a game the same way. With your help I would like to — on a game-by-game basis — find out how individual games are *actually* being played (or, more generally, how they are *used*. For example: reading or writing a guide isn't actually part of *playing* the game, but it is still connected to it).

If you are interested and want to find out more, please read on! Otherwise, thank you for reading this far. If you know anyone who might be interested, feel free to forward this along to them :-)

More about me and this project:

My name is Florian Flueggen and this project is the first part of a larger study I am doing for my PhD at Victoria University of Wellington, New Zealand. I have played and talked about computer games (all kinds, currently mainly SCII, WoW, and LoL) for the past 20 years, which is where a lot of my interest in games stems from.

If you decided to participate, you would be taking part in a focus group (essentially a group-discussion) with 3-5 other participants to discuss how you play/use [name of game]. These discussions will be conducted using the video conferencing system *zoom* and are expected to take between 45 and 60 minutes. (The upside of using zoom instead of Skype is that you don't need to tell me your username — you can simply join the conversation by following a link that I send you.) I am planning to conduct all discussions in February or early March, and I will try to arrange dates and times to (hopefully!) suit everyone.

If you would like to participate or want more information, please fill in the short form at this link (http://vuw.qualtrics.com/jfe/form/SV_8llbzOIH25Ys4KN) and I will answer your questions and/or send you the official participant information sheet. (I can't provide my e-mail address as contact here because of the Forum Guidelines/Code of Conduct.)

Thank you for reading!

Kind regards [or game-specific end of document],

Florian

This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025257].

Advertisement in paper form and on generic fora for interviews

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

Do you play multiplayer online games, would like to talk about how you play these games, and contribute to research in a new and developing field at the same time?

I (Florian Flueggen, studying at Victoria University of Wellington) am currently conducting a study on how players play multiplayer online games. I am looking for participants of any game in that category over the age of 16 who would like to take part in interviews or group discussions on this topic.

If you would like to contribute, but do not want to take part in a conversation or simply want to stay anonymous, please see the bottom of this information form for a link to a free-text survey instead.

The focus of the discussion would be how you use a game of your choice (e.g. what you prefer to do in that game, who you usually interact with, if you watch streams, write guides, etc.; but the main question will be what ***you*** think is important to describe how you play the game). This discussion would be held via skype or zoom and is expected to take 30 minutes for an interview, or 45-60 minutes for a group discussion where the other participants could be people you know (e.g. some friends or guild mates you asked to sign up, too) or random other participants, this is up to you. Participation is strictly confidential.

Your help will contribute to the understanding of how games are *actually* used, which is an important aspect for understanding the various effects games can have.

If you would like more information or want to participate, please fill in the short form (~5 minutes) at http://vuw.qualtrics.com/jfe/form/SV_8llbzOIH25Ys4KN.

As thank you, you will receive a NZD15 voucher (or nearest local equivalent, e.g. $10 US or 10 Euro) for amazon or steam, depending on your preference.

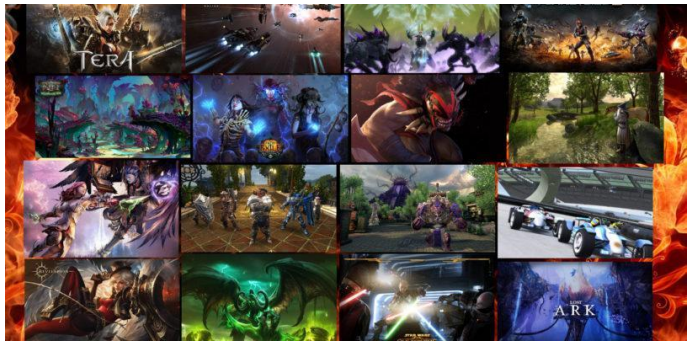
Thank you, and kind regards,

Florian Flueggen

Florian.flueggen@vuw.ac.nz

P.s.: As mentioned above, I understand that not everyone who would like to share their opinion wants to take part in an interview, for various reasons. If you feel this way, I would like to invite you to describe how you use games in this online form (http://vuw.qualtrics.com/jfe/form/SV_9FgiLFd7ov27zr7) instead. You can be as detailed or succinct as you would like to, and your participation is anonymous.

Advertisement in paper form and on fora for quantitative pilot study (various different images were used for advertisements in different places; on fora no images were used)



Piloting a Questionnaire on Game Usage – Lfm participants

Throm-ka, Stay awhile and listen, Entaro Adun, Tala Moana, or simply Hi,

I am conducting a study to find out how multiplayer online games are *actually* being used, as opposed to how people – the public and researchers, but also developers and players – *think* they are being used. **All players of all games** with a multiplayer online focus (whether you use it that way or not) are invited to participate.
If you could spare about 15-20 minutes, **please complete the questionnaire online** ☺
Participation is anonymous.

For more information on the project, please visit my website (**game-usage.weebly.com**).

You can access the questionnaire at http://vuw.qualtrics.com/jfe/form/SV_cIpUXQmg1wNfc6V or by using the QR-code at the bottom of the page.
Your help will be greatly appreciated! ☺
Thank you and kind regards, Florian

Florian Flueggen, PhD student in Education at Victoria University of Wellington
Florian.flueggen@vuw.ac.nz

This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025257].

Advertisement in paper form for longitudinal study

Gamers wanted!

I am looking for gamers of all videogames, from super casual to professional level, to complete two online questionnaires on the topics of game usage and wellbeing. They take about 10 minutes each.

What's in it for you?

- Be in to win one of 20 vouchers worth NZ$50 each (about US$35)
- Learn how you use games compared to other gamers and what your personality traits are (from a psychological perspective)
- Last but not least (I hope ☺), you are contributing to an academic study aimed at finding out how games affect us as players

Interested? Go to **https://game-usage.weebly.com** for more information and to complete the questionnaires.

Thanks a lot, and game on!

Florian Flueggen

PhD student at Victoria University of Wellington, NZ

This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025324].

Advertisement in fora and social networks for longitudinal study

Thom-Ka, Tala Moana, Entaro Adun, Stay awhile and listen, Hey, and many other greetings,

Videogames have, as we will all have noticed, a rather bad reputation and are often claimed to be bad for users' wellbeing; often, though, this is based on studies with limited reliability or claimed by people that don't (or can't) distinguish Counter Strike and Pac-Man.

Against this backdrop I am using my PhD at Victoria University of Wellington, NZ, to investigate correlations between the game usage of players and their wellbeing, while considering their personalities.

To do this I need your support and am looking for gamers (all games – from super casual to professional –, but at least 12 years old), **who would be ready to sacrifice 2x about 10 minutes to participate in this study and complete two questionnaires online** (they are written in basic English).

As thank you participants who completed both questionnaires can enter a draw for 20 vouchers worth NZ$ 50 (about US$ 35) each.

You can find the questionnaires on the study's website (in the „Surveys"-tab):

https://game-usage.weebly.com

Thank you, and game on!

Florian

Appendix D: Information and consent forms

Information sheet for participating in interviews

Project Title

The Impacts of playing Online Multiplayer Games on the Wellbeing of Adolescent Users

INFORMATION SHEET FOR PARTICIPANTS

Thank you for your interest in this project. Please read this information before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to take part, thank you for considering my request.

Who am I?

My name is Florian Flueggen and I am a Doctoral student in *Education* at Victoria University of Wellington, New Zealand. This research project is work towards my dissertation.

What is the aim of the project?

The project is aimed at identifying relationships between how players use computer games, the different influences this has on their wellbeing, and how this influence is influenced by their personality.

My motivation for this research stems in big parts from my own engagement with various computer games over the last 20 years, the observations that my friends and I all had our own ways of playing, and the feeling that playing games seems to mean something else for each of us. Yet in research on how computer games affect players, *how they play* is usually not considered. This approach has been challenged in more recent works and is a topic of high relevance for understanding the diverse influences playing computer games may have; and therefore also for potential uses of games besides entertainment, like supporting wellbeing.

For the first part of my study – the one I am inviting you to participate in right now - the focus is on investigating the different ways players use games.
This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. *0000025257*].

How can you help?

If you agree to take part you will be part of a focus group, conducted online via zoom (a software similar to skype, but easier to manage in this context, as you will not have to provide any further contact details; joining the conversation will only require you to enter personalised conversation-ID provided later). I will ask you and other participants questions about how you use games (e.g. how you behave in a game, what you prefer to do, who you usually interact with, but also game-related activities outside of the game itself, such as writing or reading on forums, planning the next time you play, or talking about a game with others in your real-life). The focus group-interview will take approximately 30-60 minutes. I will audio and/or video record the focus group with your permission and write it up later. As gratuity for participating you will receive a digital voucher worth NZD15 (or nearest local equivalent) for amazon, steam, or by agreement.

The information shared during the focus group is confidential. That means after the focus group, you may not communicate to anyone, including family members and close friends, any details about the focus group.

You can withdraw from the focus group at any time before the focus group begins.

You can also withdraw while the focus group is in progress. However, it will not be possible to withdraw the information you have provided up to that point as it will be part of a discussion with other participants.

What will happen to the information you give?

This research is confidential. This means that the researchers named below (my supervisors and me) will be aware of your preferred name, but the research data will be combined and your identity will not be revealed in any reports, presentations, or public documentation.

Only my supervisors and I will read the notes and transcripts of the focus group. The focus group transcripts, summaries and any recordings will be stored securely and will be destroyed after the dissertation has been accepted, presumably the latest by the end of 2020.
E-mail addresses can also be collected for those who wish to request a copy of the final report or who would like to join a database of participants for the further stages of this project. Joining the database does not imply an obligation for further participation. All personal details will be received separately from the focus group data to ensure that they cannot be linked.
The e-mail addresses will be confidential, meaning only my supervisors and I will have access to the e-mail address data-base. They will be stored securely and the data-base will be deleted after completion of the study, but the latest by 31.12.2019.

What will the project produce?

The information from this phase of my research will be used to create a framework for understanding and describing a player's computer game usage in the above-mentioned sense. It will be applied during the next phase of my research and will be reported in my PhD dissertation and potentially in academic publications and conferences.

If you accept this invitation, what are your rights as a research participant?

You do not have to accept this invitation if you don't want to. If you do decide to participate, you have the right to:

- choose not to answer any question;
- ask for the recorder to be turned off at any time during the focus group;
- withdraw from the focus group while it is taking part, however it will not be possible to withdraw the information you have provided up to that point;
- ask any questions about the study at any time;
- read over and comment on a written summary of the focus group;
- be able to read any reports of this research by emailing the researcher to request a copy.

If you participate in a focus group, please follow these general rules:

- The information shared in the meeting is confidential. You should not discuss the opinions and comments made by other focus group participants with anybody outside this room. I would like you and others to feel comfortable when sharing information.
- You do not need to agree with others, but you should listen respectfully as others share their views.
- I would like to hear a wide range of opinions: please speak up on whether you agree or disagree.
- There are no right or wrong answers, every person's experiences and opinions are important.
- The meeting is recorded, therefore, please one person speak at a time.
- Please make sure you have enough time and are not interrupted, please turn off your phones.

If you have any questions, concerns, or problems, who can you contact?
If you have any questions, either now or in the future, please feel free to contact me:

Student: **Supervisor:**

Name: Florian Flueggen

University email address:

Florian.flueggen@vuw.ac.nz

Name: Michael Johnston

Role: Primary Supervisor

School: Education

Phone:+64-4-463 9675

Michael.johnston@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University Human Ethics Committee Convenor: Associate Professor Susan Corbett. Email susan.corbett@vuw.ac.nz or telephone +64-4-463 5480.

Consent form for participating in interviews

Project Title

The Impacts of playing Online Multiplayer Games on the Wellbeing of Adolescent Users

CONSENT TO PARTICIPATE IN FOCUS GROUP

This consent form will be held for 3 years.

Researcher: Florian Flueggen, School of Education, Victoria University of Wellington.

- I have read the Information Sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.
- I agree to take part in an audio or audio and video recorded focus group.
- I have read and will follow the rules outlined in the participant information.
- I am over 18 years of age.

I understand that:

- I acknowledge that I am agreeing to keep the information shared during the focus group confidential. I am aware that after the focus group, I must not communicate to anyone, including family members and close friends, any details about the focus group.
- I can withdraw from the focus group while it is in progress; however, it will not be possible to withdraw the information I have provided up to that point as it will be part of a discussion with other participants.
- The identifiable information I have provided will be destroyed by 31.12.2019.
- Any information I provide will be kept confidential to the researcher and the supervisors.
- I understand that the results will be used for a PhD dissertation and academic publications and/or presented to conferences.
- My name will not be used in reports, nor will any information that would identify me.
- I would like a summary of the focus group

  Yes ☐
- I would like to receive a copy of the final report

  Yes ☐

I understand that by checking the "I consent"-box and by providing my e-mail address below I consent to all of the above.

Preferred name: _____

E-mail address: _____

Information sheet for participating in quantitative pilot

Project Title
The Impacts of playing Online Multiplayer Games on the Wellbeing of Adolescent Users

INFORMATION SHEET FOR PARTICIPANTS

Thank you for your interest in this project. Please read this information before deciding whether or not to take part. Please only take the survey if you are 12 years of age or older. If you are under the age of 16 years please ask your parent or caregiver to go through this information page with you. If you decide to participate, thank you. If you decide not to take part, thank you for considering my request.

Who am I?
My name is Florian Flueggen and I am a doctoral student in education at Victoria University of Wellington, New Zealand. This research project is work towards my dissertation, non-commercial and not affiliated with any company.
My main motivations for conducting this study are my own ongoing engagement with various games – I started playing video games when I was around 6 years old – and contributing to the understanding of the diverse effects playing games can have.
In the long run I hope this knowledge leads to users having a better understanding of why they are doing what they are doing, and to the development of games that are more effective at what they are supposed to be doing, be it for entertainment or other purposes.

What is the aim of the project?
The aim of the current part of the project is testing a questionnaire to identify the different ways players use games. For this I need as large a number and variety of participants as possible. Your responses will be used to analyse and modify the questionnaire to determine and describe players' computer game usage. It will be applied during the next phase of my research and will be reported in my PhD dissertation and potentially in academic publications and conferences.
This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025257].

How can you help?
If you agree to take part you can click the right arrow at the bottom of this page to go to an online survey which will take about 15 minutes to complete. It will ask you questions about how you use games (e.g. how you behave in a game, but also about game-related activities outside of the game itself), as well as about standard demographic variables, such as age and first language. At the end you will have the chance to give feedback on the questionnaire itself.

What will happen to the information you give?
This research is anonymous. This means that nobody, including the researcher will be aware of your identity. By answering it, you are giving consent for me to use your responses in this research. Your answers will remain completely anonymous and unidentifiable. Once you submit the survey, it will be impossible to retract your answer. Please do not include any personal identifiable information in your responses.
You can read any reports from this research by e-mailing me to request a copy.

If you have any questions or problems, who can you contact?
If you have any questions, either now or in the future, please feel free to contact me:

Student:
Name: Florian Flueggen
University email address:
Florian.flueggen@vuw.ac.nz

Supervisor:
Name: Michael Johnston
Role: Primary Supervisor
School: Education
Phone: +64-4-463 9675
Michael.johnston@vuw.ac.nz

Human Ethics Committee information
If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.

