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Player Retention in a Free-to-Play Mobile Game: The Role of Engagement

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Sitoutumisen rooli pelaamisen jatkamisessa ilmaisessa mobiilipelissä (Maiju Putkonen)
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Tämä pro gradu -tutkielma tarkastelee pelaajien sitoutumista ja pelaamisen jatkamista ilmaisessa mobiilipelissä. Tutkimuksessa tarkastellaan tilastollisen analyysin avulla 5,000 ensikertalaispelaajaa mobiilipelissä ensimmäisen pelipäivänsä aikana.

Peliin sitoutuminen määritellään yhdistelemällä aiemman tutkimuksen näkökulmia. Pohjana määrittelylle toimivat kouluoppimiseen sitoutumisen ja peleihin sitoutumisen teoriat. Peliin sitoutuminen määritellään pelaajan osallistumisena, kiinnostuksena ja suhteena peliin. Tarkemmin peliin sitoutuminen määritellään neljästä osasta koostuvana käsitteenä. Nämä osat ovat behaviouraalinen, kognitiivinen, affektiivinen ja toimijuudellinen sitoutuminen. Tässä tutkimuksessa tutkitaan behavioraalista ja toimijuudellista peliin sitoutumista.

Tutkimuksessa tarkastellaan sitä, onko pelaajien ensimmäisen pelipäivän toiminnalla yhteyttä siihen, jatkaako pelaaja pelaamista. Pelaamisen jatkamista tarkastellaan kahtena ajankohtana: ensimmäisen pelipäivän ja ensimmäisen peliviikon jälkeen. Tutkimuskysymykset tarkastelevat sitä, miten behavioraalinen ja toimijuudellinen peliin sitoutuminen ensimmäisenä päivänä ennustaa pelaamisen jatkamista ensimmäisen pelipäivän ja ensimmäisen peliviikon jälkeen.

Tutkimuksen tulokset osoittavat, että behavioraalinen ja toimijuudellinen peliin sitoutuminen ensimmäisenä pelipäivänä ennustavat tilastollisesti merkittävästi pelaamisen jatkamista. Ensimmäisen päivän pelitoiminnoilla oli erilaisia yhteyksiä yhden päivän ja yhden viikon pelaamisen jälkeen. Merkitsevimmät ensipäivän pelitoiminnot, jotka ennustivat pelaamisen jatkamista sekä ensimmäisen päivän jälkeen että ensimmäisen viikon jälkeen olivat pelin kustomointi sekä palkintojen kerääminen. Myös sosiaalisella vuorovaikutuksella ja pelissä käytetyllä ajalla oli vaikutusta ensimmäisen päivän jälkeen pelaamisen jatkamiseen. Ensimmäisen viikon jälkeen ensipäivän toiminnasta vaikuttavia olivat myös pelissä käytetty aika, palkintojen kerääminen sekä taitotaso. Tutkimuksen tuloksia voi hyödyntää erilaisten pelipohjaisten ratkaisujen suunnittelussa.

Avainsanat: sitoutuminen, peleihin sitoutuminen, pelillistäminen, pelipohjainen oppiminen, mobiilipelit, pelitutkimus

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This master's thesis studies engagement and player retention in a free-to-play mobile game. The research design of this study was causal comparative. The study was based on statistical analysis of 5,000 first time players of a mobile game. These players' behaviour on their first day of playing was analysed.

Game engagement was defined by combining views of prior research of school engagement and game engagement. Game engagement was defined as players' involvement, interest, and connection to a game. Game engagement was further defined as a four-dimensional concept consisting of behavioural, cognitive, affective, and agentic engagement. This study focused on studying behavioural and agentic game engagement.

This study focused on examining how different engaged player behaviours on the first day of gameplay were connected to whether players continue playing the game. Continued play was examined through player retention at two points in time: after the first day and after the first week of gameplay. The research questions of this study examined how behavioural and agentic game engagement on the first day of gameplay were connected to whether players continued playing the game after the first day and first week of playing.

The results of this study showed that behavioural and agentic game engagement factors on the first day of playing were important predictors in player retention both after the first day and after the first week of playing. The variables of first day gameplay had different effects after the first day and first week of gameplay. The most influential first day variables predicting continued gameplay both after a day and after a week were customising the game and gathering game rewards. Social interaction and time spent playing also impacted player retention after the first day. After the first week, influential factors were time spent playing, gathering rewards and skill level on the first day. The results of this study can be applied in developing different game-based solutions.

Keywords: engagement, game engagement, gamification, game-based learning, player retention, mobile games, game research

Contents

1. Introduction

The video game industry is constantly changing. A considerable change that is happening is how games are delivered to players. The video game industry is shifting from pay-to-play games to free-to-play games, where players can access the game for free, instead of having to buy the game before playing (Bouvier, Lavoué, & Sehaba, 2014). With free games, players are more likely to move from one game to another easily, which presents gaming companies with unique challenges to keep players engaged (Bouvier et al., 2014). This study focuses on researching how players' engagement during the first day of gameplay is related to player retention, i.e., getting players to return to the game after day one. The results of this study can be applied to further examine and develop better gaming experiences, gamified solutions, and game-based learning environments.

As Ke, Xie, & Xie (2016) have stated, an optimal gaming experience is based on a highly motivated state of engagement. But what defines engagement? Engagement has been studied for decades from the point of view of education and the point of view of human-computer interaction (Wiebe, Lamb, Hardy, & Sharek, 2014). The definitions for engagement circle around the same element of human behaviour: what it means to feel deeply involved in something, usually an external stimulus like classroom teaching or a technological application.

In this study different definitions for engagement are explored through the lens of psychology. Furthermore, this study explores how the term has been operationalised in game research. The aim of this study is to research the concept of game engagement, its applications in game research and the outcomes of engagement in relation to player retention.

The practical implications of engagement are explored through analysing the data of 5,000 first-time mobile game players. Their in-game actions are analysed to research what types of player actions showcase game engagement. Additionally, this study explores the connection between first day game engagement and returning to the game after the first day and first week of gameplay.

The aim of this study is to utilise psychological definitions of engagement to study gaming phenomena. There is a plethora of research concerning engagement in gaming, yet the

definitions and measures of engagement are not uniform. Game engagement is often not specifically defined and is measured through practical means that find no basis in engagement theory. This study explores previous definitions and operationalisations of engagement as well as offers ideas for future game engagement research.

First, the theoretical background of the study is introduced, including psychological definitions of engagement in the forms of school engagement, flow, and self-determination theory. Second, previous research on engagement in the field of game research is introduced along with multiple scales aimed to measure game engagement. Third, the research questions, data used in the study and methodology of this study are presented. Fourth, a data analysis is performed and presented, along with its results. Finally, the findings, conclusions and limitations of this study are presented and discussed.

2. Theoretical background

The theoretical background of this study consists of defining engagement both from the point of view of psychology and learning, as well as examining the ways engagement has been defined in game research literature. The main psychological background for this study is school engagement, as defined by Fredricks, Blumenfeld and Paris (2004). Additionally, the psychological models of Csikszentmihalyi's (2008) flow and Ryan and Deci's (2000) self-determination theory serve as the theoretical basis for many operationalised models of game engagement, so these theories are presented as well.

2.1 Engagement in psychology

Engagement has been broadly modelled and researched in the context of school learning as well as in relation to human-computer interaction (Wiebe et al., 2014). Engagement is a concept that is easy to understand but hard to specifically define. As a theoretical construct engagement transcends fields of research and is used broadly in many different contexts, but still lacks a uniform definition (Eccles, 2016). Despite this, defining engagement precisely is crucial to ensuring that the concept can be communicated and understood as intended (Eccles, 2016).

2.1.1 School engagement

Engagement in often researched in school contexts, and one notable definition of engagement in school engagement. School engagement is defined as the level of involvement, interest and connection students have in their learning and study environments (Axelson & Flick, 2011). School engagement can be described as a diverse construct consisting of multiple dimensions (Fredricks et al., 2004). According to Fredricks et al. (2004) there are three aspects to school engagement: behavioural engagement, emotional engagement, and cognitive engagement.

Behavioural engagement is defined as participation and involvement in school and social activities, for example effort, concentrating, and participating as well as behaving according to rules and norms (Fredricks et al., 2004). Emotional engagement is defined as positive or negative affective reactions, such as interest, boredom, happiness, sadness, and anxiety in

response to one's environment. Lastly, cognitive engagement is defined as a willingness to learn, understand, and master skills.

Defining school engagement as three dimensions has become widely accepted (Reeve & Tseng, 2011). According to Reeve and Tseng (2011) the three aspects of school engagement aptly describe how one reacts to a learning situation but fail to describe elements beyond reacting to stimuli. They thus propose a fourth element of engagement: agentic engagement. Agentic engagement is defined by Reeve and Tseng (2011) as one's own intentional contribution to the content that they are learning as well as the way that they learn. Agentic engagement includes for example how one might actively alter learning opportunities by creating their own challenges or modifying them.

Agentic engagement has been researched via using the hit-steer observation system in classrooms (Reeve & Tseng, 2011). The hit-steer system is an observational tool where an observer can assess a student's engagement by looking at how much they try to influence their learning. The system looks at the number of students' attempts to influence their learning as well as how successful those attempts are. A hit is defined as an attempt to influence the teacher whereas a steer is defined as the teacher's reaction. Research results using the hit-steer observation system find that the number of students' attempts to influence their learning correlates positively with their good perceptions of their learning environment as well as their academic achievements.

In researching school engagement, Fredricks et al. (2004) summed up how the three aspects of engagement have previously been researched. Behavioural engagement has been measured with various teacher ratings and self-report questionnaires as well as observational techniques. These measures include different actions taken by students, such as participation and positive and negative classroom behaviour. Some measures also include effort and attention, for example.

Emotional engagement measures were mostly self-evaluation questionnaires relating to positive and negative emotions about education and school environments (Fredricks et al., 2004). Some measures also included how students identified with their school as well as their orientation towards schoolwork.

Fredricks et al. (2004) describe the measures of cognitive engagement as limited. Cognitive engagement can be assessed via surveying the use of learning strategies, goal setting and planning. Observational techniques can also be used, but cognitive engagement tends to be quite difficult to measure, as cognition cannot be directly observed.

In their research on agentic engagement, Reeve and Tseng (2011) measured agentic engagement with a self-evaluation questionnaire. In Reeve and Tseng's measure (2011, p. 259) agentic engagement items were, for example, "During class, I ask questions" as well as "I tell the teacher what I like and what I don't like".

In general, Fredricks et al. (2004) describe measuring all forms of engagement as problematic. There is no consensus on whether it is best to measure types of engagement with a scale that encompasses all aspects of engagement or to have separate scales for each aspect. Different types of engagement are also often measured with overlapping items. According to Fredricks et al. (2004) one solution for the lack of clarity with measuring engagement would be to focus on each aspect of engagement separately to maintain specificity within research.

2.1.2 Flow

A considerable portion of learning research base their definitions of engagement on the concept of flow (Shernoff et al., 2016). Game research has also commonly used flow as a theoretical background to research gaming experiences (Wiebe et al., 2014). The concept of flow as defined by Csikszentmihalyi (2008) is a model of optimal experience. Flow is defined as the experience of being content and wanting to pursue a current activity for its own sake. Activities that are meant to be primarily enjoyable are especially conductive to flow.

The phenomenon of flow has eight components (Csikszentmihalyi, 2008). Not all of them must be present at the same time. The eight components of flow are (a) the task is possible to complete (b) one can concentrate on their behaviour (c) the task has clear goals (d) the task provides immediate feedback (e) one is deeply involved in the task and forgets other thoughts (f) one can control their actions (g) thoughts about the self disappear, but one's sense of self is stronger after the flow experience and (h) one's sense of the passage of time is altered.

The flow state can be modelled as a two-dimensional experience referred to as the flow channel (Csikszentmihalyi, 2014). The state of flow is the balance between an individual's

perception of challenge and their skills (Csikszentmihalyi, 2008). If one's skills are higher than the challenge provided, they become bored. If instead the challenge is too high compared to a person's skills, they feel anxious. This is how flow is facilitated: when one feels bored or frustrated, they will seek to alter the challenge or their skills levels to make activities enjoyable.

O'Brien and Toms (2008) theorise in their research that engagement and flow might have related attributes but are notably different as concepts. Flow states arise from internal motivation, whereas engaging experiences might happen in externally motivated situations, where the individual has not voluntarily chosen to interact with stimuli. Flow is also characterised by sustained long-term focus and dissociation, while engaging experiences do not require a loss of self-awareness to happen. Wiebe et al. (2014) also note that the connections between flow, engagement and gaming are often deceptively simple at a first glance, but theoretically hard to combine.

Phillips, Horstman, Vye, & Bransford (2014) critique the use of flow as a measure of engagement. They argue that using flow as a measure of engagement does not adequately distinguish between different aspects of engagement. In their opinion, specifically affective engagement is not considered enough when using flow to measure engagement. In addition, they argue that flow itself is difficult to measure, as it is a state of total immersion.

2.1.3 Self-determination theory

Engagement has also been defined as a concept related to motivation via self-determination theory (Eccles, 2016; Jang, Kim, & Reeve, 2016). Self-determination theory is based on the concept of intrinsic motivation, described as an "inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore and to learn" (Ryan & Deci, 2000, p. 70). The theory explores which conditions need to be met to promote intrinsic motivation.

Self-determination theory aims to define what drives people to be motivated and towards personal growth (Ryan & Deci, 2000). The theory outlines three needs that when fulfilled, lead to self-motivation and growth: the need for competence, relatedness, and autonomy. The need for competence is defined as a feeling of mastery, success, and ability to grow (Ryan &

Deci, 2020). The need for relatedness is described as having a sense of belonging and connection via feelings of respect and caring (Ryan & Deci, 2020). Thirdly, the need for autonomy is described as having a sense of agency and ownership in one's behaviour (Ryan & Deci, 2020).

Even though self-determination theory is a model of motivation, it has also been used as a means of defining game engagement. Self-determination theory has been used to define meaningful game experiences (Tan & Hew, 2016) and game engagement as a concept (Przybylski, Rigby, & Ryan, 2010). However, defining game engagement as a concept based on self-determination is less common than basing definitions of game engagement on flow or school engagement.

2.2 Engagement in gaming

Engagement specifically in video games has not been broadly researched (Boyle, Connolly, Hainey, & Boyle, 2012). In digital games, engagement is hard to define as multiple concepts overlap and are used interchangeably (Bouvier et al., 2014).

This study focuses on the connection between game engagement and player retention. Player retention is defined as a player re-engaging with the game after their initial playing session. To define game engagement, this chapter discusses previous definitions of game engagement and provides a new definition used in this study.

2.2.1 Defining game engagement

There have been multiple different conceptions of engagement in digital environments. In their research O'Brien and Toms (2008) focused on user experience with technology. They aimed to define engagement to develop better user engagement measures. They described engagement as a process with four stages: the point of engagement, period of engagement, disengagement, and re-engagement (O'Brien & Toms, 2008).