Information sheet for participating in longitudinal study (first time)

INFORMATION SHEET FOR PARTICIPANTS:
The Impacts of playing Online Multiplayer Games on the Wellbeing of Users
This information sheet is just a brief summary. The full form can be found on the study's website https://game-usage.weebly.com under the "surveys" tab.
First of all, thank you for your interest in this project. Please only take the survey if you are **12 years of age or older**, and if you are under the age of 16 years, please ask your parent or caregiver to go through this information page with you. Participation is anonymous.

The basic study - 2 separate questionnaires
This survey consists of two questionnaires which will take about **10 minutes each** to complete.
- One on **personality, wellbeing**, and demographics
- One on **game usage**

At the end of this questionnaire you will get a random number called **de-identifier**. Please use this when completing the other questionnaire.

Longitudinal - participate up to 3 times
The project runs until September 2019. You can (but do not have to) **participate once every three months**.
Next time you would only complete the wellbeing and game usage questionnaires.
If you want to participate again, please **use the same de-identifier you get now**.

Vouchers - you can enter a draw for NZ$50
There will be **three draws**, one at the middle of February, one in May, and one in September. You can enter each one **if you have completed a full set of questionnaires** since the last draw. If it was your second or third participation your chance to win a voucher is doubled or tripled, respectively.

Each draw will have **20 vouchers worth NZ$50 (or closest local equivalent, roughly US$35)** each. The voucher would be, by your choice, for **amazon or in-game currency** (e.g. riot points, steam money).

(Standard) Additional information about this research
Participation now or in the future is completely voluntary.
This research is anonymous. However, you can enter a database to be sent reminders of when you can participate again. That database is separate from your de-identifier, so they cannot be linked. You can also enter your e-mail address at the end of this questionnaire, though, to enable me to send you your de-identifier in case you lose it; this would obviously enable me to link your responses and your e-mail address, but I will not do that.
The research is non-commercial and not affiliated with any other institute or company other than my university.
By participating you consent to me using your responses for my research (but for no other purposes).
The results will be published in my thesis and potentially also in journals and at conferences.
You can read any reports from this research by e-mailing me to request a copy.
You can find more information about the project and me on the study's website: https://game-usage.weebly.com

About issues or questions
If you have any questions, either now or in the future, please feel free to contact me:

Student:
Name: Florian Flueggen
University email address:
Florian.flueggen@vuw.ac.nz

Supervisor:
Name: Michael Johnston
Role: Primary Supervisor
School: Education
Phone: +64-4-463 9675
Michael.johnston@vuw.ac.nz

Human Ethics Committee information
This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025324].

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.

Information sheet for participating in longitudinal study (repeated)

INFORMATION SHEET FOR PARTICIPANTS:
The Impacts of playing Online Multiplayer Games on the Wellbeing of Users
Repeated

First of all, thanks a lot for participating again!
Here is just some information. As last time, this information sheet is just a brief summary. The full form can be found on the study's website https://game-usage.weebly.com under the "surveys" tab.

Participating again - What is different?
It are still two questionnaires, but
- The questionnaire on **wellbeing** is considerably shorter (you do not need to complete the personality or demographics parts again).
- At the end of the questionnaires you will get a short one-page **"follow up"** questionnaire. It consists of a set of yes/no questions asking about reasons for why you believe your game usage or wellbeing might have changed (if it did).

Keep in mind, participate multiple times
The project runs until September 2019. You can (but do not have to) **participate once every three months**.

Vouchers - you can enter a draw for NZ$50
There will be **two more draws**, one at the end of May, and one at the beginning of September. You can enter each one **if you have completed a full set of questionnaires** since the last draw. If it was your second or third participation your chance to win a voucher is doubled or tripled, respectively.

Each draw will have **20 vouchers worth NZ$50 (or closest local equivalent, roughly US$35)** each. The voucher would be, by your choice, for **amazon or in-game currency** (e.g. riot points, steam money).

(Standard) Additional information about this research
Participation now or in the future is completely voluntary.
This research is anonymous. However, you can enter a database to be sent reminders of when you can participate again. That database is separate from your de-identifier, so they cannot be linked. You can also enter your e-mail address at the end of this questionnaire, though, to enable me to send you your de-identifier in case you lose it; this would obviously enable me to link your responses and your e-mail address, but I will not do that.
The research is non-commercial and not affiliated with any other institute or company other than my university.
By participating you consent to me using your responses for my research (but for no other purposes).
The results will be published in my thesis and potentially also in journals and at conferences.
You can read any reports from this research by e-mailing me to request a copy.
You can find more information about the project and me on the study's website: https://game-usage.weebly.com

About issues or questions
If you have any questions, either now or in the future, please feel free to contact me:

Student:
Name: Florian Flueggen
University email address: Florian.flueggen@vuw.ac.nz
Role: Primary Supervisor
School: Education

Supervisor:
Name: Michael Johnston
Phone: +64-4-463 9675
Michael.johnston@vuw.ac.nz

Human Ethics Committee information
This research has been approved by the Victoria University of Wellington Human Ethics Committee [application no. 0000025324].

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.

Appendix E: Written response form

The choice of the specific prompts included in the written response form were influenced by own experiences, previously conducted interviews in this study, and existing publications (Bean & Groth-Marnat, 2014; Blake & Klimmt, 2012; Bostan, 2010; Colwell, 2007; Kallio, Mäyrä, & Kaipainen, 2011; Martončik, 2015; Yee & Ducheneaut, 2016). The key prompt, however, is the brainstorming.

Written response prompts replacing interviews

Thank you very much for taking the time to fill in this form and thereby helping me find out how games are used by players. Please consider in-game behaviour (e.g. what you mainly do in a game, whether you rather play alone or with friends, etc.) as well as game-related out-of-game behaviour (e.g. if you watch streams, talk about the game with friends, etc.).

Most importantly, though, I would like to encourage you to write what aspects you believe you would have to tell someone for them to understand how you play the game; to make clear how your playing differs from someone else's.
You can write this freely in the second box, or you can follow the prompts/suggestions on the form. You do not have to write something for every prompt (the prompts are just suggestions for what you could think/write about), but please participate in the brainstorm.
You can be as succinct or as detailed as you would like for all questions/prompts.

Please choose a specific game you have in mind while writing your response, or mention for individual statements which game they relate to.

Which game(s) do you mainly play?

Please brainstorm: What are different aspects that would in your eyes be required to describe how you use the game? (Imagine you want someone else to understand how you play/use the game. What would that person need to know about? If you would like to, feel free to use this box for your full response to the overall question of how you use games, or write what comes to your mind for each prompt.)

What activities do you mainly do in the game?

Do you always play the game the same way?

Do you have a main character/race/game-mode?

What do you enjoy most about this game?

Do you rather play alone/with RL-friends/with in-game friends/with family?

Do you play with fix groups (if at all), or do you change groups regularly?

When you play in a group, please describe your general behaviour. (e.g. What usually is your role in the group? Do you interact with others? Does how you interact with group members depend on your mood?)

How do you go about planning gaming sessions? Do you plan them at all?

Please describe a "typical" gaming session. (is there such thing as a typical gaming session for you?)

Is how you play influenced by your RL? Does that/how you play the game influence your RL?

What game related activities do you do outside the game itself (e.g. streaming, reading guides, talking about games with friends)?

Are game-community aspects of the games important to you?

Do you think a lot about the game? What do you think about? (e.g. story, in-game events, strategies, why you play, etc.)

What are the differences between how you and how others you know play?

Would you say your usage of games has changed over time? If yes, please explain what has changed, when, and if possible also why.

More generally, how is how you use this game related to how you use other games? Do you see patterns (in your own or others' behaviour)?
(E.g., do you use this game differently or the same way as other games? Do you choose this game for specific purposes/in specific situations and other games in other cases?)

If there is anything else you would like to say on the wider topic of how you or others use games, please feel free to do that here.

If you would like to enter the e-mail database for future stages of the study, please send an e-mail to the primary researcher at florian.flueggen@vuw.ac.nz.

Appendix F: Codes and themes developed during thematic analysis

List of codes by interview

Written_response_2

- Communication
- Community
- Complexity
- Content
- Forums
- Fun
- Guild
- Hardcore
- Involvement
- Negative feelings
- Personal choice
- Playing with others
- Playstyle
- Pressure
- Skill
- Strategy
- Time
- Training

Written_response_3

- Community
- Doing one's best
- For fun
- Game related activities
- In game activities
- In life priorities
- Involvement
- Main class
- Personal choice
- Playing with others
- Playstyle
- Purpose
- Relaxation
- Social contacts in game
- Story
- To feel good
- Using information resources
- Variety

Written_response_1

- Change
- Communication
- Community
- Content
- Guild
- Helping others
- Involvement
- Modify game
- Negative feelings
- Other
- Other things (non-game)
- Own Goals
- Planning playing
- Playing with others
- Playstyle
- Priorities in life
- RL Support
- Role in group
- Skill
- Social
- Strategy
- Time
- Non-entertainment reasons
- Variety

MMORPG 4

- Activities involving friends
- Advancing
- Being someone else
- Challenge
- Clan
- Communication
- Community
- Duration and time of play
- For fun
- Freedom to express oneself
- Friends
- Game related activities outside game
- Game specifics
- Game variety
- Helping others
- Mastering challenges with friends
- Negative feelings
- Other things (non-game)
- Playing with others
- Playstyle
- Relaxation
- Skill
- Solo
- Story
- Strategy
- Taking breaks
- Team
- Using information resources

MMORPG 1

- Accessing information on game
- Advancing
- Community
- Content
- Distraction
- Doing nothing as positive
- Forums
- Friends
- Game related out of game activities
- General interest in games
- Guild
- Helping others
- Interacting with community
- Involvement
- Negative feelings
- Own Goals
- Peace Quiet
- Place and Time to process
- Playing as choice
- Playing with others
- Playstyle
- Purpose Motivation
- Refuelling
- Relax
- RL Money
- RL support
- Self-determined Freedom
- Seriousness
- Story
- Time
- Variety

FPS 1

- Accessing information
- Choice of games
- Communication
- Community
- Competition
- Content
- Development
- Distraction
- Entertainment
- Focus while playing
- Forums
- Friends
- Game as part of RL
- Game related activities
- Immersion
- In game behaviour
- Involvement
- Negative feelings
- Playing with others
- Playstyle
- Purpose
- Relaxation
- RL Money
- Self-determination/Freedom Choice
- Social
- Story
- Time
- Variety

MOBA 4

- Accessing information
- Ambition

Breaks from the game
Collecting Completeness
Communication
Competitiveness
Content
Effectiveness
Effort Involvement
Feeling special
Friends
Fun
Game related activities
Learning Training
Money
Negative feelings
Own creativity - choice freedom self determined
Own goals
Phases
Playing with others
Playstyle
Pressure
Priorities in life
Progress
Rewards Success
Role in groups
Skill
Thinking planning
Time
Use Goal Purpose
Variety

FPS 4

Communication
Content
Effectivity
Focus Involvement
Friends
Language
Learning Training
Motivation
Negative feelings
Out of game activities
Playing with others
Playstyle
Reason for Choice of playstyle
Responsibility
Skill
Story
Strategy
Switching roles
Taking breaks
Time Intensity
Type of game
Using outside sources on game
Variety
Winning

MMORPG 5

Accessing information
Challenge
Communication
Community
Competitiveness
Completing Collecting
Content
Exciting Interesting
Explore
Feeling at Home
Forums
Friends
Guild
Involvement
Learn Improve
Leisure Hobby
Money
Negative feelings
New Updated
Other games
Out of game activities
Own goals
Playing with others
Playstyle
Positive feelings
Priorities in life
Purpose
Relax
Rewards
Skill level
Social aspect
Story
Taking breaks from games
Tech side of game
Time
Utilising game in RL
Variety
Virtual World

ARPG FPS

Ambition
Challenge Complexity
Clan
Communication
Community
Competitiveness
Content
Friends
Game related activities
Gaming behaviour
Gaming experiences
Immersion
Interest
Involvement
Money
Motivation
Negative feelings
Out of game activities
Personality
Planning
Playing with others
Playstyle
Positive feelings
Priorities Importance in life
Relaxing
RL influences
Role in group
Skill Rank
Social aspects
Time
Training
Variety

MOBA 5

Ambition
Behaviour in game
Challenge
Communication
Community
Content
Control over playing
Experimenting
Friends
Game related activities
Getting better
Immersion
Involvement
Motivation
Negative feelings
None game
Other games
Planning
Playing with others
Playstyle
Positive feelings
Purpose
RL influences
Role in Groups
Self-determined
Skill
Social interactions
Time
Variety

MOBA 3

Accessing information on game
Ambition
Analysing gameplay
Communication
Competitiveness
Complexity
Control over gaming
Distraction Avoidance
Friends
Game related activities
How game is experienced
Involvement

Motivation
Negative feelings
Other games
Out of game activities
Priorities in life
Playing with others
Playstyle
Relax
Stress
Success in game
Taking breaks from game
Time

MOBA 6

Accessing information on game
Amount of time or matches played
Behaviour in game and out
Communication
Competitiveness
Content
Distraction
Efficiency
Enjoyment
Friends
Game as break in-between
Game related activities
Getting better
Helping
Music
Negative feelings
New and different
Other games
Planning
Playing as work
Playing with others
Playstyle
Positive feeling
Progress
Purpose
Relaxation
RL influence of game experience
Self-determined
Social aspects
Stopping to play
Thinking about game
Time
Variety

MMORPG 2

Ambition
Beyond the game
Challenge
Communication
Experimenting
Forums
Friends
Game as habit
Game related activities
Immersion
Influence of game
Involvement
Letting go of thoughts
Money
Motivation
Multiple games
Player personality
Playing with others
Playstyle
Priorities in life
Purpose
RL influence on game
Self-determined
Social interactions
Thinking about game
Time

MOBA 7

Acceptance of gaming
Achievements
Ambition
challenge
Communication
community
Competitive
Complexity
Content
Enjoyment
Forums
Friends
Game related activities
In game behaviour
Involvement
Learning
Motivation
Multiple games
Negative feelings
Planning
Playing with others
Playstyle
Priorities in life
Purpose
Self-determined
Social interactions
Story
Strategy
Time
Usefulness of games in RL

FPS 2

Acceptance of gaming
Accessing information on game
Ambition
Behaviour in game
Communication
Competitive
Content
Experimenting
Friends
Game as exhausting
Game related activities
Group
Have quiet
Improving Learning
Influence on RL
Involvement
Money
Motivation
Negative feelings
Planning
Playing with others
Playstyle
Priorities in life
Purpose
RL influence on game
Social aspects
Story
Stress
Taking breaks of game
Tension positive
Thinking about game
Time
Using game as vent
Variety
Winning Main Aspect

FPS 3

Accessing information on game
Behaviour in game
Commitment
Communication
Community
Competitive
Content
Control over gaming
Friends
Game as vent
Game related activities
Group
Influence on RL
Involvement Intensity of play
Learning Practicing
Motivation
Multiple games
Negative feelings
Playing as work
Playing with others
Playstyle
Priorities in life
Purpose
RL influence on game
skill
Strategy

- Thinking about game
- Time
- Understanding games Complexity

MOBA 1

- Ambition
- Behaviour in game
- Communication
- Community
- Competitive
- Content
- Control over gaming
- Distraction
- Expression of Skill Self
- Friends
- Game as vent
- Immersion Story
- Involvement
- Main aspect Goal
- Motivation
- Multiple games
- Negative feelings
- Playing with others
- Playstyle
- Positive feelings
- Pressure
- Priorities in life
- Progress
- Purpose
- RL influence on gaming
- Self-determined
- Social aspects
- Strategy
- Success
- Taking break from game
- Team
- Thinking about game
- Time
- Variety