The point of engagement is how engaging experiences start when one encounters stimuli (O'Brien & Toms, 2008). The next stage of engagement is the period of engagement, which is characterised by sustained attention and interest. The next stage is disengagement. It is the stage where one decides to intentionally stop engaging or when the environment causes them

to disengage with stimuli. The final stage of engagement is re-engagement when one comes back to engage with stimuli in short or long-term timeframes. O'Brien and Toms (2008) also outlined a scenario where one simply did not engage with stimuli: nonengagement. One might experience barriers of engagement, such as poor usability of software or content in the case of digital stimuli.

The process of engagement as described by O'Brien and Toms (2008) is made up of both engagement factors and outcomes of engagement and it lacks a concrete definition of engagement itself (Bouvier et al., 2014). Describing engagement as a path of events does not anchor the term in any theoretical framework. Observing engagement as phases might be useful in practical applications, but it does not provide a general definition of engagement, only how it progresses.

Game engagement has also been defined through self-determination theory and psychological need fulfilment (Przybylski et al., 2010). In their research, Przybylski et al. (2010) describe how fulfilling the three basic needs of self-determination theory led to sustained game engagement. They argue that the appeal of video games is based on games providing an optimal environment for fulfilling needs of competence, relatedness, and autonomy, thus leading to game engagement. Engagement itself is not defined in their research, instead it is used a self-explanatory term and outcome of motivation.

Specific definitions of engagement in gaming have similar issues, as they often base their definitions of engagement on other ambiguous terms like immersion and are often context-dependent and operational definitions (Bouvier et al., 2014). Defining engagement through practical means or steps to become engaged often overlooks the psychological basis for the term and precision in describing what the concept means and consists of. This makes it difficult to define game engagement and to pinpoint what it truly means.

2.2.2 Measuring game engagement

To better understand and research game engagement, multiple scales and measured have been developed (Wiebe et al., 2014). The theoretical bases for the scales are varied: some are deeply connected to psychological concepts; some are more practical tools that have been developed with their own background factors.

The first measure developed specifically to measure game engagement was the Game Engagement Questionnaire (Brockmyer et al., 2009). It is a self-evaluation questionnaire. The theoretical basis for the scale included flow theory and concepts of psychological absorption, immersion, presence, and dissociation (Brockmyer et al., 2009). The core idea behind developing the scale was that that playing violent video games could have a negative effect on the players, for example via unconscious aggressive scripts developing as a result of playing (Brockmyer et al., 2009). The scale measures four dimensions: absorption, flow, presence and immersion (Brockmyer et al., 2009). According to Wiebe et al. (2014), the Game Engagement Questionnaire has not been used very often in research.

Another self-evaluation instrument that is based in flow theory and has been used more widely in game research is the Flow State Scale (Wiebe et al., 2014). While originally developed to measure physical activity, the Flow State Scale has been broadly used in game research as the scale items are worded in a way that is suitable for different activities (Wiebe et al., 2014). The Flow State Scale consists of 36 items divided into nine groups of four, each group measuring one dimension of Csikszentmihalyi's Flow (Jackson & Marsh, 1996).

Game engagement has also been measured from a more practical point of view. The User Engagement Scale developed by O'Brien and Toms (2010) is not based on flow theory. Instead, the theoretical basis for the User Engagement Scale was formed from research into user experience in technology and human-computer interaction (O'Brien & Toms, 2008). The scale includes six dimensions: aesthetics, endurability, felt involvement, focused attention, novelty, and perceived usability (Wiebe et al., 2014).

In their research, Abbasi, Ting and Hlavacs (2017) criticise previous game engagement scales and game engagement research as not having properly conceptualised and operationalised the term engagement. They also critique the fact that game engagement studies have highlighted different psychological concepts, such as immersion or flow, without paying attention to behavioural aspects of engagement.

After reviewing previous research, Abbasi, Ting and Hlavacs (2017) developed a scale to measure game engagement that includes psychological, affective, and behavioural measures of engagement, instead of just some aspects of engagement. They conceptualised consumer video game engagement as defined as "a psychological state that triggers due to two-way interactions between the consumer and video game product, which generates different level of

consumer engagement states (cognitive, affective, and behavioural) (Abbasi, Ting, & Hlavacs, 2017, p. 4)".

Consumer video game engagement consists of three engagement states: cognitive, affective, and behavioural (Abbasi, Ting, & Hlavacs, 2017). Based on reviewing previous research literature, Abbasi et al. (2017) further divide each state of engagement into subdimensions, with cognitive engagement consisting of conscious attention and absorption, affective engagement consisting of dedication and enthusiasm, and behavioural engagement consisting of interaction and social interaction.

Even though the consumer video game engagement scale by Abbasi et al. (2021) includes the three dimensions of school engagement as defined by Fredricks et al. (2004), they are not comparable in how the factors are represented or measured. The consumer video game engagement scale further divides the three dimensions into six subdimensions, which are measured individually. However, the underlying concept of three-dimensional engagement is the same.

These measures of game engagement are varying in their methods and theoretical underpinnings, highlighting the difficulty of measuring game engagement. As Whitton and Moseley (2014) state, measuring engagement can be problematic, as it is an internal experience that cannot be accessed from the outside, but asking an engaged participant about their experiences interrupts the experience of engagement. The variety of game engagement scales highlights the need for further research aimed at creating a uniform measure of game engagement, whether it is a self-evaluation questionnaire or another way of measuring game engagement which does not interrupt the engaged activity.

2.3 Game engagement as a four-dimensional concept

It is quite evident that game engagement is a difficult concept to research and operationalise. Game engagement research has other issues as well, apart from defining terms. When studying game engagement, it is typical to only study the behavioural or cognitive aspects of engagement (Phillips et al., 2014).

In their study of engagement in educational games, Phillips et al. (2014) qualitatively analysed game engagement as consisting of three aspects: behavioural, affective, and

cognitive. They based their categories and theory on school engagement but aimed to create measures for engagement in video games, rather than just educational tasks. The three aspects of engagement were described through operationalisations in previous research. Behavioural engagement was described as including systems of rewards and reinforcements of encouraged player behaviour. Cognitive engagement was described as including immersion, thinking, learning and metacognition. Affective engagement was described as including emotional investment in characters, social groups, and narratives.

The use of school engagement as the theoretical basis for measuring game engagement in Phillips et al.'s (2014) shows that game engagement can be theoretically defined through aspects of school engagement. This study continues this branch of game engagement research by defining engagement based on the concept of school engagement and its four dimensions instead of a ready scale or previous operationalisation of game engagement. In this study, game engagement is defined as players' involvement, interest, and connection to a game. This definition is based on Axelson and Flick's (2011) definition of school engagement. Additionally, game engagement is defined as consisting of four dimensions that together build to form overall game engagement. The four dimensions of game engagement are behavioural, cognitive, affective, and agentic engagement, based on Fredricks et al.'s (2004) concept of school engagement as well as Reeve and Tseng's (2011) concept of agentic engagement.

2.4 Researching behavioural and agentic game engagement

This study is based on game engagement as a four-dimensional concept. This study focuses specifically on behavioural and agentic game engagement. As Phillips et al. (2014) warned, focusing only on these two aspects will not provide a full picture of game engagement. However, researching these specific aspects can provide useful information on how behavioural and agentic engagement can be measured in game research. This study focuses only on behavioural and agentic game engagement, as examining affective or cognitive game engagement would require input from the players. Researching internal processes of emotions and cognition cannot be done via only observing players behaviour. Researching behavioural engagement can be especially valuable when researching engagement in mobile games, as the emotional state of players cannot be analysed (Psaltis, Apostolakis, Dimitropoulos, & Daras, 2018).

Next, behavioural and agentic game engagement are defined and described in the context of this study. Previous game research focusing on behavioural and agentic game engagement aspects is described, and measures for both categories of engagement are outlined for this study.

2.4.1 Behavioural game engagement

There is no agreed-upon definition or measure for behavioural game engagement. In their research, Kim et al. (2017) studied behavioural game engagement by defining behavioural game engagement as consisting of attention, participation, diligence, persistence, on-task activities, and interaction. Psaltis et al. (2018) define behavioural game engagement as focused activity towards a task. Few other definitions exist, but behavioural game engagement has been measured in a multitude of ways. This study combines the conceptualisations of Abbasi et al. (2017) and Fredricks et al. (2004) to include social interaction, the views of Dagan et al. (2015), Psaltis et al. (2018) and Ronimus et al. (2014) to include time spent in the game and Kim et al. (2017) and Psaltis et al.'s (2018) views to include focused activity towards a task as measures of behavioural game engagement.

It is easier to analyse behavioural engagement through data alone, when compared to affective or cognitive engagement (Phillips et al., 2014). As such, behavioural game engagement has been measured with objective usage data on gameplay frequency and duration (Ronimus et al., 2014). More specifically, behavioural game engagement measures often include the time spent on playing (Petko, Schmid, & Cantieni, 2020).

In-game time has been used as the sole measure of behavioural engagement in multiple game engagement studies (Psaltis et al., 2018; Ronimus et al., 2014) and as a part of instruments that include other behavioural aspects, such as game progression and in-game purchases (del Rio, Pei Chen, & Perianez, 2019). In-game time can be measured with user data (Ronimus et al., 2014) or by self-reports of users (Burke & Lucier-Greer, 2021), making it a relatively accessible measure of behavioural game engagement.

In studies of game engagement, behavioural engagement has also been measured with replay cycles and persistence of overcoming challenges (Petko et al., 2020). Players find games more

engaging when the challenges of the game match their skill level (Martinovic, Burgess, Pomerleau, & Marin, 2016).

In practice, players who play at the same level of a game without improving their rank are more likely to stop engaging with the game (Huang, Jasin, & Manchanda, 2019). Thus, it is important to match the players' skills and the game difficulty. Adapting a game's difficulty to balance players' skill levels can improve game engagement and player retention (Hendrix, Bellamy-Wood, McKay, Bloom, & Dunwell, 2019). Dynamically changing game difficulty to line up with a players' skills has been found to increase game engagement more than static changes with time, as players are provided with new goals and sense of their skills (Altimira et al., 2017). Thus, players' skill level seems to be connected to their level of behavioural engagement.

In their research on game engagement, Abbasi et al. (2017) included social interaction into their measure of behavioural game engagement. Social interaction is also a part of behavioural engagement in school engagement research (Fredricks et al., 2004). Modern gaming is a highly social activity, and social aspects of games are often the reason why players like certain games (Ekman et al., 2012).

Social aspects of games have been proven to improve game engagement (Laffan, Greaney, Barton, & Kaye, 2016; Schwarz, Huertas-Delgado, Cardon, & Desmet, 2020) and lead to higher player retainment and player satisfaction (Esteves, Valogianni, & Greenhill, 2021; Wu, Wang, & Tsai, 2010). In multiplayer games competition and co-operation can lead to better engagement, both while playing against A.I. opponents and other players (Schwarz et al., 2020). In practice, social interaction in games can be implemented with different features, such as leader boards and individual scores (Esteves et al., 2021). Thus, social interaction seems to be an influential behavioural game engagement factor.

In their research, Phillips et al. (2014) included systems of rewards into their description of behavioural game engagement. Players' experiences of engagement and feeling rewarded when playing a game are connected (McKernan et al., 2015) and reward elements are often important to players' game engagement (Laffan et al., 2016). Based on this information, Psaltis et al's (2018) definition of behavioural game engagement could be fulfilled by focused activity towards game rewards.

Despite the evidence of engaging game rewards, the connection between rewards and game engagement does not appear to be linear. The feeling of playing a rewarding game does not always mean the game giving out more rewards, instead some players feel rewarded when they are successful in a game (McKernan et al., 2015). McKernan et al. (2015) highlight that adding more in-game rewards might not improve game engagement, as feelings of satisfaction and challenge can engage players more effectively. However, according to Zapata-Caceres & Martin-Barroso (2021), some players do not play games to learn or overcome challenges, instead they focus on getting rewards. Rewards have also been shown to increase game engagement, as for example in Park, Kim, Kim, & Yi's (2019) study on game-based learning. Thus, the connection between game rewards and game engagement seems to be complicated, but it appears that pursuing game rewards can be interpreted as part of behavioural game engagement, as it is a focused activity towards a task.

Behavioural game engagement factors in this study thus include social interaction, time in game, rewards behaviour, and skill level. How these features of behavioural game engagement are measured in this study is described in section 4.2.

2.4.2 Agentic game engagement

Agentic engagement as a subdimension of engagement has not been studied in game engagement research. However, agency, autonomy, and control as qualities of player experience have been studied in relation to games, both from the point of view of school engagement in learning-based games and game engagement in commercial games.

In school engagement research, Buil, Catalán, and Martínez (2020) found that feelings of autonomy when playing a learning game led to higher engagement in undergraduate students. The importance of agency was also found in game engagement. Higher agency correlates with higher engagement in a game, making it important to provide players with at least some possibilities for influence (Taub et al., 2020). When players have no agency in a game, they are less engaged compared to players who have control over their game (Taub et al., 2020).

Player agency can take many forms. For example, players who can choose the difficulty level of a game have higher retainment than players without the same choice (Leiker et al., 2016). Research has also shown that being able to customise a player's avatar increases engagement

in the game (Birk & Mandryk, 2019). The same increase in engagement through avatar customisation was found in the context of educational games as well in Chen, Lu and Lu's (2019) research on game-based learning. In their study customisation was also related to the feeling of autonomy students experienced.

There are no previous measures of agentic game engagement in game research, and the measures for agentic engagement in school engagement are also sparse. Reeve and Tseng's (2011, p. 259) measure of agentic engagement is solely focused on school contexts, with items such as "I tell the teacher what I like and what I don't like" and "I offer suggestions about how to make the class better". Transforming these items to apply to game engagement could be relevant in studies where input from the players is gathered through self-evaluation, interviews, or other measures. However, in this study, agentic game engagement can only be observed from the outside. The specific measure of agentic game engagement used is players' customisation of their game.

Players want to have control over how they are represented in games (Turkay & Adinolf, 2010) and being able to customise the look of game characters and game objects increases game engagement (Schwarz et al., 2020). Turkay and Adinolf (2015) studied the effects of character customisation on a player's desire to play the game again. Customisation was defined as changing the game's functionality, appearance, or usability through a player's personal choices. Comparing two groups of players, one who had customisation options and one who did not, the players who had control and customisation options in the game were more willing to come back to play the game.

There are three types of customisations in games (Turkay & Adinolf, 2010). These types can be described as functional, cosmetic and usability customisations (Turkay & Adinolf, 2015). Turkay and Adinolf (2015) describe these customisation categories. Functional customisation describes a player's ability to change game mechanics and dynamics, such as customising their game character's skills. Cosmetic customisations do not affect gameplay, instead they are for example visual changes to the player's character. The third category of customisations is usability customisation, which refers to changes that do not affect gameplay but the player experience, such as changing the game's interface.

Agentic game engagement in this study is therefore measured with customisation actions taken in the game. How customisation and consequently, agentic game engagement was measured in this study is described in section 4.2.