Real Time Strategy

- Activities while playing
- Challenge
- Communication
- Competitiveness
- Content
- Distraction Relax
- Friends
- Game as break
- Game as vent
- Game related activities
- Improving
- Involvement
- Main aspect Goal
- Motivation
- Multiple games
- Negative feelings
- Planning
- Playing with others
- Playstyle
- Priorities in life
- Relaxing
- RL influence on gaming
- Story
- Strategy
- Thinking about game
- Time

MOBA 2

- Accessing information on game
- Ambition
- Analysing game
- Behaviour in game
- Being good Winning
- Communication
- Community
- Competitive
- Content
- Effect on RL
- Effectiveness
- Forums
- Friends
- Game related activities
- Group
- Immersion
- Involvement
- Knowledge of game
- Learning
- Learning things in-game for RL
- Motivation
- Multiple games
- Negative feelings
- Own playing vs guides
- Planning
- Playing with others
- Playstyle
- Priorities in RL
- Purpose
- Responsibility
- Role in group
- Seriousness
- Social interactions
- Stopping to play
- Strategies
- Time
- Variety

Turn-Based Strategy

- Accessing information on game
- Activities while playing
- Anonymity
- Behaviour in game
- challenge
- Communication
- Community
- Comparing with others
- Competitive
- Complexity
- Content
- Forums
- Friends
- Game related activities
- Groups
- Immersion
- Involvement
- Main aspect
- Motivation
- Negative feelings
- Planning
- Playing well
- Playing with others
- Playstyle
- Positive feelings
- Practicing
- Priorities in life
- Purpose
- Responsibility in game
- RL support
- Self-determined
- Social interactions
- Strategy
- Stress Pressure
- Taking a break from game
- Time
- Transferring from game to RL
- Variety

MMORPG 3

- Ambition
- Commitment
- Communication
- Community
- Content
- Effectiveness
- Freedom
- Friends
- Game related activities
- Gaming as unpleasant work
- Group Guild
- Helping others
- Immersion Story
- In game behaviour
- Involvement
- Learning
- Motivation
- Multiple games
- Negative feelings
- Playing with others
- Playstyle
- Positive feelings
- Priorities in life
- Progress

- Purpose
- Responsibility
- Role in groups
- Social aspects Interactions
- Taking breaks from game
- Technical limitations
- Time
- Variety

MMORPG 6

- Accessing information about game
- Ambition
- Anonymity
- Bored in game
- Challenge
- Communication
- Community
- Comparing with others
- Competitiveness
- Completionism
- Complexity
- Content
- Effectiveness
- Exploring Discover
- Friends
- Game Mechanics
- Game related activities
- Getting better
- Group Guild
- In-game behaviour
- Involvement
- Knowledge of game
- Money
- Motivation
- Multiple games
- Negative feelings
- Planning
- Playing with others
- Playstyle
- Progress
- Purpose
- Self-determined
- Social interactions
- Story
- Strategy
- Thinking about game
- Time
- Training
- Variety Experimenting
- Virtual World

List of codes by theme

RL Variables determining/describing gaming
- Time
- Changes
- Priorities in life
- RL support
- Planning playing
- Duration and time of play
- RL Money
- Priorities in life
- Phases
- Utilising game in RL
- RL influences
- Control over playing
- Game as break in between
- Game as habit
- Usefulness of games in RL
- Stopping to play
- Transferring from game to RL

Subjective Experience of Gaming
- Pressure
- Negative feelings
- Personal choice
- Community
- Freedom to express oneself
- Game specifics
- Self determination
- Playing as choice
- Game as part of RL
- Immersion
- Freedom
- Choice
- Feeling special
- Responsibility
- Virtual World
- Feeling at home
- Positive feelings
- Exciting/Interesting
- How game is experienced
- Influence of game
- Acceptance of gaming

Level of Involvement (short- and long-term)
- Hardcore
- Involvement
- Skill
- Doing one's best
- Taking breaks (from game)
- Seriousness
- Effort
- Focus
- Time/Intensity
- Learn Improve
- Updates
- Getting better
- Amount of time or matches played
- Stopping to play
- Progress
- Playing well

Choice of Content/Setting/(Game)
- Content
- Complexity
- Guild/Clan
- Playing with others
- Own goals
- Challenge
- Mastering challenges with friends
- Friends
- Team
- Game variety
- Solo
- General interest in games
- Competition (aspects of it)
- Choice of games
- Collecting
- Variety
- Reason for choice of playstyle
- Type of game
- Strategy
- Language
- Competitive
- Other games
- Music
- Community
- Achievements
- (Interacting with) Story
- Group

In-Game Behaviour/Playstyle
- Playstyle
- Communication
- Training
- Role in group
- Variety
- Helping others
- Main class
- Social contacts in game
- Interacting with community
- Doing nothing as positive

- Effectiveness
- Training
- Learning
- Switching roles
- Explore
- Experimenting
- New and different
- Social interactions/aspects
- Team
- Anonymity
- Comparing with others

Game Related Activities

- Forums
- Strategy
- Modify game
- Activities involving friends
- Game related activities outside game
- Using/accessing information resource
- Story
- Thinking/Planning
- Using outside sources on game
- Gaming behaviour
- Planning
- Learning

Thinking/Analysing

- Tech side of things
- Analysing gameplay
- Beyond game
- Analysing game
- Game mechanics

Ambition/Motivation/Goal/Main aspect

- Fun
- Social
- Story
- Being someone else
- Advancing
- Peace/Quiet

Place/time to process

Friends

Competition/Competitiveness

Development

Rewards/Success

Progress

Ambition

Motivation

Winning

Leisure/Hobby

Rewards

Completing

- Collecting
- Interest
- Success in game
- Enjoyment
- Challenge
- Main aspect
- Goal
- Strategy

- Purpose (Why do you play?)
- Non-entertainment uses
- Relaxation
- To feel good
- Purpose

Motivation/Purpose

- Distraction
- Refuelling
- Entertainment
- Use/Goal
- Avoidance
- Letting go of thoughts

Unrelated to game usage

- Other things (non game)
- Others
- Non game
- Personality

Final list of all categories with subcategories (for questionnaire-construction)

In-game behaviour

- Social interactions/Behaviour
  - friendly/helpful
  - troll/flamer
  - communicate/chat/voice
  - express emotions in-game
  - express self
  - be/express being someone else
  - being anonymous/withdrawn/open
- Playstyle
  - aggressive/defensive
  - team-centred <-> self-centred
  - follower – leader
  - experimental/explorer – set – guided – efficient – effective

Choice of content, setting, and game

- Playing with/against others
  - alone, randoms, set group, in-game friends, RL friends
- Joining set group/clan/guild
- Content (its aspects)
  - (levels of) challenge, competition, complexity, PvP, PvE, casual, ranked
  - genre, big/small amount of players
  - grinding/preparing for main content, side aspects ("fun maps"), own goals
- Ambience
  - music, in-game sounds voice chat

Involvement/Attitude towards game

- Focus
  - try hard/intensity
  - strategy
- Casual/Hardcore
  - skill
  - knowledge
  - learning
- Seriousness
  - commitment
  - caring
  - effort
- On one's mind while not playing

Subjective experience of gaming

- Experience of social interactions
  - friends (real, not real, long term)
  - part of a community/group
  - toxic/friendly
- Gaming as negative
  - daft, stupid, useless, waste of time
  - stress, pressure, work
  - boring
  - frustrating, annoying
  - mad, angry, upset
  - insufficient
  - alone
- Positive feelings
  - excitement
  - tension (positive)
  - fun
  - successful, accomplished, satisfied, content, fulfilled
- Gaming as self-determined
  - choosing to play
  - actions in game
  - responsibility
  - obligations
  - virtual freedom
- Immersion

Game related activities

- Thinking/Analysing
  - beyond game
  - tech side
  - processing story
  - people
  - gaming itself
- Planning/Preparing/Informing
- Streams/Videos

- pro scene
- Meeting/Talking in RL
- Creating game relating things
  - cosplay
  - art
  - writing

Allocation of RL resources

- Time spent on games
  - when
  - regularity
- Priority of gaming
  - schedule
  - importance
- Control over gaming
- Money
- Influence game <-> RL
- personality
- (acceptance of gaming)

Intention

- Achievements/Collecting
- Being good/Becoming better
  - progressing
  - recognition
  - not letting friends down
- winning
- Social
  - team
- Fun
- Story/Narrative
- Change/New
- None

Appendix G: Construction of the game usage questionnaire

This section covers the development of the game usage questionnaire used Study 2. The development of the game usage questionnaire was mainly based on the main themes and respective sub-themes identified in the analysis (see Table 5). Individual items leaned heavily on comments and suggestions of participants. The questionnaire went through three iterations. In the first iteration, it was first thought about how to best represent each sub-theme in as few questions as possible. Once questions had been chosen, response categories for each question were devised. As the plan was to in the end test the framework with factor analysis, it was attempted to use as few items with nominal response categories as possible. For example, for the social interactions sub-theme seven key behaviours had been found: being helpful, being a flamer, communicating via chat or voice, expressing emotions in the game, expressing ones' personality, being someone else, and being anonymous, withdrawn, or open. Informed by quotes from the interviews this was translated into four questions with different response categories. These regarded 1) if one interacted with other unknown people using chat or voice chat with a scale from never to always; 2) a nominal question about one's behaviour when interacting with others, with response options like trolling, friendly, unfriendly, neutral, and open or reserved; 3) if one expresses oneself in the game, with a response scale from expressing who one is to pretending to be someone else; and 4) whether one lets how one feels show in how one plays, with a scale from disagree to agree. This process resulted in 67 questions with unequal distributions to the themes and a large variety of response scales.

During the second iteration the variety of used scales was reviewed. Having too many different scales may be confusing for participants and potentially weakens the strength of analyses conducted on the data. Especially nominal categories pose issues for common analysis techniques. Therefore, the response categories were simplified and questions reworded, until most questions suited either an agreement or a frequency scale, and those that did not had clear ordinal scales. For example, the response categories for question 2 above were reordered from friendly over neutral to unfriendly, and question 3 above was reworded to whether one tries or pretends to be someone else in interactions with others with a scale from never to always.

During this iteration, the response categories for agreement and frequency scales were chosen. The major arguments that guided these decisions were to make the scales intuitive for participants and informative for the researcher. It was decided to use a scale with an even number of options to force participants to choose a tendency. Otherwise, especially with more difficult questions, it was assumed that participants would tend to choose the apparent "neutral" option, which for frequency scales does not actually exist, and for items with an agreement scale in the developed questionnaire would not be meaningful. Additionally, most participants were assumed to have tendencies, even if they are only slight. Making this intention clear was part of devising the labels for the categories. With the considerations mentioned above in mind the commonly used options of *completely dis/agree*, *dis/agree*, and *slightly dis/agree* were rejected. There is no intuitive difference between completely dis/agree and dis/agree, and slightly dis/agree is ill-defined, leaving participants possibly unsure which option best reflects how they feel. It can also be that participants have more nuanced feelings regarding items, meaning they may agree with a statement to a certain degree, but also partly disagree. This was assumed to be of particular relevance for the game usage questionnaire, because from the interviews it was clear that people's game usage may vary with the situation or their mood. To counter those issues the response options chosen instead were *completely dis/agree*, *mostly dis/agree*, and *tentatively dis/agree*. It was explained at the start of the questionnaire that tentatively dis/agree explicitly includes feeling conflicted or mostly neutral and is to be interpreted as a tendency. The options for the frequency scales were informed by a thesis on equidistant scales (Casper, Edwards, Baron, Eastman, & Wallace, 2013). It was decided to use two different frequency scales to fit the questions better. They were *almost never, rarely, sometimes, often, usually, almost always*. These options were chosen for topics that all players passively get confronted with regularly and where their response is relative to how often they get confronted with a situation. An example is whether people interact with players they do not know or whether they play alone. The other frequency scale used was *very rarely, rarely, occasionally, sometimes, often, very often* and was chosen for behaviours that players actively choose to engage in. Examples would be how often people participate in forums or create game related content. In these cases, options such as usually or almost always do not make sense. The response categories had already been deployed in a previous sub-study (the not-reported evaluation of an adjusted wellbeing questionnaire) and received mostly positive feedback. The categories themselves were received positively, with a few participants noting that they liked the structure or that the categories were easier to understand than the usual agreement scales. The lack of a neutral category got mixed feedback, with some liking it, while others were missing it.

In the third iteration, the layout of the questionnaire was designed, and all questions were reviewed as items. Some items were adjusted to suit one of the three main scales and four items were removed because their content was included in a different item for a total of 63 items, and an introductory section for the questionnaire – called "game demographics" – was developed. While the rest of the questionnaire focuses on a specific game, the purposes of this introductory section is to gather information about the general

gaming behaviour of the players. In addition, it is explained to players what game they should choose in case they play more than one. They key questions are establishing how many games players consider to be their "main"-games at that time, how frequently their main games switch, what game they will focus on during the questionnaire, how they would describe it in terms of genre, and what platform they play it on. Players were asked to answer all questions in the main sections with regard to the last month before taking the questionnaire. A longer timeframe could have been problematic as the longer the timeframe is, the higher the likelihood is that players' game usage changed within that period. In addition, it is unlikely that players can accurately remember the details asked in the questionnaire from more than a month ago; a month is probably already on the border to being too long. A shorter timeframe, however, may not be representative of their more general game usage and could overemphasise irregular periods. Moreover, this questionnaire is intended to be used in conjunction with a questionnaire on participants' eudaimonic wellbeing, which will also require considering a timeframe of about one month to be representative of participants' general feeling of wellbeing. The final question of the questionnaire asks if participants consider their responses in this questionnaire to be representative of their usage of games in general.

Following the questionnaire, participants were invited to provide feedback on any part of the questionnaire – explicitly including its design, the wording of included items, and the topics asked about – in an open text box. After the construction of the questionnaire it was first tested informally and independently with several acquaintances with different first languages and main games. They were asked to provide detailed feedback on how they experienced the questionnaire and to point out any difficulties or potential for misunderstandings. Only after their feedback had been addressed was the questionnaire subjected to the formal pilot.

Appendix H: All versions of the game usage questionnaire

Online-game usage questionnaire used in pilot study

Q6 Please indicate the gender you identify with most

- Male (1)
- Female (2)
- Diverse (3)
- Uncertain (5)

Display This Question:

If Please indicate the gender you identify with most = Diverse

Q12 -> You may (but do not have to) specify what gender you identify with most

_____

Q7 Please write the country you have lived in most during the past 6 months

_____

Q8 Please write the ethnicity you identify with most

_____

Q56 Please write your first language.

_____

Q5 Please write your age in years

_____

Start of Block: General questions about the game

Q54 General questions and choice of game

Q13 How many games have you played as main games over the last month?

- mainly one game (1)
- mainly 2 different games (2)
- mainly 3 different games (3)
- 4+ games, none being a clear "main" game for me (4)

Q55 How frequently does your your main game switch?

- I don't have "main" games (1)
- More or less weekly (2)
- Every few months (3)
- Maybe once a year (4)
- My main game stays constant over years (5)

Q14 For this survey, please choose one game with an online multiplayer focus, that you have played most over the last month. If there should be multiple games that you have played more or less equally, please choose the game you prefer. If you should like them equally, please choose the one you have played more recently.
Please enter the name of the game you have chosen.

_____

Q15 Would you consider this game to have been your main game over the last month (if you have had multiple main games, please indicate "No")?

- Yes (1)
- No (2)

Q14 How would you describe this game's genre (multiple ticks possible)?

- Action (includes action-rpgs) (1)
- Strategy (2)
- Role playing (3)
- Simulation (4)

Q15 Please classify this game's plattform (the way you mainly use it)

- PC application (1)
- Console game (2)
- Browser game (3)

End of Block: General questions about the game

Start of Block: In-game Behaviour

Q16 Please answer all of the following questions with regard to the last month and the game you have chosen before. There are a total of 7 categories with between seven and fourteen items each.
Please answer the questions by indicating which response best describes you.
Important Note: Do *not* respond according to how you would like it to be. Please respond based on *how it actually has been* during the last month.

Q47
1. In-game Behaviour

Q17 For the following questions: If your chosen game does not offer the possibility to chat or interact, please select "Almost never".

	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
I interact with other players I do not know using in-game or voice chat (saying more than "Hi" or "Thanks for group") (1)	○	○	○	○	○	○
In interactions with others I do not know, I am helpful (2)	○	○	○	○	○	○
In this game I act differently than I would in RL (3)	○	○	○	○	○	○

Q20

	Completely disagree (1)	Mostly disagree (2)	Tentatively disagree (3)	Tentatively agree (4)	Mostly agree (5)	Completely agree (6)
The way I currently feel shows in how I play (1)	○	○	○	○	○	○
Overall, I would describe my playstyle as active/aggressive (2)	○	○	○	○	○	○

Q22 When I play in a group, I usually

- follow (1)
- lead (2)
- don't care if I lead or follow (3)
- act independently from the group (4)
- I usually don't play this game in a group (5)

Q23 In this game I tend to (multiple ticks possible)

- be experimental (1)
- explore a lot (2)
- quickly develop a set playstyle (3)
- strictly follow guides (4)
- try to be very efficient (5)
- come up with my own goals (6)

Start of Block: Choice of Content and Setting

Q48 2. Choice of Content and Setting

Q24

	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
Of the times I play this game, I play: alone (1)	○	○	○	○	○	○
with randoms (2)	○	○	○	○	○	○
with in-game contacts (3)	○	○	○	○	○	○
with RL-contacts (4)	○	○	○	○	○	○
I engage in PvP activities/content (5)	○	○	○	○	○	○
I play modes/do activities that are ranked/rated (6)	○	○	○	○	○	○
I engage in content that I find challenging (7)	○	○	○	○	○	○

Start of Block: Involvement and Attitude Towards the Game

Involvement and Attitude Towards the Game

Q25

	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
When I play I focus entirely on the game (1)	○	○	○	○	○	○
In this game I try-hard (2)	○	○	○	○	○	○
I think about why I win or lose in order to improve (3)	○	○	○	○	○	○

Q26 For the following questions: If your chosen game does not have any story/lore, please select "Completely disagree".

	Completely disagree (1)	Mostly disagree (2)	Tentatively disagree (3)	Tentatively agree (4)	Mostly agree (5)	Completely agree (6)
I care about how things turn out when playing (1)	○	○	○	○	○	○
If I start something in this game, I will complete it (2)	○	○	○	○	○	○
I have extensive knowledge about this game's: game-mechanics (3)	○	○	○	○	○	○
I have extensive knowledge about this game's: story (4)	○	○	○	○	○	○

Q27 The level at which I play this game is

- beginner (1)
- experienced beginner (2)
- intermediate (3)
- advanced (4)
- semi-professional (5)
- professional (6)

Start of Block: Subjective Experience of Gaming

Q28

	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
After playing the game I feel content (1)	○	○	○	○	○	○
After playing the game I feel I have wasted my time (2)	○	○	○	○	○	○
When playing this game I get excited (3)	○	○	○	○	○	○
When playing this game I feel stressed (4)	○	○	○	○	○	○
When playing the game I have fun (5)	○	○	○	○	○	○
When playing this game I get mad (6)	○	○	○	○	○	○
When playing this game I feel alone (7)	○	○	○	○	○	○

Q29

	Completely disagree (1)	Mostly disagree (2)	Tentatively disagree (3)	Tentatively agree (4)	Mostly agree (5)	Completely agree (6)
Playing this game, I feel I am part of a community (1)	○	○	○	○	○	○
I consider friends I have only met in the game to be real friends (2)	○	○	○	○	○	○
I feel I am free to do what I want to do in this game (3)	○	○	○	○	○	○
I do some activities in the game only because I feel I miss out if I don't (4)	○	○	○	○	○	○
When I play this game, I am immersed in the virtual world (5)	○	○	○	○	○	○

Start of Block: Game Related Activities

Q51 5. Game Related Activities

	Almost never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Often (5)	Very often (6)
I think about the story/lore of the game (1)	○	○	○	○	○	○

I inform myself about aspects of the game (2)	○	○	○	○	○	○
I think about the tech-side of gaming (3)	○	○	○	○	○	○
After playing I think about interactions I had with people in the game (4)	○	○	○	○	○	○
I watch streams or videos related to this game (5)	○	○	○	○	○	○
I follow the professional scene (6)	○	○	○	○	○	○
I talk with others about the game (in RL) (7)	○	○	○	○	○	○
I actively participate in forums related to this game (8)	○	○	○	○	○	○
I create things related to this game (e.g. costumes, writing, artwork, …) (9)	○	○	○	○	○	○

Start of Block: Intersection of RL and Game Usage

Q52 6. Allocation of RL resources

Q32 I play this game longer than I had intended

- Almost never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Usually (5)
- Almost always (6)

Q33 Playing this game has a high priority for me in daily life

- Completely disagree (1)
- Mostly disagree (2)
- Tentatively disagree (3)
- Tentatively agree (4)
- Mostly agree (5)
- Completely agree (6)

Q34 My typical play session is

- 10-30 min (2)
- 30 min-1h (3)
- 1-2h (4)
- 2-4h (5)
- 4-8h (6)
- >8h (7)

Q35 The average time I spend playing this game per week is

1-5h (2)

5-10h (3)

10-20h (4)

20-30h (5)

30-40h (6)

>40h (7)

Q36 I mainly play this game (multiple ticks possible)

morning to midday (1)

midday to afternoon (2)

afternoon to evening (3)

evening to night (4)

night to morning (5)

Q37 Regarding this game, I spend money on (please estimate the yearly amounts for each category as value in USD or Euro)

the game, expansions, and subscriptions (1) _____

game related physical articles (2) _____

virtual in-game articles (3) _____

Q38 If I was not playing this game, I would probably be

playing a different game (1)

doing something else for leisure (2)

doing something career oriented (e.g. for studying or working) (3)

doing something not-leisure and not-career oriented (e.g. cleaning) (4)

doing nothing (5)

Start of Block: Intention while playing

Q31 My MAIN intention while playing this game is	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
collecting something (e.g. achievements, toys, ...) (1)	○	○	○	○	○	○
making progress (includes becoming better) (2)	○	○	○	○	○	○
winning (includes beating bosses in PvE) (3)	○	○	○	○	○	○
not letting friends down (4)	○	○	○	○	○	○
showing others that I am good at the game (5)	○	○	○	○	○	○
experiencing the story (6)	○	○	○	○	○	○
testing or analysing game mechanics (14)	○	○	○	○	○	○
chatting with others (non-friends) (7)	○	○	○	○	○	○
expressing myself (16)	○	○	○	○	○	○
seeing or trying something new (8)	○	○	○	○	○	○
achieving something as part of a group (9)	○	○	○	○	○	○
just having fun (10)	○	○	○	○	○	○

just doing something together with friends (11)	○	○	○	○	○	○
just playing, doing whatever; no actual intention (12)	○	○	○	○	○	○
other (please specify so that I can potentially include it in the next version of the questionnaire): (13)	○	○	○	○	○	○

Q57 I would consider how I use (use as covered in this questionnaire) this game to be representative of how I use multiplayer online games in general.

- Completely disagree (1)
- Mostly disagree (2)
- Tentatively disagree (3)
- Tentatively agree (4)
- Mostly agree (5)
- Completely agree (6)

Start of Block: Thank you for participating and invitation to provide feedback

Q10 Thank you for taking part in this survey and having filled in the questionnaire! Your participation helps me a lot with testing the model behind the questionnaire, adjusting and refining it, and making it a (hopefully) less annoying experience.
If you have any comments or feedback regarding how you experienced this questionnaire (e.g. if you felt something that you deem important to describe how you use games was missing; if the questionnaire contains some difficult, stupid, or inappropriate questions; questions where you did not know what I meant; words you did not know; weird phrases; questions you feel leave too much room for interpretation or are far too vague; etc.), please feel free to describe this in the following free-text box.
Otherwise just click the "next" (right) arrow at the bottom of the page to end the questionnaire.

Online-game usage questionnaire used in longitudinal study

Q4 Choice of game

For this survey, please choose the game you would consider to have been your "main" game over the last month, the one that during that time you have played most or that you feel has been the most important to you. If there should be multiple games that you have played more or less equally, please choose one with an online multiplayer functionality. If all or none of them can be played online, please choose the game you prefer. If you should like them equally, please choose the one you have played more recently.

Q5 Please enter the name of the game you have chosen.

_____

Q6 Do you play this game online (independent of whether you play alone or with others)?

- Yes (1)
- No (2)

Q7 How would you describe this game's genre (multiple ticks possible)?

- Action (includes action rpgs and shooters) (1)
- Strategy (2)
- Role playing (3)
- Simulation (4)

Q8 Please classify this game's platform (the way you mainly use it)

- PC application (1)
- Console game (2)
- Browser game (3)
- Mobile app (4)

Start of Block: Question Page 1

Q9
Please answer all of the following questions with regard to the last month and the game you have chosen before. The questions are split over three pages, with the last page being the shortest one and only being displayed for online games. Please answer the questions by indicating which response best describes you.
If the game chosen by you does not have a certain aspect (e.g. there simply is no story or no PvP) or does not allow for a certain activity (e.g. there is no chat-function), please choose the left-most category.

Important Note: Do *not* respond according to how you would like it to be. Please respond based on *how it actually has been* during the last month.

Q11

	Completely disagree (1)	Mostly disagree (2)	Tentatively disagree (3)	Tentatively agree (4)	Mostly agree (5)	Completely agree (6)
I have extensive knowledge about this game's game-mechanics (1)	○	○	○	○	○	○
If I start something in this game, I will complete it (2)	○	○	○	○	○	○
I do some activities in the game only because I feel I miss out if I don't (3)	○	○	○	○	○	○
Playing this game, I feel I am part of a community (4)	○	○	○	○	○	○
I have extensive knowledge about this game's story (5)	○	○	○	○	○	○
I care about how things turn out in the game (6)	○	○	○	○	○	○
Playing this game has a high priority for me in daily life (7)	○	○	○	○	○	○

Q12	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
When playing the game I have fun (1)	○	○	○	○	○	○
When I play I focus entirely on the game (2)	○	○	○	○	○	○
When playing this game I get angry (3)	○	○	○	○	○	○
When playing this game I get excited (4)	○	○	○	○	○	○
I think about why I win or lose in order to improve (5)	○	○	○	○	○	○
I play this game longer than I had intended (6)	○	○	○	○	○	○
When playing this game I feel alone (7)	○	○	○	○	○	○
I engage in content that I find challenging (8)	○	○	○	○	○	○

After playing the game I feel I have wasted my time (9)	○	○	○	○	○	○
Of the times I play this game, I play with "Real Life" (RL)-contacts (10)	○	○	○	○	○	○
When playing this game I feel stressed (11)	○	○	○	○	○	○
In this game I try-hard (13)	○	○	○	○	○	○
After playing the game I feel content (14)	○	○	○	○	○	○

Start of Block: Second question block

Q13 Question page 2 (last page for non-online games)

Q14 The average time I spend playing this game per week is

- 0-5h (1)
- 5-10h (2)
- 10-20h (3)
- 20-30h (4)
- 30-40h (5)
- >40h (6)

Q15 How many days a week do you usually play this game?

- 1-2 (1)
- 2-3 (2)
- 3-4 (3)
- 4-5 (4)
- 5-6 (5)
- 6-7 (6)

Q16 My MAIN intention while playing this game is	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
expressing myself (1)	○	○	○	○	○	○
testing game mechanics (2)	○	○	○	○	○	○
trying something new (3)	○	○	○	○	○	○
winning (includes beating bosses in PvE) (4)	○	○	○	○	○	○
making progress (includes becoming better) (5)	○	○	○	○	○	○
doing something together with friends or family (6)	○	○	○	○	○	○
not letting friends down (7)	○	○	○	○	○	○
just playing it, without real intention in the game (8)	○	○	○	○	○	○

processing something from my RL (9)	○	○	○	○	○	○
collecting something (e.g. achievements, collectibles, ...) (10)	○	○	○	○	○	○
just having fun (11)	○	○	○	○	○	○
experiencing the story (12)	○	○	○	○	○	○

Q17

	Almost never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Often (5)	Very often (6)
I think about the story/lore of the game (1)	○	○	○	○	○	○
I follow the professional scene (2)	○	○	○	○	○	○
I talk with others about the game (in RL) (3)	○	○	○	○	○	○
I create things related to this game (e.g. costumes, writing, artwork, …) (4)	○	○	○	○	○	○
I actively participate in forums related to this game (5)	○	○	○	○	○	○

Start of Block: Online only question block

Display This Question:

If Do you play this game online (independent of whether you play alone or with others)? = Yes

Q18 Online-game only questions (last page)

Display This Question:

If Do you play this game online (independent of whether you play alone or with others)? = Yes

Q19

	Almost never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Almost always (6)
My MAIN intention while playing this game is chatting with others (non-friends) (1)	○	○	○	○	○	○
My MAIN intention while playing this game is achieving something as part of a group (2)	○	○	○	○	○	○
I play modes/do activities that are ranked/rated (3)	○	○	○	○	○	○
I interact with other players I do not know using text or voice chat (saying more than "Hi" or "Thanks for group") (4)	○	○	○	○	○	○
Of the times I play this game, I play alone (5)	○	○	○	○	○	○
Of the times I play this game, I play with randoms (6)	○	○	○	○	○	○

I engage in PvP activities/content (8)	○	○	○	○	○	○
Of the times I play this game, I play with in-game contacts (7)	○	○	○	○	○	○

Display This Question:

If Do you play this game online (independent of whether you play alone or with others)? = Yes

Q20 How much money have you spent on this game in average every year in Euro or USD (includes purchase price, subscriptions, virtual in-game articles, and game-related physical articles)?

0-60 (1)

60-110 (2)

110-170 (3)

170-250 (4)

250-500 (5)

>500 (6)

Display This Question:

If Do you play this game online (independent of whether you play alone or with others)? = Yes

Q21 I consider "friends" I have only met in the game to be real friends.