3. Aim and research questions

This study focuses on defining game engagement based on psychological definitions of engagement. One aim of this study is to better understand how the concept of engagement could be utilised outside of school contexts and specifically in the context of game research. Another aim is to research behavioural and agentic game engagement to better provide a picture of game engagement as a four-dimensional concept.

Cognitive and affective engagement are difficult to analyse through data alone (Phillips et al., 2014). The data used in this study does not include any contributions from the players, as the data is only a collection of actions the players have taken. Thus, examining cognitive and affective engagement was not done, as researching those aspects of engagement would have been difficult based on only player data. This study focuses instead on the behavioural and agentic aspects of engagement.

This study investigates the relationship between game engagement and player retention. In this study, player retention is researched at two points in time: after the first day of gameplay and after the first week of gameplay. The differences in player retention at these times are compared to players' engagement behaviour on their first day of playing.

This study focuses on answering the following research questions:

1. What is the relationship between behavioural game engagement on the first day and player retention after the first day?
2. What is the relationship between agentic game engagement on the first day and player retention after the first day?
3. What is the relationship between behavioural game engagement on the first day and player retention after the first week?
4. What is the relationship between agentic game engagement on the first day and player retention after the first week?

The specific emphasis on researching player activity is on whether aspects of behavioural or agentic game engagement on their first day predict player retention. The measures for behavioural and agentic aspects of game engagement are defined as game engagement variables in the next chapter.

4. Methodology

This chapter describes the methodology of this study. First, the research design is presented. Then variables for the data analysis are defined by highlighting relevant research and specifics of the data of this study. After that, the data of this study is introduced.

4.1 Research design

The research design of this study is causal comparative. Causal comparative research studies the relationships between independent and dependent variables by comparing different groups of individuals (Brewer & Kubn, 2012). These relationships are studied after events or outcomes have already happened without manipulating circumstances. The data of this study has been gathered by measuring the players at one specific time, after they have started the game.

In causal comparative research, research subjects are usually grouped based on the dependent variable that is being studied (Brewer & Kubn, 2012). In this study that dependent variable is player retention, i.e., which players keep playing the game after their first day of gameplay. Players are grouped into two groups based on whether they continued playing the game after their first day of gameplay or did not continue playing.

Causal comparative research is a viable approach when independent variables cannot, or should not be manipulated, for example for ethical reasons (Brewer & Kubn, 2012). In this study, the independent variable of player retention was not and could not be manipulated. Manipulating player retention to examine game engagement could be unethical, especially when it comes to game addiction or monetary costs in-app purchases, for example.

Although this research design is very applicable in the context of this study, causal comparative research has many limitations. The dependent variable may be influenced by independent variables that are not measured in the study, or the causal effect of the variables might be reversed, meaning that the dependent variable is influencing the independent variables (Brewer & Kubn, 2012). In this study it is however quite unlikely that player retention could affect the independent game engagement variables, as only the first day of gameplay is studied, and a player returning to play after their first day cannot affect their first day behaviour after the fact.

4.2 Variables

In this chapter, the dependent variables affecting player retention are outlined. The variables are derived from game engagement as a four-dimensional concept, as outlined in section 2.3. This study focuses on examining behavioural and agentic game engagement and their effect on player retention. To examine these two components of game engagement, variables appropriate to studying game engagement were formed, based on previous research.

Behavioural game engagement is examined through players' social interaction, time in game, skill level and acquisition of rewards. Agentic game engagement is examined through players' customisation of their game experience. This chapter outlines why these variables were chosen and how these aspects of player actions are measured in this study. First, four behavioural game engagement variables are introduced. Second, one agentic game engagement variable is introduced.

4.2.1 Social interaction

The first variable of behavioural game engagement is social interaction. Social interaction in this study is measured through sharing the game. Sharing the game includes two types of actions: sharing a score of the game on social media or inviting someone to play the game. Sharing the game is measured through whether players shared the game on their first day. Some players shared the game multiple times, but this variable assigns the same value to all players who shared or did not share the game, as players who shared the game multiple times were very rare.

The measure for social interaction could have also been a sum variable consisting of sharing the game and joining a team, since the game includes teams as a part of the game's internal social actions. The reason joining a team was not included in the measure was since of the 5,000 players examined, only two joined a team on their first day of playing. Thus, joining a team was not deemed a significant variable in this specific study.

4.2.2 Time in game

The second behavioural game engagement factor of this study is time spent in the game. In this study, the time in game was measured through game data and recorded as minutes spent

in the game on the first day of playing. The time in game variable includes all time spent in the game, whether that be active playing or having the game open on the phone screen.

4.2.3 Rewards behaviour

The third behavioural game engagement variable is rewards behaviour. In this study, the effects of rewards on engagement and thus player retention are studied to try to determine if rewards increase game engagement. Rewards in this study are measured with redeeming rewards for the game's daily tasks. The game sets daily tasks and task rewards for players. The tasks can be completed during regular gameplay, but the rewards must be intentionally claimed. Therefore, simply completing tasks is not a viable measure of behavioural game engagement. Instead, completing the tasks and then claiming the rewards is a more accurate measure of player behaviour.

4.2.4 Skill level

The fourth and last behavioural game engagement variable is players' skill level. In this study, skill level is measured with players' average performance in specific early game levels. The game includes other game modes, but the main mode of playing is through levels. The game levels examined were the first beginner levels every player encounters. Examining the development of players' skills would also be a possible measure of skill level, but many players did not play very far into the levels on their first day. Thus, comparing skill level in levels that most players are likely to play gives a more representative result.

4.2.5 Customisation

The one variable that is measuring agentic game engagement in this study is game customisation. In this study, customisation is measured with a sum variable consisting of multiple customisation options: name changes, character customisations, and item customisations. Changing the player's name is a voluntary action that changes the screen name that is visible to other players. Customising the playable character means making visual changes to the playable character's looks. Customising items makes similar visual changes to the player's items in the game. These customisations do not change the gameplay, their only

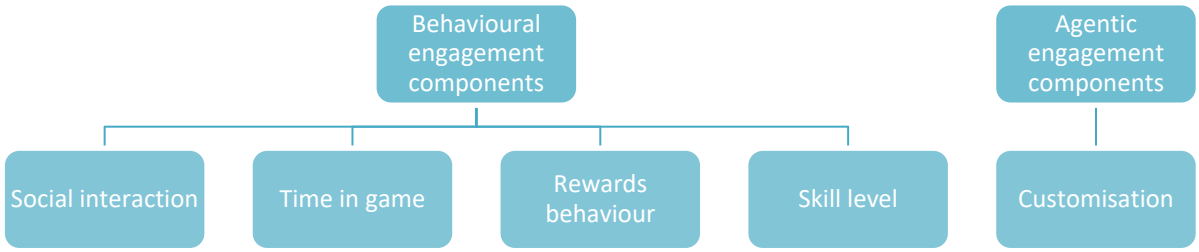
purpose is making aesthetic changes, thus they only represent cosmetic customisations as defined by Turkay and Adinolf (2015). All these actions can be repeated at any time. The measure of this study only measures whether a player has made customisations on each three options, not how many times they have, for example, changed their name.

4.2.6 Overview

The overview of variables examined is represented in Figure 1. The cross-sectional nature of this study limits the use of variables, and operationalising behavioural and agentic engagement into these specific measures is relevant in this study, but might not be suited for other research.

Figure 1

Components of behavioural and agentic game engagement used in this study's data analysis



4.3 Data

The data was gathered from a mobile game published in 2016. The game is being updated regularly and new players start playing daily. The game is a single- and multiplayer game where the player controls their character in a 2D environment. The data used in this study was obtained from the game company developing the game.