Completely disagree (1)

Mostly disagree (2)

Tentatively disagree (3)

Tentatively agree (4)

Mostly agree (5)

Completely agree (6)

I do not have "friends" or other kinds of regular contacts in this game (7)

List of items remaining after factor analysis in longitudinal study

Response categories are either the agreement scale (completely disagree | mostly disagree | tentatively disagree | tentatively agree | mostly agree | completely agree), the frequency scales “1” (almost never | rarely | sometimes | often | usually | almost always) and “2” (almost never | rarely | occasionally | sometimes | often | very often), or individual categories

Priority

Playing this game has a high priority for me in daily life: - agreement -

The average time I spend playing this game per week is: 0-5h | 5-10h | 10-20h | 20-30h | 30-40h | >40h

How many days a week do you usually play this game? 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7

Friends

My MAIN intention while playing this game is: doing something together with friends or family: - frequency 1 -

Of the times I play this game, I play with "Real Life" (RL)-contacts: - frequency 1 -

Of the times I play this game, I play alone:

My MAIN intention while playing this game is: not letting friends down: - frequency 1 -

Positive Emotions

When playing the game I have fun: - frequency 1 -

My MAIN intention while playing this game is: just having fun: - frequency 1 -

After playing the game I feel content: - frequency 1 -

Negative Emotions

When playing this game I get angry: - frequency 1 -

When playing this game I feel stressed: - frequency 1 -

Seriousness

In this game I try-hard: - frequency 1 -

I think about why I win or lose in order to improve: - frequency 1 -

My MAIN intention while playing this game is: winning (includes beating bosses in PvE): - frequency 1 -

My MAIN intention while playing this game is: making progress (includes becoming better): - frequency 1 -

Experimenting

My MAIN intention while playing this game is: trying something new: - frequency 1 -

My MAIN intention while playing this game is: testing game mechanics: - frequency 1 -

Social

My MAIN intention while playing this game is: I interact with other players I do not know using text or voice chat (saying more than "Hi" or "Thanks for group"): - frequency 1 -

My MAIN intention while playing this game is: chatting with others (non-friends): - frequency 1 -

Story

I think about the story/lore of the game: - frequency 2 -

My MAIN intention while playing this game is: experiencing the story: - frequency 1 -

I have extensive knowledge about this game's story: - agreement -

Appendix I: Supplemental data for the factor analyses of the game usage questionnaires

Table I-1

Varimax rotated component matrix for the factor analysis of the original questionnaire in the pilot study with forced 9-factor extraction

	Component								
Items	1	2	3	4	5	6	7	8	9
I have extensive knowledge about this game's: story	0.85								
I care about how things turn out when playing	0.78								
I think about the story/lore of the game	0.75								
If I start something in this game, I will complete it	0.67		0.33						
experiencing the story	0.66								
I have extensive knowledge about this game's: game-mechanics	0.54								
When playing the game I have fun		0.76							
After playing the game I feel content		0.76							
just having fun		0.66							
When playing this game I get excited		0.55	0.32				0.34		
When I play this game, I am immersed in the virtual world	0.38	0.46							
I feel I am free to do what I want to do in this game		0.35							
I think about why I win or lose in order to improve			0.66						
In this game I try-hard		0.64							
When I play I focus entirely on the game		0.61							
winning		0.58							
I engage in content that I find challenging	0.32	0.57							
making progress		0.51							
Overall, I would describe my playstyle as active/aggressive		0.37							
I think about the tech-side of gaming		0.35							
testing or analysing game mechanics			0.64						
expressing myself			0.59						
chatting with others (non-friends)			0.58						0.36
seeing or trying something new	0.39		0.55						
The level at which I play this game is (beginner, experienced beginner, intermediate, advanced, semi-pro, pro)			0.50						
with in-game contacts			0.43		0.30				0.37
I create things related to this game (e.g. costumes, writing, artwork, …)			0.41						
I actively participate in forums related to this game			0.35		-0.32				
The way I currently feel shows in how I play									
The average time I spend playing this				0.74					

game per week is (<1, 1-5, 5-10, 10-20, 20-30, 30-40, >40)						
Playing this game has a high priority for me in daily life			0.72			
My typical play session is (<10, 10-30, 30-1, 1-2, 2-4, 4-8, >8)			0.64			
collecting something			0.46			
I play this game longer than I had intended			0.42			
I do some activities in the game only because I feel I miss out if I don't			0.42			
I inform myself about aspects of the game	0.36	0.33	0.37			
just doing something together with friends				0.77		
with RL-contacts				0.76		
not letting friends down				0.68		
I talk with others about the game (in RL)				0.49	0.41	
achieving something as part of a group				0.48		0.46
showing others that I am good at the game		0.31		0.41		
When playing this game I feel stressed					0.67	
I engage in PvP activities/content					0.59	
I follow the professional scene			0.32		0.56	
I play modes/do activities that are ranked/rated					0.53	
When playing this game I get mad					0.51	
I watch streams or videos related to this game					0.36	
After playing I think about interactions I had with people in the game					0.32	
I interact with other players I do not know using in-game or voice chat (saying more than "Hi" or "Thanks for group")						0.64
with randoms				-0.30		0.54
Of the times I play this game, I play: alone				-0.39		-0.54
Playing this game, I feel I am part of a community	0.40					0.43
In interactions with others I do not know, I am helpful						0.35
In this game I act differently than I would in RL						
After playing the game I feel I have wasted my time						-0.60
I consider friends I have only met in the game to be real friends						0.52
When playing this game I feel alone						-0.49
just playing, doing whatever; no actual intention		-0.32				-0.41

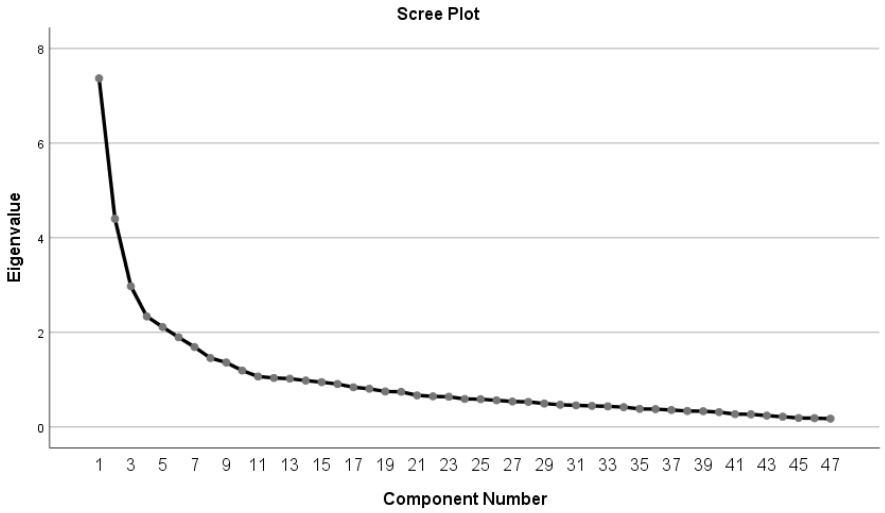


Figure I-1: Scree plot for the factor analysis of the item-adjusted game usage questionnaire

Table I-2

Pattern matrix for the factor analysis of the full questionnaire in the longitudinal study with forced 9-factor extraction

	Factor								
Items	1	2	3	4	5	6	7	8	9
Winning	0.63								
Try-hard	0.59								
Making progress	0.55								
Think why win or lose to improve	0.49								
No real intention	-0.48								
Engage content that I find challenging									
Ranked/Rated									
Focus									
Complete									
Think about story/lore		0.75							
Experiencing the story		0.74							
Knowledge of story		0.69							
Collecting		0.47							
Care how things turn out	0.43								
Don't miss out									
Doing something together with friends		-0.81							
Play alone		0.67							
Not letting friends down		-0.60							
Play with RL contacts		-0.58							
Achieving something as part of group		-0.51							
Play with in-game contacts		-0.48							
Angry			0.67						
Stressed			0.55						
Wasted time			0.52						
Longer than intended			0.42						
Feel alone									
Priority				-0.77					
Days a week				-0.74					
Time per week				-0.73					
5,10,20,30,40,>40									
Real friends				-0.44					
Spent per year, 60, 110, 170, 250, 500, >500									
Knowledge of game mechanics									
Trying something new					0.59				
Expressing					0.49				
Testing game mechanics					0.49				
Processing RL									
Create									
Actively participate in forums									
Interact with others I do not know over text or voice chat							-0.68		
Play with randoms							-0.51		
Chatting with others (nonfriends)							-0.46		
Engage in PvP activities/content							-0.42		
Have fun								0.61	
My main intention is just having fun								0.58	
Excited								0.56	
Content								0.52	
Community									
Follow professional scene									-0.55
Talk with others about game in RL									

Appendix J: Issues with and suggestions for recruitment

One of the biggest challenges for the study was finding and retaining participants in the study for the course of one year. Several strategies for retaining participants in longitudinal studies were suggested in the reviews on effective retention strategies in longitudinal studies by Cotter *et al.* (2002) and by Robinson *et al.* (2007). The main strategies identified that are possible in an online study were: making participants feel comfortable, regular correspondence between assessments, sending out reminders, explaining the study's details in advance, additional regular information about the study's progress and researchers, minimising the burden on participants time- and effort-wise, providing directly study-related benefits, and offering financial or non-financial gratuities. A selection of different methods was shown to be most effective. For this study, all of the above methods were employed in some way and are described in the respective sections.

Based on the experience of this study the most effective places for advertisements were subreddits and – against the researcher's expectations – physical advertisements around universities. Subreddits and many fora have an increasing issue with surveys and research being prohibited (e.g. under the categories of soliciting, surveys, or advertisements). It is also generally suggested to contact the respective moderators beforehand, as some forums do allow research if approval is sought *before* posting. The next issue with using forua is that – as long as no help from a moderator is provided – inactive posts quickly move down the page and away from the front page, which means that it is very unlikely new people will see it; *bumping*, meaning one posting on one's own post with the intention of bringing it to the first page again, is usually not supported in fora and may lead to a post being deleted or the author being prevented from making future posts. In this research most of the participants only participated and did not comment on the research in the post. Therefore, one suggestion is to try to engage in, or even initiate, discussions related to one's post, just to keep it active.

Social networks can also be a powerful tool if one can tap into an extant network, for example appropriate Facebook-groups, although active groups, similarly to active forums, get dozens of new posts a day, meaning if it does not get "likes" it will also quickly move down the list. The author would generally advise against "boosting" posts on facebook through the official built-in advertisement system. The option tested costed NZD 50 over seven days with a nearly world-wide target audience. The chosen desired aim was "link clicks". According to the ad centre on Facebook the post performed very well, reached 187,000 people, had 1,383 engagements, and 1,256 link clicks. However, this did not show at all in the number of participants or visitors to the linked website. During the week the post was boosted, the study had only 12 new participants, most of which could be attributed to a recent post on a subreddit. The study website statistics did not count that supposed influx of 1256 people, either. Finally, it also is striking that despite the region at the start having been set to world-wide with minor limitations – which in retrospect was a mistake –, by far most "post-engagements" (>99%) on the target population of online video gamers were from various third-world countries, making the author wonder if in some of those countries people possibly get paid to interact with Facebook advertisements.

Finally, the study was advertised through high schools in New Zealand and in Germany; these countries were chosen because of personal relations. Because students engaging heavily in video games and a prevalence of students having low wellbeing are issues commonly mentioned by teachers or the media, it was expected that schools would have a high inherent interest in this study and would like to participate. However, that was generally not the case. Many of the larger schools contacted in New Zealand replied saying they "do not have time to participate in research" in general. This was seen by the researcher as highly problematic, because if large schools do not participate in research, it is very difficult to improve the situation for, and education of, students. Some of the reluctance, though, stemmed from the larger schools in New Zealand simply receiving too many research-related enquiries. A second issue was that while some schools were interested in the study and the results, they did not provide opportunities for the researcher to advertise the study. The success of advertising the study at schools came down to finding deputy principals who were enthusiastic about the topic and willing to *actively* advertise the study, of which there were fewer than expected.

Appendix K: Wellbeing and personality questionnaires used in longitudinal study

Big Five Personality inventory short form

(Soto & John, 2017b)

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please indicate for each statement the extent to which you agree or disagree with that statement.

I am someone who...

	1 Disagree Strongly	2 Disagree a little	3 Neutral; no opinion	4 Agree a little	5 Agree strongly
Tends to be quiet.	○	○	○	○	○
Is compassionate, has a soft heart.	○	○	○	○	○
Tends to be disorganized.	○	○	○	○	○
Worries a lot.	○	○	○	○	○
Is fascinated by art, music, or literature.	○	○	○	○	○
Is dominant, acts as a leader.	○	○	○	○	○
Is sometimes rude to others.	○	○	○	○	○
Has difficulty getting started on tasks.	○	○	○	○	○
Tends to feel depressed, blue.	○	○	○	○	○
Has little interest in abstract ideas.	○	○	○	○	○
Is full of energy.	○	○	○	○	○
Assumes the best about people.	○	○	○	○	○
Is reliable, can always be counted on.	○	○	○	○	○
Is emotionally stable, not easily upset.	○	○	○	○	○
Is original, comes up with new ideas.	○	○	○	○	○
Is outgoing, sociable	○	○	○	○	○
Can be cold and uncaring.	○	○	○	○	○
Keeps things neat and tidy.	○	○	○	○	○
Is relaxed, handles stress well.	○	○	○	○	○
Has few artistic interests.	○	○	○	○	○
Prefers to have others take charge.	○	○	○	○	○
Is respectful, treats others with respect.	○	○	○	○	○

Is persistent, works until the task is finished.	○	○	○	○	○
Feels secure, comfortable with self.	○	○	○	○	○
Is complex, a deep thinker.	○	○	○	○	○
Is less active than other people.	○	○	○	○	○
Tends to find fault with others.	○	○	○	○	○
Can be somewhat careless.	○	○	○	○	○
Is temperamental, gets emotional easily.	○	○	○	○	○
Has little creativity.	○	○	○	○	○

Basic Psychological Needs Satisfaction and Frustration Scale

(Chen *et al.*, 2014)

Please indicate how true you feel each of these statements is in your real-life, using a score ranging from 1 (completely untrue) to 5 (completely true).

	1 (completely untrue)	2	3	4	5 (completely true)
I feel a sense of choice and freedom in the things I undertake	○	○	○	○	○
I feel that my decisions reflect what I really want	○	○	○	○	○
I feel my choices express who I really am	○	○	○	○	○
I feel I have been doing what really interests me	○	○	○	○	○
Most of the things I do feel like ‘‘I have to’’	○	○	○	○	○
I feel forced to do many things I wouldn’t choose to do	○	○	○	○	○
I feel pressured to do too many things	○	○	○	○	○
My daily activities feel like a chain of obligations	○	○	○	○	○
I feel that the people I care about also care about me	○	○	○	○	○

I feel connected with people who care for me, and for whom I care	○	○	○	○	○
I feel close and connected with other people who are important to me	○	○	○	○	○
I experience a warm feeling with the people I spend time with	○	○	○	○	○
I feel excluded from the group I want to belong to	○	○	○	○	○
I feel that people who are important to me are cold and distant towards me	○	○	○	○	○
I have the impression that people I spend time with dislike me	○	○	○	○	○
I feel the relationships I have are just superficial	○	○	○	○	○
I feel confident that I can do things well	○	○	○	○	○
I feel capable at what I do	○	○	○	○	○
I feel competent to achieve my goals	○	○	○	○	○
I feel I can successfully complete difficult tasks	○	○	○	○	○
I have serious doubts about whether I can do things well	○	○	○	○	○
I feel disappointed with many of my performance	○	○	○	○	○
I feel insecure about my abilities	○	○	○	○	○
I feel like a failure because of the mistakes I make	○	○	○	○	○

WHO-5

(Topp *et al.*, 2015)

Please indicate for each of the five statements which is closest to how you have been feeling over the last month.

	At no time	Some of the time	Less than half of the time	More than half of the time	Most of the time	All of the time
I have felt cheerful and in good spirits	○	○	○	○	○	○
I have felt calm and relaxed	○	○	○	○	○	○
I have felt active and vigorous	○	○	○	○	○	○
I woke up feeling fresh and rested	○	○	○	○	○	○
My daily life has been filled with things that interest me	○	○	○	○	○	○

Appendix L: Supplemental tables for longitudinal analysis

For easier comparisons with samples in other studies, the statistics describing the sample – based on averaged total scores – are presented in Table L-1 *to* Table L-3.

Table L-1

Sample-averages and standard deviations of the game usage factors for participants in the longitudinal study

	Experi-menting	*Friends*	*Negative Emotions*	*Positive Emotions*	*Priority*	*Seriousness*	*Social*	*Story*
Mean	*3.32*	*3.06*	*2.49*	*4.82*	*3.33*	*4.48*	*2.42*	*3.67*
Std. dev	*1.15*	*1.46*	*0.98*	*0.76*	*1.25*	*0.98*	*1.41*	*1.38*

Table L-2

Sample-averages and standard deviations of the wellbeing and needs for participants in the longitudinal study

	WHO-5	*Autonomy satisfaction*	*Autonomy frustration*	*Relatedness satisfaction*	*Relatedness frustration*	*Competence satisfaction*
Mean	*3.56*	*3.60*	*2.80*	*3.94*	*1.97*	*3.43*
Std. dev	*0.97*	*0.83*	*0.92*	*0.91*	*0.96*	*0.96*

Table L-3

Sample-averages and standard deviations of the personality traits for participants in the longitudinal study

	Openness	*Conscientiousness*	*Extraversion*	*Agreeableness*	*Negative Emotionality*
Mean	*3.76*	*3.08*	*2.81*	*3.47*	*2.87*
Std. dev	*0.70*	*0.75*	*0.85*	*0.72*	*1.00*

Table L-4

*Correlation matrix for all game usage factors at time 1, online players only (n=431). Correlations significant at p=0.05 are indicated with *, those significant at p=0.01 with ***

Game Usage	*Experimen-ting*	*Friends*	*Negative Emotions*	*Positive Emotions*	*Priority*	*Serious-ness*	*Social*	*Story*
Experimen-ting	*1.00*	*0.00*	*0.03*	*.26***	*.10**	*0.08*	*.12**	*.29***
Friends		*1.00*	*0.09*	*0.09*	*-0.04*	*.13***	*.26***	*-0.03*
Negative Emotions			*1.00*	*-.23***	*0.06*	*.24***	*.10**	*-0.07*
Positive Emotions				*1.00*	*0.05*	*.14***	*.14***	*.20***
Priority					*1.00*	*.30***	*.21***	*.17***
Seriousness						*1.00*	*.24***	*-0.03*
Social							*1.00*	*.11**
Story								*1.00*

Table L-5

*Correlation coefficients between game usage factors and personality traits, needs, and wellbeing for online players at time 1 (full table). Correlations significant at p=0.05 are indicated with *, those significant at p=0.01 with ***

	Experimen-ting	Friends	Negative Emotions	Positive Emotions	Priority	Seri-ousness	Social	Story
Openness	.14**	-.10*	-0.07	0.08	-.11*	0.01	-0.05	.15**
Conscientious-ness	-0.02	-0.01	-.12*	0.07	-0.03	.10*	0.03	0.02
Extraversion	-0.06	.13**	-0.06	0.07	-.26**	0.05	0.09	-0.05
Agreeableness	-0.05	0.01	-.16**	.11*	-0.07	-0.01	0.00	.11*
Negative Emotionality	.11*	-0.06	.26**	-.18**	0.06	-0.04	-0.08	0.07
WHO-5	0.02	.13**	-.10*	.27**	-.12*	0.06	.10*	0.01
Autonomy satisfaction	0.05	0.07	-.12*	.28**	-0.06	.13**	0.05	0.00

Autonomy frustration	.13**	-0.01	.19**	-.13**	0.06	0.01	-0.02	0.08
Relatedness satisfaction	0.02	.22**	-.11*	.17**	-.14**	0.04	0.07	0.02
Relatedness frustration	.12*	-.11*	.25**	-.20**	0.08	-0.01	-0.02	0.04
Competence	-0.06	0.07	-.17**	0.09	-0.04	.15**	0.09	-0.07

Table L-6

*Correlations between changes of game usage factors and changes of needs and wellbeing (full table). Correlations significant at p=0.05 are indicated with *, those significant at p=0.01 with ***

	WHO-5	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence satisfaction
Experimen-ting	-0.05	-0.02	-0.05	0.11	0.08	-0.10
Friends	0.19	0.06	0.01	0.17	-0.11	0.04
Negative emotions	-0.02	0.16	-0.01	-0.08	0.09	0.03
Positive emotions	.25*	0.02	-0.03	0.17	-0.14	-0.07
Priority	0.04	0.06	0.09	-0.03	0.12	-0.01
Seriousness	0.03	-0.06	0.01	-0.16	.22*	-0.02
Social	-0.08	-0.08	0.11	-.25*	0.12	-0.08
Story	-0.05	0.01	-0.11	-0.04	0.02	-0.01

Table L-7

*Correlation matrix for all personality factors at time 1, online players only (n=431). Correlations significant at p=0.05 are indicated with *, those significant at p=0.01 with ***

	Openness	Conscienti-ousness	Extraversion	Agreeableness	Negative Emotionality
Openness	1.00	.11*	.20**	.16*	-0.03
Conscienti-ousness		1.00	.28**	.25**	-.27**
Extraversion			1.00	.16**	-.39**
Agreeableness				1.00	-.14**
Negative Emotionality					1.00

Table L-8

*Correlation matrix for all personality factors at time 1, online players only (n=431). Correlations significant at p=0.05 are indicated with a *, those significant at p=0.01 with ***

	WHO-5	Autonomy satisfaction	Autonomy frustration	Relatedness satisfaction	Relatedness frustration	Competence satisfaction
WHO-5	1.00	.57**	-.43**	.43**	-.45**	.53**
Autonomy satisfaction		1.00	-.45**	.45**	-.40**	.54**
Autonomy frustration			1.00	-.26**	.44**	-.47**
Relatedness satisfaction				1.00	-.57**	.30**
Relatedness frustration					1.00	-.46**
Competence satisfaction						1.00

Table L-9

t-tests comparing average game usage factors between Time 1 and Time 2

	Paired Differences					t	Df	Sig. (2-tailed)
	Difference of Means	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Experimenting	0.10	1.17	0.12	-0.13	0.33	0.83	99	0.41
Friends	-0.10	0.88	0.09	-0.27	0.07	-1.14	99	0.26
Negative Emotions	-0.22	0.85	0.09	-0.39	-0.05	-2.54	99	0.01
Positive Emotions	-0.12	0.93	0.09	-0.30	0.07	-1.25	99	0.22
Priority	-0.30	0.94	0.09	-0.48	-0.11	-3.17	99	0.00
Seriousness	-0.25	0.81	0.08	-0.41	-0.09	-3.15	99	0.00
Social	0.01	0.90	0.09	-0.17	0.19	0.07	99	0.94
Story	-0.06	0.91	0.09	-0.24	0.12	-0.62	99	0.54

Table L-10

t-tests comparing average wellbeing and needs between Time 1 and Time 2

	Paired Differences					t	df	Sig. (2-tailed)
	Difference of Means	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
WHO-5	-0.13	1.00	0.10	-0.33	0.07	-1.30	99	0.20
Autonomy satisfaction	-0.26	0.91	0.09	-0.44	-0.08	-2.85	99	0.01
Autonomy frustration	0.23	1.02	0.10	0.03	0.43	2.27	99	0.03
Relatedness satisfaction	-0.14	0.91	0.09	-0.32	0.04	-1.50	99	0.14
Relatedness frustration	0.01	0.86	0.09	-0.16	0.18	0.12	99	0.90
Competence satisfaction	-0.08	0.84	0.08	-0.25	0.08	-1.00	99	0.32

Table L-11

Differences of means of game usage scores between participants whose wellbeing is higher and lower than expected based on the respective need. Values are standardised on the full data at Time 1. Positive values indicate people with higher wellbeing have a higher score in the respective game usage factor (full table; statistically significant values based on ANCOVAs with the other needs and wellbeing as covariates are highlighted in red)

	Experimenting	Friends	Negative emotions	Positive emotions	Priority	Seriousness	Social	Story
Autonomy satisfaction	-0.08	0.30	-0.08	0.36	-0.29	-0.02	0.14	-0.02
Autonomy frustration	0.21	0.31	-0.06	0.61	-0.28	0.19	0.24	0.05
Relatedness satisfaction	0.00	0.01	-0.12	0.57	-0.19	0.11	0.12	-0.02
Relatedness frustration	0.14	0.18	0.01	0.56	-0.30	0.14	0.26	0.13
Competence	0.09	0.31	0.03	0.69	-0.28	0.03	0.11	0.15

Table L-12

ANCOVA with social as dependent variable for participants whose wellbeing was higher than expected based on their relatedness frustration when controlling for all other needs and wellbeing

Descriptive Statistics

Dependent Variable: Social

Relatedness frustration	Mean	Std. Deviation	N
	0.15	0.90	186.00
Wellbeing lower than expected	0.20	0.95	120.00
Wellbeing higher than expected	0.46	0.96	125.00
Total	0.25	0.94	431.00

Tests of Between-Subjects Effects

Dependent Variable: Social

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.754	7.00	1.68	1.92	0.07
Intercept	30.70	1.00	30.70	35.06	0.00
Autonomy satisfaction	0.51	1.00	0.51	0.59	0.44
Relatedness satisfaction	1.25	1.00	1.25	1.43	0.23
Autonomy frustration	0.50	1.00	0.50	0.57	0.45
WHO-5	0.10	1.00	0.10	0.12	0.73
Competence satisfaction	2.37	1.00	2.37	2.70	0.10
Relatedness frustration	5.59	2.00	2.80	3.19	0.04
Error	370.37	423.00	0.88		
Total	409.97	431.00			
Corrected Total	382.12	430.00			

Table L-13

ANCOVA with positive emotions as dependent variable for participants whose wellbeing was higher than expected based on their relatedness frustration when controlling for all other needs and wellbeing

Descriptive Statistics

Dependent Variable: Positive Emotions

Relatedness frustration	Mean	Std. Deviation	N
	0.02	0.94	201.00
Wellbeing lower than expected	-0.48	1.07	112.00
Wellbeing higher than expected	0.23	0.85	118.00
Total	-0.05	0.99	431.00

Tests of Between-Subjects Effects

Dependent Variable: Positive Emotions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52.377[a]	7.00	7.48	8.67	0.00
Intercept	1.73	1.00	1.73	2.00	0.16
Autonomy satisfaction	11.59	1.00	11.59	13.43	0.00
Relatedness satisfaction	0.20	1.00	0.20	0.23	0.63
Autonomy frustration	0.74	1.00	0.74	0.86	0.35
WHO	0.04	1.00	0.04	0.04	0.84
Relatedness frustration	2.85	1.00	2.85	3.30	0.07
Competence satisfaction	8.34	2.00	4.17	4.83	0.01
Error	365.20	423.00	0.86		
Total	418.67	431.00			
Corrected Total	417.57	430.00			

Table L-14

Results of clustering by needs and wellbeing. Descriptives of the needs and wellbeing of the ANOVA establishing differences between the clusters.

	Cluster number	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Autonomy satisfaction	1	69	-0.63	0.77	0.09	-0.81	-0.44	-2.05	1.95
	2	123	0.27	0.60	0.05	0.16	0.37	-1.23	1.95
	3	40	0.12	0.69	0.11	-0.10	0.34	-1.23	1.95
	4	125	0.87	0.71	0.06	0.75	1.00	-0.73	1.95
	5	59	-1.48	0.74	0.10	-1.67	-1.28	-3.16	-0.05
	6	46	0.53	0.63	0.09	0.34	0.72	-0.74	1.95
	7	69	-0.59	0.54	0.07	-0.72	-0.46	-2.04	0.42
	Total	531	0.00	1.00	0.04	-0.09	0.09	-3.16	1.95
Autonomy frustration	1	69	0.84	0.77	0.09	0.66	1.03	-1.06	2.63
	2	123	-0.35	0.73	0.07	-0.48	-0.21	-2.34	1.19
	3	40	0.80	0.73	0.12	0.57	1.03	-0.49	2.63
	4	125	-0.85	0.82	0.07	-1.00	-0.70	-2.34	1.48
	5	59	0.85	0.68	0.09	0.67	1.02	-1.33	2.17
	6	46	-0.37	0.76	0.11	-0.59	-0.14	-1.83	1.79
	7	69	0.37	0.68	0.08	0.21	0.53	-1.81	1.86
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.34	2.63
Relatedness satisfaction	1	69	-0.11	0.68	0.08	-0.27	0.05	-1.79	1.38
	2	123	0.71	0.66	0.06	0.59	0.83	-0.78	1.38
	3	40	-0.36	0.71	0.11	-0.59	-0.13	-1.87	1.38
	4	125	0.71	0.63	0.06	0.60	0.83	-1.00	1.38
	5	59	-1.35	0.79	0.10	-1.56	-1.15	-2.90	0.47
	6	46	-1.05	0.65	0.10	-1.24	-0.86	-2.90	0.20
	7	69	-0.38	0.57	0.07	-0.52	-0.25	-1.36	1.38
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.90	1.38
Relatedness frustration	1	69	0.10	0.72	0.09	-0.07	0.28	-1.25	1.43
	2	123	-0.53	0.59	0.05	-0.64	-0.43	-1.25	0.71
	3	40	1.29	0.56	0.09	1.11	1.47	0.66	3.02
	4	125	-0.82	0.55	0.05	-0.92	-0.72	-1.25	1.26
	5	59	1.50	0.58	0.08	1.35	1.65	0.49	3.02
	6	46	0.16	0.86	0.13	-0.10	0.41	-1.25	2.61
	7	69	0.20	0.63	0.08	0.05	0.35	-1.25	1.61
	Total	531	0.00	1.00	0.04	-0.09	0.09	-1.25	3.02
Competence satisfaction	1	69	-1.16	0.50	0.06	-1.28	-1.04	-2.90	-0.38
	2	123	-0.13	0.43	0.04	-0.20	-0.05	-1.40	0.81
	3	40	-0.23	0.44	0.07	-0.37	-0.09	-1.05	0.97
	4	125	1.07	0.56	0.05	0.97	1.17	0.19	2.03
	5	59	-1.34	0.73	0.09	-1.53	-1.15	-2.90	0.61

	6	46	0.85	0.58	0.09	0.68	1.02	-0.19	2.03
	7	69	0.16	0.51	0.06	0.03	0.28	-0.70	2.03
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.90	2.03
WHO-5	1	69	-0.88	0.70	0.08	-1.05	-0.71	-2.84	0.93
	2	123	0.25	0.64	0.06	0.14	0.37	-1.74	3.06
	3	40	0.00	0.64	0.10	-0.21	0.20	-1.27	1.46
	4	125	1.02	0.71	0.06	0.89	1.14	-1.05	3.06
	5	59	-1.27	0.64	0.08	-1.44	-1.11	-2.46	0.29
	6	46	-0.05	0.80	0.12	-0.29	0.18	-2.13	1.45
	7	69	-0.29	0.58	0.07	-0.43	-0.15	-1.81	1.42
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.84	3.06

Table L-15

ANOVA analysing differences in needs and wellbeing between groups based on clustering of needs and wellbeing.