The sample includes 5,000 first-time players who started playing on October 8, 2021. They were chosen at random from a population of players that started playing on that day. The data was gathered from the first day of playing and in addition, the data included the number of

days a player kept playing the game for up until February 3, 2022. All players included in the sample had agreed to the game's terms of service, which state that the player data gathered from users can be analysed in an anonymised form.

Before gathering the sample, some exclusions were made. The population which the 5,000 players were randomly chosen from did not include players who downloaded the game due to an advertisement, or players who had made in-app purchases in the first seven days of playing. These players were excluded to make the sample more representative of a certain group of players, so that their actions in the game could be studied with less outside variables affecting their gameplay.

The ethical aspects of in-app purchases were also considered. The ethics of in-game purchases are complicated (Neely, 2021). Research has found that game addiction and in-app purchase behaviour are connected, which makes it difficult for game developers to balance increasing game revenue while considering the ethics of in-app purchases (Balakrishnan & Griffiths, 2018). Thus, the effects of in-app purchases on player behaviour were ruled out by excluding players who had made purchases in their first week of playing.

No exclusions in the sample were made based on any other factors, such as player location or age. Demographic information on players is not gathered by the game company, so it was not used. The game in question is a mobile game, but device information of players was not specified.

For each player, the data includes information on their performance in early game levels, socials actions taken, customisation actions taken, rewards claimed, time spent in the game, and on how many days they returned to play the game. There data did not include information on whether a player had previously played the game, which could affect players' first-time playing behaviour. Thus, the effect of returning players re-downloading the game cannot be estimated in the sample. The sample size is however large and gathered on a representative first day of gameplay, so any effect of returning players would most likely be similar in repeat measurements of the same game. Regardless, the possibility of returning players affecting the results should be noted, as well as other variation of players on different days. Some players might also have experience in similar games which could lead to higher skill levels or otherwise differing gameplay actions.

The period of gameplay that was researched was the beginning continuum of the game, where all players go through the same steps of gameplay. After this beginning period the player gains more independence and choice. The beginning period of the game is divided into two distinctive parts: the first part being the tutorial and the second the linear beginning path. The tutorial happens when a player opens the application. After completing the tutorial, the gameplay progresses in a linear way until a specific point where the player gets more freedom. The data explores only the continuum made up of the tutorial and the linear beginning path of the game. All players encounter the same continuum of first-time gameplay until they complete the same steps and gain enough points to progress. The duration of the beginning continuum varies from player to player based on how many tries the player takes to complete each task and progress in the game. More skilled players will gain more points and thus complete the beginning of the game faster.

This first part of the game was chosen as the topic of the analysis because this study focuses on first-time player experience and the development of engagement through behavioural and agentic engagement aspects. The beginning of the game showcases varying player behaviour in a controlled environment where player choices are limited. Latter parts of the game could be more difficult to research, as players have more control over what types of actions they take in the game and players complete different stages of the game at different times, making it more complicated to compare players.

Thus, the data used in this study and exclusions made to it has been introduced. The next chapter focuses on results of the data analysis which was completed by grouping the 5,000 players into different groups and comparing their behaviour on their first day of gameplay.

5. Analysis and findings

The data of this study was analysed by using IBM SPSS Statistics. The data analysis was completed by comparing player groups with an independent samples t-test. Independent t-tests are a method used in causal comparative research to test relationships between variables and to research whether the relationships between variables are statistically significant (Brewer & Kubn, 2012).

In this analysis, two t-tests were performed. First, the connection between first day behaviour and first day retention was explored. Second, the connection between first day behaviour and first week retention was explored. Both t-tests were completed by dividing the players into two groups: those who continued to play after the specified time, and those who did not.

Thus, the independent variable of the t-tests was player retention after the first day and first week. The dependent variables were behavioural and agentic game engagement variables outlined in section 4.2. The behavioural game engagement variables were social interaction, time in game, rewards behaviour, and skill level. Agentic game engagement was analysed with one variable: customisation.

5.1 First day behaviour and first day retention

For the first part of the data analysis of this study, players were divided into two groups based on player retention after the first day: the Discontinued group represented players who stopped playing after the first day and the Continued group represented players who came back to play after the first day.

Table 1

Player groups after the first day of gameplay

Player group	Frequency	Percent	Valid Percent	Cumulative Percent
Discontinued	2,867	57.3	57.3	57.3
Continued	2,133	42.7	42.7	100.0
Total	5,000	100.0	100.0	

The Discontinued group was moderately bigger. Of the 5,000 players included in the data, 57.3% stopped playing after the first day and 42.7% continued engaging with the game. Of interest in this study is examining gameplay variables to see if components of behavioural or agentic game engagement can explain the development of player retention, i.e., why some players continue playing while others do not.

Table 2

Retainment periods of players after the first week

Player group	Frequency	Percent	Valid Percent	Cumulative Percent
One day	2,867	57.3	57.3	57.3
One to seven days	1,022	20.4	20.4	77.8
Seven or more days	1,111	22.2	22.2	100.0
Total	5,000	100.0	100.0	

Additionally, of the players in the Continued group, the portion of players who keep playing the game after the first week is 22.2%. Therefore, 57.3% of players were only engaged in the game for a day or less, 20.4% of players were engaged in the game for up to seven days and 22.2% of players stayed engaged for longer than seven days. The first part of this data analysis focuses on players' retainment after the first day of gameplay. The second part of this data analysis in section 5.2 focuses on the differences between players after the first week of gameplay.

5.1.1 Results of the first day player retention analysis

All dependent variables analysed presented differences in means between the two player groups Continued and Discontinued. To examine whether these differences were statistically significant, an independent samples t-test was performed. First a Levene's test for equality of variances was carried out. The test indicated unequal variances for all variables. All degrees of freedom were adjusted accordingly based on these results. Next, the results of the t-test for each variable are detailed.

Table 3

Results of the first day player retention analysis examining first day player behaviour

Variable	Discontinued			Continued			df	t	p	Cohen's d
	N	M	SD	N	M	SD				
Social interaction	2,867	.04	.19	2,133	.08	.28	3,521.13	-6.76	<.001	.2
Time in game	2,858	9.46	34.24	2,129	22.07	42.22	4,007.36	-11.28	<.001	.33
Rewards behaviour	2,867	.08	.27	2,133	.25	.43	3,364.05	-15.55	<.001	.47
Skill level	948	1.23	.5	1,358	1.21	.46	1,939.88	1.4	.162	.06
Customisa-tion	2,867	.32	.65	2,133	.77	.87	3,781.57	-19.91	<.001	.59

Social interaction

The first behavioural game engagement factor examined was social interaction. The independent samples t-test was conducted to determine whether there is a difference in levels of social interaction on the first day between the two player groups Discontinued and Continued.

The players who stopped playing the game after day one in group Discontinued (n = 2,867) demonstrated less social interaction on their first day (M = .04, SD = .19) compared to players in group Continued (n =2,133), who demonstrated higher levels of social interaction (M = .08, SD = .28). The difference between the groups was statistically significant: t(3521.13) = -6.76, p <.001, d = .2.

Previous research by Esteves et al. (2021) and Wu et al. (2010) found that social aspects of games are connected to higher player retainment. The results of this t-test support this finding. Players who demonstrated higher levels of social interaction on their first day of playing returned to play the game on consecutive days. Thus, it can be estimated that higher levels of

social interaction on day one can produce higher player retainment after the initial day of gameplay.

However, the effect size value of .2 only estimates a small effect. Thus, these results cannot be widely generalised to say that social interaction on the first day of playing greatly increases player retention. In total, social interaction on the first day of gameplay seems to slightly promote higher player retention after the first day of gameplay.