Need		Sum of Squares	df	Mean Square	F	Sig.
Autonomy satisfaction	Between Groups	297	6	49	111	0.000
	Within Groups	234	524	0		
	Total	531	530			
Autonomy frustration	Between Groups	237	6	40	71	0.000
	Within Groups	294	524	1		
	Total	531	530			
Relatedness satisfaction	Between Groups	300	6	50	114	0.000
	Within Groups	231	524	0		
	Total	531	530			
Relatedness frustration	Between Groups	324	6	54	136	0.000
	Within Groups	207	524	0		
	Total	531	530			
Competence satisfaction	Between Groups	380	6	63	220	0.000
	Within Groups	151	524	0		
	Total	531	530			
WHO-5	Between Groups	293	6	49	107	0.000
	Within Groups	238	524	0		

Table L-16

Results of clustering by needs and wellbeing. Descriptives of the game usage factors of the ANOVA establishing differences between the clusters.

						95% Confidence Interval for Mean			
	Cluster number	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Mini mum	Maxi mum
Experi-menting	1	69.00	-0.10	0.87	0.11	-0.31	0.11	-2.15	2.44
	2	123.00	0.12	0.98	0.09	-0.06	0.29	-2.15	2.44
	3	40.00	0.55	0.98	0.16	0.23	0.86	-2.15	2.44
	4	125.00	-0.11	1.07	0.10	-0.30	0.08	-2.15	2.44
	5	59.00	-0.05	1.08	0.14	-0.33	0.23	-2.15	2.44
	6	46.00	-0.25	1.08	0.16	-0.57	0.08	-2.15	2.44
	7	69.00	-0.02	0.80	0.10	-0.21	0.17	-2.15	1.43
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.15	2.44
Friends	1	69.00	-0.04	1.06	0.13	-0.30	0.21	-1.62	1.60
	2	123.00	0.26	0.94	0.08	0.09	0.43	-1.62	2.25
	3	40.00	0.10	1.08	0.17	-0.24	0.45	-1.62	2.25
	4	125.00	0.00	1.02	0.09	-0.18	0.18	-1.62	1.90
	5	59.00	-0.36	0.95	0.12	-0.61	-0.12	-1.62	1.55
	6	46.00	-0.28	0.90	0.13	-0.55	-0.01	-1.62	1.57
	7	69.00	0.01	0.96	0.12	-0.22	0.24	-1.62	1.83
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-1.62	2.25
Negative Emotions	1	69.00	0.07	0.99	0.12	-0.16	0.31	-1.74	2.27
	2	123.00	-0.07	0.92	0.08	-0.24	0.09	-1.74	3.08
	3	40.00	0.55	1.09	0.17	0.20	0.90	-1.74	3.08
	4	125.00	-0.33	1.02	0.09	-0.51	-0.14	-1.74	3.08
	5	59.00	0.32	1.04	0.14	0.05	0.59	-1.74	3.08
	6	46.00	-0.01	0.99	0.15	-0.31	0.28	-1.74	2.66
	7	69.00	0.07	0.79	0.10	-0.12	0.26	-1.74	1.96
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-1.74	3.08
Positive Emotions	1	69.00	-0.26	1.05	0.13	-0.52	-0.01	-2.80	1.82
	2	123.00	0.34	0.82	0.07	0.19	0.48	-1.58	1.82
	3	40.00	-0.10	0.95	0.15	-0.41	0.20	-2.34	1.82
	4	125.00	0.17	0.93	0.08	0.00	0.33	-2.55	1.82
	5	59.00	-0.57	1.15	0.15	-0.87	-0.27	-3.05	1.82
	6	46.00	-0.03	1.05	0.15	-0.34	0.28	-2.38	1.82
	7	69.00	-0.07	0.96	0.12	-0.30	0.16	-2.86	1.82
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-3.05	1.82
Priority	1	69.00	0.11	1.02	0.12	-0.14	0.36	-2.13	1.95
	2	123.00	-0.14	0.99	0.09	-0.32	0.04	-2.13	2.39
	3	40.00	0.01	1.00	0.16	-0.30	0.33	-1.65	1.95
	4	125.00	-0.13	1.01	0.09	-0.31	0.05	-2.13	1.95
	5	59.00	0.08	1.04	0.14	-0.19	0.35	-2.13	2.39

	6	46.00	0.30	1.00	0.15	0.00	0.60	-1.66	2.39
	7	69.00	0.10	0.89	0.11	-0.11	0.31	-1.66	2.39
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.13	2.39
Seriousness	1	69.00	-0.14	0.99	0.12	-0.38	0.09	-2.52	1.90
	2	123.00	-0.07	1.00	0.09	-0.25	0.11	-2.28	1.90
	3	40.00	0.35	1.01	0.16	0.02	0.67	-2.52	1.90
	4	125.00	0.14	0.95	0.08	-0.03	0.31	-2.22	1.90
	5	59.00	-0.36	0.99	0.13	-0.62	-0.10	-2.53	1.90
	6	46.00	0.44	1.03	0.15	0.14	0.75	-2.36	1.90
	7	69.00	-0.17	0.93	0.11	-0.40	0.05	-3.41	1.90
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-3.41	1.90
Social	1	69.00	-0.17	0.87	0.10	-0.38	0.04	-1.10	2.12
	2	123.00	0.07	1.06	0.10	-0.12	0.26	-1.10	2.52
	3	40.00	0.24	1.04	0.16	-0.09	0.57	-1.10	2.52
	4	125.00	0.00	1.01	0.09	-0.18	0.18	-1.10	2.52
	5	59.00	-0.12	1.01	0.13	-0.38	0.15	-1.10	2.52
	6	46.00	0.23	1.09	0.16	-0.09	0.55	-1.10	2.52
	7	69.00	-0.15	0.87	0.10	-0.35	0.06	-1.10	1.43
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-1.10	2.52
Story	1	69.00	0.05	0.92	0.11	-0.17	0.27	-1.55	1.96
	2	123.00	0.07	1.04	0.09	-0.12	0.25	-2.16	1.96
	3	40.00	0.13	0.80	0.13	-0.12	0.39	-1.73	1.96
	4	125.00	-0.15	1.03	0.09	-0.33	0.04	-2.16	1.96
	5	59.00	0.05	1.08	0.14	-0.24	0.33	-2.16	1.96
	6	46.00	0.03	1.01	0.15	-0.28	0.33	-2.16	1.96
	7	69.00	-0.04	0.98	0.12	-0.28	0.20	-2.16	1.96
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.16	1.96

Table L-17

ANOVA analysing differences in game usage between groups based on clustering of needs and wellbeing.

		Sum of Squares	df	Mean Square	F	Sig.
Experi-menting	Between Groups	19	6	3	3	0.004
	Within Groups	511	524	1		
	Total	530	530			
Friends	Between Groups	20	6	3	4	0.002
	Within Groups	510	524	1		
	Total	530	530			
Negative Emotions	Between Groups	33	6	5	6	0.000
	Within Groups	497	524	1		
	Total	530	530			
Positive Emotions	Between Groups	42	6	7	8	0.000
	Within Groups	488	524	1		
	Total	530	530			
Priority	Between Groups	11	6	2	2	0.100
	Within Groups	519	524	1		
	Total	530	530			
Seriousness	Between Groups	28	6	5	5	0.000
	Within Groups	502	524	1		
	Total	530	530			
Social	Between Groups	10	6	2	2	0.137
	Within Groups	520	524	1		
	Total	530	530			
Story	Between Groups	4	6	1	1	0.631
	Within Groups	526	524	1		
	Total	530	530			

Table L-18

Results of clustering by game usage. Descriptives of the game usage factors of the ANOVA establishing differences between the clusters.

						95% Confidence Interval for Mean			
	Cluster number	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Experi-menting	1	75	-0.50	0.82	0.10	-0.69	-0.31	-2.15	1.03
	2	56	-0.31	0.87	0.12	-0.54	-0.07	-2.15	1.43
	3	55	0.64	0.90	0.12	0.40	0.88	-1.13	2.44
	4	67	-0.47	0.86	0.11	-0.68	-0.26	-2.15	1.03
	5	47	-0.60	0.76	0.11	-0.82	-0.37	-2.15	0.60
	6	45	-0.04	0.91	0.14	-0.31	0.24	-2.15	1.89
	7	60	0.89	0.83	0.11	0.67	1.10	-0.70	2.44

	8	73	0.56	0.83	0.10	0.37	0.76	-2.15	2.44
	9	53	-0.25	0.88	0.12	-0.49	0.00	-2.15	1.43
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.15	2.44
Friends	1	75	-1.01	0.65	0.07	-1.16	-0.86	-1.62	1.42
	2	56	0.30	0.88	0.12	0.06	0.54	-1.62	1.83
	3	55	0.66	0.65	0.09	0.49	0.84	-1.62	2.25
	4	67	0.49	0.89	0.11	0.27	0.71	-1.62	2.25
	5	47	0.29	0.88	0.13	0.03	0.55	-1.62	2.25
	6	45	-1.13	0.60	0.09	-1.31	-0.96	-1.62	0.41
	7	60	-0.46	0.77	0.10	-0.66	-0.27	-1.62	1.42
	8	73	0.66	0.65	0.08	0.51	0.81	-0.95	1.83
	9	53	0.13	0.81	0.11	-0.09	0.36	-1.62	1.58
	Total	531	0.00	1.00	0.04	-0.09	0.09	-1.62	2.25
Negative	1	75	-0.04	0.71	0.08	-0.20	0.12	-1.74	1.14
Emotions	2	56	1.42	0.69	0.09	1.24	1.61	0.09	3.08
	3	55	0.67	1.02	0.14	0.40	0.95	-1.74	3.08
	4	67	-0.43	0.69	0.08	-0.60	-0.26	-1.74	1.14
	5	47	-0.05	0.67	0.10	-0.25	0.14	-1.74	1.61
	6	45	-1.18	0.55	0.08	-1.35	-1.02	-1.74	-0.39
	7	60	0.40	0.62	0.08	0.24	0.56	-0.46	2.27
	8	73	-0.21	0.74	0.09	-0.38	-0.04	-1.74	1.14
	9	53	-0.72	0.74	0.10	-0.92	-0.51	-1.74	0.64
	Total	531	0.00	1.00	0.04	-0.09	0.09	-1.74	3.08
Positive	1	75	-0.93	0.79	0.09	-1.11	-0.74	-2.86	0.55
Emotions	2	56	-1.15	0.78	0.10	-1.36	-0.94	-3.05	0.68
	3	55	0.46	0.81	0.11	0.24	0.68	-0.91	1.82
	4	67	0.35	0.72	0.09	0.17	0.52	-1.11	1.82
	5	47	-0.13	0.84	0.12	-0.38	0.11	-2.16	1.82
	6	45	0.75	0.65	0.10	0.55	0.94	-0.39	1.82
	7	60	0.74	0.74	0.10	0.55	0.93	-1.18	1.82
	8	73	0.40	0.65	0.08	0.25	0.56	-1.13	1.82
	9	53	-0.30	0.81	0.11	-0.52	-0.08	-2.27	1.82
	Total	531	0.00	1.00	0.04	-0.09	0.09	-3.05	1.82
Priority	1	75	-0.70	0.78	0.09	-0.88	-0.52	-2.13	1.31
	2	56	-0.08	0.80	0.11	-0.30	0.13	-1.60	1.95
	3	55	1.06	0.70	0.09	0.87	1.25	-0.48	2.39
	4	67	-0.91	0.66	0.08	-1.08	-0.75	-2.13	0.71
	5	47	0.54	0.89	0.13	0.28	0.80	-1.26	2.39
	6	45	-0.06	0.81	0.12	-0.30	0.19	-1.65	1.95
	7	60	0.24	0.84	0.11	0.02	0.46	-2.13	2.39
	8	73	-0.38	0.67	0.08	-0.54	-0.22	-2.13	1.25
	9	53	0.95	0.66	0.09	0.77	1.13	-0.53	2.39
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.13	2.39
Seriousness	1	75	-0.83	0.81	0.09	-1.02	-0.64	-2.53	1.32
	2	56	0.05	0.82	0.11	-0.17	0.27	-2.22	1.90
	3	55	1.17	0.64	0.09	1.00	1.34	0.02	1.90
	4	67	-0.48	0.83	0.10	-0.69	-0.28	-2.47	1.32
	5	47	1.29	0.51	0.07	1.14	1.44	0.37	1.90
	6	45	-0.44	0.80	0.12	-0.68	-0.20	-3.41	1.01
	7	60	0.32	0.83	0.11	0.10	0.54	-1.34	1.90
	8	73	-0.17	0.66	0.08	-0.33	-0.02	-1.90	1.40
	9	53	-0.37	0.62	0.09	-0.54	-0.20	-2.52	0.65
	Total	531	0.00	1.00	0.04	-0.09	0.09	-3.41	1.90
Social	1	75	-0.89	0.42	0.05	-0.99	-0.79	-1.10	0.73
	2	56	0.25	0.80	0.11	0.03	0.46	-1.10	2.12
	3	55	1.27	0.77	0.10	1.06	1.47	-1.10	2.52
	4	67	-0.61	0.66	0.08	-0.77	-0.45	-1.10	1.79
	5	47	0.48	0.72	0.10	0.27	0.69	-1.10	2.52
	6	45	-0.79	0.57	0.08	-0.96	-0.62	-1.10	0.98
	7	60	-0.81	0.50	0.06	-0.94	-0.69	-1.10	0.84
	8	73	0.82	0.64	0.07	0.67	0.97	-1.10	2.52
	9	53	0.49	0.66	0.09	0.31	0.68	-1.10	2.12
	Total	531	0.00	1.00	0.04	-0.09	0.09	-1.10	2.52
Story	1	75	-0.03	0.87	0.10	-0.24	0.17	-2.16	1.96
	2	56	-0.60	0.77	0.10	-0.81	-0.40	-2.16	1.24
	3	55	0.36	0.91	0.12	0.12	0.61	-1.73	1.96
	4	67	-0.91	0.78	0.10	-1.10	-0.72	-2.16	1.09
	5	47	-0.82	0.63	0.09	-1.00	-0.63	-2.16	0.51
	6	45	0.90	0.74	0.11	0.68	1.12	-1.02	1.96
	7	60	0.77	0.76	0.10	0.58	0.97	-1.73	1.96
	8	73	0.45	0.78	0.09	0.27	0.63	-1.55	1.96
	9	53	-0.07	0.82	0.11	-0.29	0.16	-2.16	1.48
	Total	531	0.00	1.00	0.04	-0.09	0.09	-2.16	1.96

Table L-19

ANOVA analysing differences in game usage between groups based on clustering of game usage

		Sum of Squares	df	Mean Square	F	Sig.
Experi-menting	Between Groups	152	8	19	26	0.000
	Within Groups	378	522	1		
	Total	530	530			
Friends	Between Groups	230	8	29	50	0.000
	Within Groups	300	522	1		
	Total	530	530			
Negative Emotions	Between Groups	254	8	32	60	0.000
	Within Groups	276	522	1		
	Total	530	530			

Positive Emotions	Between Groups	234	8	29	51	0.000
	Within Groups	296	522	1		
	Total	530	530			
Priority	Between Groups	231	8	29	50	0.000
	Within Groups	299	522	1		
	Total	530	530			
Seriousness	Between Groups	245	8	31	56	0.000
	Within Groups	285	522	1		
	Total	530	530			
Social	Between Groups	316	8	40	97	0.000
	Within Groups	214	522	0		
	Total	530	530			
Story	Between Groups	202	8	25	40	0.000
	Within Groups	328	522	1		
	Total	530	530			

Table L-20

Results of clustering by game usage. Descriptives of the needs and wellbeing of the ANOVA establishing differences between the clusters.

						95% Confidence Interval for Mean			
	Cluster number	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
WHO-5	1	75.00	-0.37	0.89	0.10	-0.58	-0.16	-2.84	1.46
	2	56.00	-0.35	1.08	0.14	-0.64	-0.06	-2.42	1.46
	3	55.00	0.14	1.07	0.14	-0.15	0.43	-2.53	3.06
	4	67.00	0.30	0.80	0.10	0.10	0.49	-1.57	2.23
	5	47.00	0.09	1.07	0.16	-0.22	0.41	-2.13	3.06
	6	45.00	0.34	0.96	0.14	0.05	0.63	-1.74	2.30
	7	60.00	0.01	0.96	0.12	-0.23	0.26	-2.00	3.06
	8	73.00	0.09	0.83	0.10	-0.10	0.29	-2.11	2.01
	9	53.00	-0.14	1.20	0.16	-0.47	0.19	-2.47	3.06
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.84	3.06
Autonomy satisfaction	1	75.00	-0.30	0.91	0.11	-0.51	-0.09	-2.08	1.95
	2	56.00	-0.54	1.18	0.16	-0.86	-0.23	-3.16	1.95
	3	55.00	0.16	1.04	0.14	-0.13	0.44	-2.75	1.95
	4	67.00	0.27	0.71	0.09	0.09	0.44	-1.23	1.95
	5	47.00	0.11	0.98	0.14	-0.18	0.40	-3.16	1.95
	6	45.00	0.38	0.97	0.14	0.09	0.67	-1.68	1.95
	7	60.00	0.10	1.03	0.13	-0.17	0.37	-2.04	1.95
	8	73.00	0.10	0.87	0.10	-0.11	0.30	-2.04	1.95
	9	53.00	-0.17	1.05	0.14	-0.47	0.12	-2.75	1.95
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-3.16	1.95
Autonomy frustration	1	75.00	0.28	0.80	0.09	0.10	0.46	-1.41	2.18
	2	56.00	0.29	1.03	0.14	0.01	0.56	-2.34	2.17
	3	55.00	0.32	1.08	0.15	0.03	0.62	-1.83	2.63
	4	67.00	-0.37	0.83	0.10	-0.57	-0.17	-2.34	1.79
	5	47.00	-0.38	1.04	0.15	-0.69	-0.08	-2.34	1.78
	6	45.00	-0.36	1.04	0.15	-0.68	-0.05	-2.34	1.86
	7	60.00	0.17	0.89	0.11	-0.06	0.40	-1.83	1.88
	8	73.00	-0.01	1.00	0.12	-0.24	0.23	-2.34	2.17
	9	53.00	-0.10	1.08	0.15	-0.40	0.20	-2.34	1.80
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.34	2.63
Relatedness satisfaction	1	75.00	-0.24	0.98	0.11	-0.46	-0.01	-2.90	1.38
	2	56.00	-0.25	1.01	0.14	-0.53	0.02	-2.90	1.38
	3	55.00	0.05	1.03	0.14	-0.23	0.33	-2.33	1.38
	4	67.00	0.33	0.79	0.10	0.14	0.52	-1.51	1.38
	5	47.00	-0.05	1.05	0.15	-0.36	0.25	-2.24	1.38
	6	45.00	0.24	0.93	0.14	-0.03	0.52	-1.30	1.38
	7	60.00	-0.02	1.10	0.14	-0.30	0.26	-2.90	1.38
	8	73.00	0.19	1.01	0.12	-0.05	0.43	-2.90	1.38
	9	53.00	-0.26	0.94	0.13	-0.52	0.00	-2.28	1.38
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.90	1.38
Relatedness frustration	1	75.00	0.29	0.95	0.11	0.08	0.51	-1.25	2.10
	2	56.00	0.42	0.98	0.13	0.15	0.68	-1.25	2.43
	3	55.00	0.09	1.22	0.16	-0.24	0.42	-1.25	3.02
	4	67.00	-0.39	0.79	0.10	-0.58	-0.19	-1.25	2.57
	5	47.00	-0.14	0.96	0.14	-0.42	0.14	-1.25	2.03
	6	45.00	-0.50	0.80	0.12	-0.74	-0.26	-1.25	2.61
	7	60.00	0.12	1.00	0.13	-0.14	0.38	-1.25	3.02
	8	73.00	-0.06	0.96	0.11	-0.29	0.16	-1.25	2.02
	9	53.00	0.03	1.01	0.14	-0.25	0.31	-1.25	3.02
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-1.25	3.02
Competence satisfaction	1	75.00	-0.21	1.12	0.13	-0.47	0.04	-2.55	2.03
	2	56.00	-0.32	1.04	0.14	-0.60	-0.04	-2.90	2.03
	3	55.00	0.02	0.94	0.13	-0.24	0.27	-2.15	2.03
	4	67.00	0.13	0.90	0.11	-0.09	0.35	-2.90	2.03
	5	47.00	0.35	1.11	0.16	0.03	0.68	-2.90	2.03
	6	45.00	0.31	0.92	0.14	0.04	0.59	-1.75	2.03
	7	60.00	-0.11	1.00	0.13	-0.37	0.15	-2.90	2.03
	8	73.00	-0.04	0.82	0.10	-0.23	0.15	-1.75	2.03
	9	53.00	0.05	1.02	0.14	-0.23	0.34	-1.90	2.03
	Total	531.00	0.00	1.00	0.04	-0.09	0.09	-2.90	2.03

Table L-21

ANOVA analysing differences in needs and wellbeing between groups based on clustering of game usage

		Sum of Squares	df	Mean Square	F	Sig.
WHO-5	Between Groups	31	8	4	4	0.000
	Within Groups	500	522	1		
	Total	531	530			
Autonomy satisfaction	Between Groups	39	8	5	5	0.000
	Within Groups	492	522	1		
	Total	531	530			
Autonomy frustration	Between Groups	41	8	5	5	0.000
	Within Groups	490	522	1		
	Total	531	530			
Relatedness satisfaction	Between Groups	24	8	3	3	0.002
	Within Groups	507	522	1		
	Total	531	530			
Relatedness frustration	Between Groups	40	8	5	5	0.000
	Within Groups	491	522	1		
	Total	531	530			
Competence satisfaction	Between Groups	22	8	3	3	0.005
	Within Groups	509	522	1		
	Total	531	530			

Table L-22

ANOVA comparing the game usage of online and offline players

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
Experimenting	Between Groups	0.19	3	1	2.81	2.82	0.09
	Within Groups		527	529	1.00		
	Total		530	530			
Friends	Between Groups	1.20	116	1	116.17	148.50	0.00
	Within Groups		414	529	0.78		
	Total		530	530			
Negative Emotions	Between Groups	0.17	2	1	2.28	2.28	0.13
	Within Groups		528	529	1.00		
	Total		530	530			
Positive Emotions	Between Groups	-0.27	6	1	5.83	5.88	0.02
	Within Groups		524	529	0.99		
	Total		530	530			
Priority	Between Groups	0.65	34	1	33.97	36.23	0.00
	Within Groups		496	529	0.94		
	Total		530	530			
Seriousness	Between Groups	0.49	19	1	19.26	19.95	0.00
	Within Groups		511	529	0.97		
	Total		530	530			
Story	Between Groups	-0.45	17	1	16.63	17.14	0.00
	Within Groups		513	529	0.97		
	Total		530	530			

Table L-23

ANOVA comparing the age and personality traits of online and offline players

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	0.00	0	1	0.00	0.00	1.00
	Within Groups		29596	529	55.95		
	Total		29596	530			
Openness	Between Groups	-0.14	1	1	1.48	1.48	0.22

	Within Groups		529	529	1.00			
	Total		530	530				
Conscientiousness	Between Groups	-0.24	5	1	4.55	4.58	0.03	
	Within Groups		525	529	0.99			
	Total		530	530				
Extraversion	Between Groups	0.00	0	1	0.00	0.00	0.98	
	Within Groups		530	529	1.00			
	Total		530	530				
Agreeableness	Between Groups	-0.19	3	1	2.97	2.98	0.08	
	Within Groups		527	529	1.00			
	Total		530	530				
Negative Emotionality	Between Groups	-0.19	3	1	3.02	3.03	0.08	
	Within Groups		527	529	1.00			
	Total		530	530				

Table L-24

ANOVA comparing the wellbeing and needs of online and offline players

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
WHO	Between Groups	-0.01	0	1	0.01	0.01	0.94
	Within Groups		531	529	1.00		
	Total		531	530			
Autonomy satisfaction	Between Groups	-0.13	1	1	1.36	1.36	0.24
	Within Groups		530	529	1.00		
	Total		531	530			
Autonomy frustration	Between Groups	-0.08	1	1	0.51	0.51	0.48
	Within Groups		530	529	1.00		
	Total		531	530			
Relatedness satisfaction	Between Groups	-0.12	1	1	1.22	1.22	0.27
	Within Groups		530	529	1.00		
	Total		531	530			
Relatedness frustration	Between Groups	-0.03	0	1	0.07	0.07	0.79
	Within Groups		531	529	1.00		
	Total		531	530			
Competence satisfaction	Between Groups	-0.01	0	1	0.02	0.02	0.90
	Within Groups		531	529	1.00		
	Total		531	530			

Table L-25

ANOVA comparing the game usage of adolescents and older participants

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
Online	Between Groups	-0.02	0	1	0.04	0.26	0.61
	Within Groups		81	529	0.15		
	Total		81	530			
Experimenting	Between Groups	0.11	1	1	1.30	1.30	0.26
	Within Groups		529	529	1.00		
	Total		530	530			
Friends	Between Groups	0.27	8	1	7.61	7.70	0.01
	Within Groups		522	529	0.99		
	Total		530	530			
Negative Emotions	Between Groups	0.19	4	1	3.67	3.69	0.06
	Within Groups		526	529	0.99		
	Total		530	530			
Positive Emotions	Between Groups	0.18	4	1	3.67	3.69	0.06
	Within Groups		526	529	0.99		
	Total		530	530			
Priority	Between Groups	-0.04	0	1	0.21	0.21	0.64

	Within Groups		530	529	1.00		
	Total		530	530			
Seriousness	Between Groups	0.04	0	1	0.15	0.15	0.70
	Within Groups		530	529	1.00		
	Total		530	530			
Social	Between Groups	0.29	9	1	8.81	8.94	0.00
	Within Groups		521	529	0.99		
	Total		530	530			
Story	Between Groups	0.03	0	1	0.07	0.07	0.80
	Within Groups		530	529	1.00		
	Total		530	530			

Table L-26

ANOVA comparing the personality traits of adolescents and older participants

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
Openness	Between Groups	-0.28	8	1	8.21	8.33	0.00
	Within Groups		522	529	0.99		
	Total		530	530			
Conscientiousness	Between Groups	-0.25	7	1	6.71	6.79	0.01
	Within Groups		523	529	0.99		
	Total		530	530			
Extraversion	Between Groups	0.02	0	1	0.05	0.05	0.83
	Within Groups		530	529	1.00		
	Total		530	530			
Agreeableness	Between Groups	-0.10	1	1	1.02	1.02	0.31
	Within Groups		529	529	1.00		
	Total		530	530			
Negative Emotionality	Between Groups	0.00	0	1	0.00	0.00	0.97
	Within Groups		530	529	1.00		
	Total		530	530			

Table L-27

ANOVA comparing the wellbeing and needs of adolescents and older participants

		Difference of means	Sum of Squares	df	Mean Square	F	Sig.
WHO-5	Between Groups	0.01	0	1	0.01	0.01	0.94
	Within Groups		531	529	1.00		
	Total		531	530			
Autonomy satisfaction	Between Groups	-0.01	0	1	0.02	0.02	0.88
	Within Groups		531	529	1.00		
	Total		531	530			
Autonomy frustration	Between Groups	0.02	0	1	0.04	0.04	0.85
	Within Groups		531	529	1.00		
	Total		531	530			
Relatedness satisfaction	Between Groups	0.01	0	1	0.02	0.02	0.90
	Within Groups		531	529	1.00		
	Total		531	530			
Relatedness frustration	Between Groups	0.21	5	1	4.59	4.61	0.03
	Within Groups		526	529	1.00		
	Total		531	530			
Competence satisfaction	Between Groups	-0.13	2	1	1.90	1.89	0.17
	Within Groups		529	529	1.00		
	Total		531	530			

Appendix M: Plots of sample-split by expected wellbeing

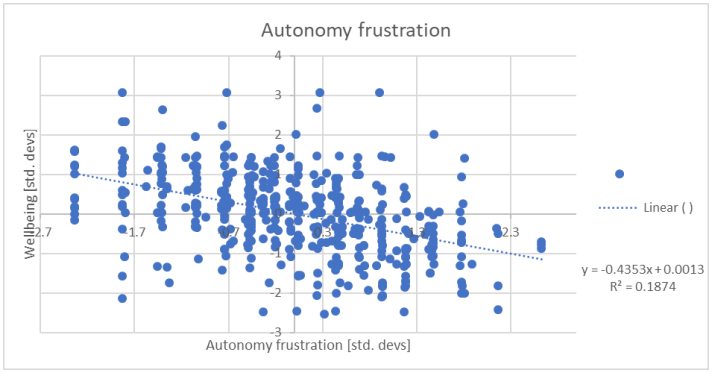


Figure M-1:Plot of sample split by expected wellbeing based on autonomy frustration

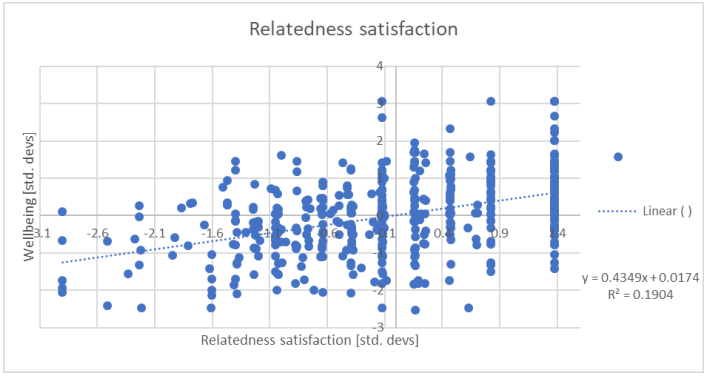


Figure M-2: Plot of sample split by expected wellbeing based on relatedness satisfaction

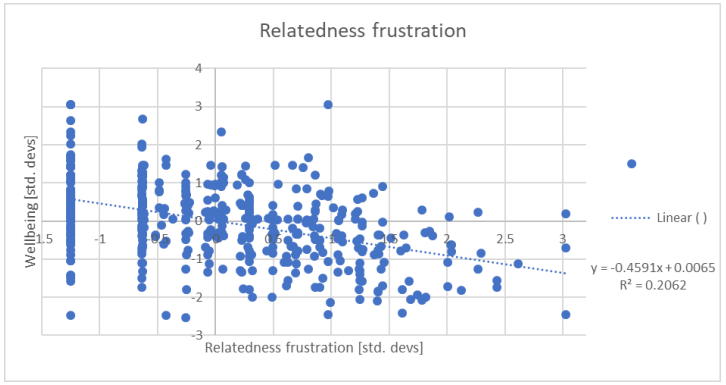


Figure M-3: Plot of sample split by expected wellbeing based on relatedness frustration

Figure M-4: Plot of sample split by expected wellbeing based on competence satisfaction