Time in game

The second behavioural game engagement factor examined was time in game. The independent samples t-test examined whether the means of the player groups differed in the time players spent in the game on their first day.

When examining the data of playtime, multiple outliers were found. All values that exceeded 24 hours of playtime during the first day were excluded, as they were not possible real values of playtime from the first day of playing. This removal amounted to seven excluded outliers. Additionally, six values were missing from the data set entirely. This could be due to an error in measurements of the data. These missing cases were not replaced, making the number of players whose playtime was examined a total of 4,987.

Comparing the time players spent in the game on their first day, players in group Continued (n = 2,129) spent considerably more time playing the game (M = 22.07, SD = 42.22) than players in group Discontinued (n = 2,858, M = 9.46, SD = 34.24). The difference between the groups was statistically significant: $t(4007.36) = -11.28$, $p < .001$, $d = .33$.

The differences between first day playtime between the groups are significantly different. The players who came back another day played on average 22 minutes on their first day, whereas the players who discontinued playing the game played for nine minutes on average until stopping entirely. However, the effect size estimate of .33 is quite small. While there is a significant difference between the groups, the relationship between time spent in the game and player retention is not very strong. Still, these results indicate that a player's playtime on their first day is connected to whether they continue playing.

Rewards behaviour

The third behavioural game engagement factor that was studied was rewards behaviour. The differences between the player groups' rewards behaviour on the first day of playing was analysed with the independent samples t-test.

When looking at rewards behaviour, players in group Discontinued (n = 2,876) claimed less rewards than those in group Continued (n = 2,133) on the first day. The mean of group Discontinued .08 (SD = .27) was significantly lower than the mean of group Continued .25 (SD = .43), as proven by the independent samples t-test: t(3364.05) = -15.55, p <.001, *d* = .47.

The likelihood of a player in group Continued claiming rewards on their first day was more than double compared to group Discontinued. This result is made even more significant by the effect size estimation of .47, which signifies a medium effect size. First day rewards behaviour seems to have a medium-strong relationship with player retention, and the relationship appears to be stronger than the previous variables' relationships.

Skill level

The fourth behavioural game engagement factor analysed was skill level. The players who stopped playing the game after day one in group Discontinued (n = 948) demonstrated a higher skill level (M = 1.23, SD = .5) when compared to group Continued (n =1,358), who demonstrated a lower skill level (M = 1.21, SD = .46). The difference between the groups was, however, not statistically significant: t(1939.88) = 1.4, p = .162, d = .06.

As the difference between the player groups did not prove to be statistically significant, conclusions about the effect of first day skill level on player retention cannot be drawn. However, previous research indicates that games that are too easy can fail to engage players, meaning that a connection might exist between higher player skill and disengaging from the game.

The measure for skill level was based on players' performance in the first levels of the game. Other game modes were not included in the measure or in this study overall. Instead of the whole sample of 5,000 players, the number of players compared in the t-test was only 2,306, which can be explained by 2,694 players having not played any levels on their first day.

The missing values of players were analysed, and of the players who did not play any levels on their first day, 775 were in group Continued and 1,919 in Discontinued. Thus, 775 players only started playing levels of the game on another day or continued only playing other game modes. Thus, playing different game modes and not playing levels might have an impact on player retention. The players who continued playing after the first day despite not playing any levels will be further analysed in the second t-test of this study.

Customisation

Agentic game engagement was analysed with the customisation variable. The differences in first day customisation were analysed with the independent samples t-test. The amount of first day game customisation differed between player groups Discontinued and Continued. On average, players in group Continued customised their game 0.77 times (SD = .87, n = 2,133) during their first day of playing, whereas players in group Discontinued customised their game only 0.32 times (SD = .65, n = 2,867) on average. This difference was proven to be statistically significant: t(3781.57) = -19.91, p <.001, d = .59.

The difference between the player groups' practices of customising their playing experience on their first day of playing is evident. The difference in means is notable, the results is significant, and the effect size of .59 estimates a medium effect. This effect size estimate makes the relationship between first day customisation and first day player retention evident, and the strongest connection in this t-test.

5.2 First day behaviour and first week retention

The second part of the data analysis of this study was completed to research the relationship of first day player behaviour and player retention after a week. The players who did not continue playing after their first day were excluded from this analysis. The players were again divided into two groups: group Max seven days consisting of players who continued playing for a maximum of seven days and group Over seven days who continued playing after the first week.

Table 4

First week player groups

Player group	Frequency	Percent	Valid Percent	Cumulative Percent
Max seven days	1,022	47.9	47.9	47.9
Over seven days	1,111	52.1	52.1	100.0
Total	2,133	100.0	100.0	

The size of the player groups was fairly even. Of the 2,133 players who continued playing after the first day, 47.9% stopped playing within a week and 52.1% continued playing the game for longer than a week. This second analysis focuses on exploring whether first day user behaviour influences player retention after the first week. In practice, the behavioural and agentic game engagement variables used in the first analysis are analysed again between player groups Max seven days and Over seven days. The aim of the analysis is to see if the players' first day behaviour still influences their engagement in the game after the first day of playing. These results can clarify whether first day activities have longstanding consequences.

5.2.1 Results of the first week player retention analysis

When comparing the two player groups, there were differences in means in all dependent variables analysed. To determine the statistical significance of these differences, another independent samples t-test was carried out. The Levene's test indicated unequal variances for all variables. All degrees of freedom were adjusted accordingly based on the test. Next, the results for each variable are presented.

Table 5

Results of the first week player retention analysis examining first day player behaviour

Variable	Max seven days			Over seven days			df	t	p	Cohen's d
	N	M	SD	N	M	SD				
Social interaction	1,022	.08	.26	1,111	.09	.28	2.130.71	-1.09	.278	.05
Time in game	1,020	18.08	28.45	1,109	25.73	51.49	1,264.02	-3.06	.002	.13
Rewards behaviour	1,022	.18	.39	1,111	.30	.46	2,115.66	-6.41	<.001	.28
Skill level	593	1.24	.49	765	1.18	.44	1,188.71	2.46	.014	.14
Customisa-tion	1,022	.63	.80	1,111	.89	.90	2,128.78	-7.01	<.001	.3

Social interaction

For behavioural game engagement factors, social interaction was the first analysed. The players who played for a maximum of seven days (n = 1,022) demonstrated less social interaction (M = .08, SD = .26) compared to players who played for over a week (n =1,111), who had higher levels of social interaction (M = .09, SD = .28). The difference between the groups was, however, not statistically significant: t(2,130.71) = -1.09, p = .278, d = .05.

This result differs from the results of the first analysis. The connection between social interaction and day one retention was statistically significant, albeit with a small effect size. The connection between first day social interaction and first week retention appears non-existent.

This result can be explained by many things. As previous research and the results of the first analysis indicate, social interaction is an important part of game engagement. Based on the difference of means in groups Max seven days and Over seven days, it could be assumed that

the level of social interaction on the first day carries little meaning after multiple days have gone by.

Hence, it seems that to improve game engagement and player retention in the longer term, it is not sufficient to amplify social interaction merely on the first day of playing. Perhaps a more influential way to keep up engagement and player retention would be investing in social interaction possibilities for every day of playing.

Time in game

Continuing with the analysis of behavioural game engagement variables, time in game was analysed for the player groups. The same outliers were removed from the playtime data as in the first analysis. A total of four values for players' time in game were missing from this analysis. These missing values were not replaced, making the total of players analysed 2,129.

Comparing the time players spent in the game, players in group Max seven days (n = 1,020) spent a little less time playing the game on their first day (M = 18.08, SD = 28.45) than players in group Over seven days (n = 1,109, M = 25.73, SD = 51.49). The difference between the groups was statistically significant: t(1,264.02) = -3.06, p = .002, d = .13.

This result is in line with the result of the first analysis. Those who play more on their first day seem to continue playing the game for longer, even after the first week of playing. The effect size estimate of .13 is however very minimal, so the effect of first day playtime on first week retention is likely quite small, as it was with first day retention as well. This results further highlights that playtime might not be the best measure of game engagement, as the connection between in game time and player retention is not very strong.

Rewards behaviour

The third behavioural game engagement factor analysed for first week retention was rewards behaviour. The difference in first day rewards behaviour of players in group Max seven days (n = 1,022, M = .18, SD = .39) and group Over seven days (n = 1,111, M = .30, SD = .46) was statistically significant: t(2,115.66) = -6.41, p <.001, d = .28.

As the t-test results show, players who claimed more rewards on their first day of playing were more likely to continue playing after the first week. The effect size estimation of the

result was however small at .28. Even though previous research into game rewards has found the relationship between rewards and game engagement complicated, the results of both the first and second analysis of this study indicate that claiming rewards on the first day of playing improves player retention.

Skill level

The final behavioural game engagement factor analysed was skill level. The difference of means in the first day skill level of players in group Max seven days (n = 593, M = 1.24, SD = .49) and group Over seven days (n = 765, M = 1.18, SD = .44) was statistically significant: t(1,188.71) = 2.46, p = .014, d = .14.

The players who stopped engaging with the game before the first week was over showcased a slightly higher skill level. When comparing first day skill level and first day player retention in the first analysis of this study, the result was not found statistically significant. However, the relationship between first day skill level and first week retention is statistically significant. This supports the findings of previous research, where players who found games easy were more likely to stop playing.

As with the first analysis, the number of players compared in skill level was not the entire sample. The number of players analysed was only 1,358 compared to the combined 2,133 players in both categories. These missing players were further analysed, and out of the 775 players who did not play any levels on their first day and continued playing after the first day, 429 were in group Max seven days and 346 were in group Over seven days. That means that players who did not play any levels on their first day continued playing days or even weeks later.

Customisation

The variable measuring agentic game engagement was customisation. The difference of first day customisation behaviour of players in group Max seven days (n = 1,022, M = .63, SD = .80) and group Over seven days (n = 1,111, M = .89, SD = .90) was statistically significant: t(2,128.78) = -7.01, p <.001, d = .3.

The significance of customisation on the first day is still evident during the first week of gameplay. The players who continued playing for longer than seven days had customised

their game more on the first day of playing. The effect size estimate of .3 indicates a small effect size, but it is the largest effect size of all the variables in the second analysis.

The next chapter focuses on further discussing the results of this analysis. After that, the findings of this study are discussed in relation to previous research findings. Finally, the results of the two analyses completed are compared to answer the research questions of this study.

6. Discussion

This chapter rounds up the results of this study by answering the research questions set out in the beginning of the study. Limitations and ethical considerations of this study are also presented.

6.1 Answers to this study's research questions

The aim of this study was to investigate the connection between first day game engagement and player retention, specifically after one day of playing and after the first week of playing. Next, research questions of this study are answered, and the results of this study are compared.

The first research question of this study was "What is the relationship between behavioural game engagement on the first day and player retention after the first day?" The overall relationship showcased a connection: higher behavioural game engagement was related to higher player retention after the first day. Thus, the relationship between first day behavioural game engagement and first day player retention appeared to be a positive and influential relationship.

The individual behavioural game engagement variables analysed had slightly differing relationships with first day player retention. The differences within the player groups in social interaction was proven to be significant with a small effect size. Time spent in the game also differed with a small effect size.

Time spent in the game has been one of the most used behavioural engagement measures in game research. As Psaltis et al. (2018) and Ronimus et al. (2014) point out, time spent in the game has also been used as a solitary measure of behavioural game engagement. The results of the first t-test of this study do not support measuring game engagement solely through in-game time. The relationship between playtime and player retention was proven, but the estimated effect size remained small. Therefore, these results indicate that in-game time is an appropriate measure of game engagement, leading to player retention, but playtime should not be used as a sole measuring instrument, as the effect size seems to be small.

Rewards behaviour differences were also significant with a medium effect size estimation. The previous research results on the effects of rewards on game engagement are inconclusive, as further detailed in section 4.2.3. It appears that players who claim more rewards are more likely to continue playing the game after their first day of playing. It is however difficult to say whether simply playing for a longer time promotes claiming rewards, or if it is an indication of behavioural game engagement and active involvement in the game.

Social interaction, time in game and rewards behaviour as behavioural game engagement factors evidently do explain to some extent what type of player actions are connected to player retention. Therefore, it seems that behavioural game engagement should be considered when designing games, as these variables had a clear influence on players' tendencies to return to the game.

However, all behavioural game engagement variables did not influence first day retention in the same way. Of the behavioural game engagement variables analysed, skill level did not appear to significantly influence player retention after the first day. The measure for skill level was focused on only one game mode, which makes it a less reliable measure and could have influenced the results not being significant.

In total, higher behavioural game engagement on the first day led to higher player retention after the first day of playing. The most influential variable analysed was rewards behaviour, which indicates that players who firstly, complete, and secondly, actively claim rewards for completed daily tasks are engaged players who are likely to continue playing the game for longer than their counterparts.

The second research question of this study was "What is the relationship between agentic game engagement on the first day and player retention after the first day?" The connection was explored through the first independent samples t-test, which analysed the relationships between one agentic game engagement variable and player retention after the first day of gameplay.

The agentic game engagement variable analysed was customisation. Out of all game engagement variables analysed, customisation had the biggest estimated effect on day one player retention. The effect size estimation on .59 estimated a medium effect. Thus, the relationship between customisation and player retention on day one was evident from the

analysis of this study. Customisation seems to be a highly influential gameplay action, which promotes player retention.

As the first day player groups analysed differed significantly in agentic game engagement, the results of this study suggest that investing in agentic game engagement could improve player experience and thus lead to higher player retention. Agentic game engagement was, however, only measured with one variable. Thus, no finite conclusions can be made of the role of agentic game engagement.

The influence of customisation on player experience has also been found in previous research. In their research, Turkay and Adinolf (2010) found that giving players more customisation options promoted higher player retainment. Schwarz et al. (2020) also found that player engagement increased with customisation options. Therefore, it seems that customisation is a viable measure of agentic game engagement as well as a significant factor in players' developing game engagement. Further research is needed to examine other agentic game engagement factors and customisation's role compared to other factors.

The third research question of this study was "What is the relationship between behavioural game engagement on the first day and player retention after the first week?" The relationship was researched through the second independent samples t-test, which analysed the relationships between four behavioural game engagement variables and player retention after the first week of gameplay.

Statistically significant differences were found in three of the four behavioural game engagement variables between the two player groups compared: time spent in the game, rewards behaviour, and skill level. Players who continued playing the game for longer than a week had spent more time playing and had claimed more rewards on their first day of gameplay. These results were similar to those in the first analysis.

The connection between claiming rewards on the first day and player retention after the first week was not as strong as the connection with first day retention, but the connection was still significant. This highlights that first day player experiences are meaningful and should be invested in, as they can have long lasting consequences. However, with rewards behaviour, ongoing rewards behaviour is most likely more meaningful in player retention than simply the experiences of the first day of gameplay.

Thus, it seems that players' first day playtime and rewards behaviour are connected to higher player retainment both after the first day and first week of playing. This result indicates that first day behaviour has consequences even after the first week of playing or is at least correlated with player behaviour further down the line.

As for the rest of the behavioural game engagement variables analysed, social interaction on the first day was found to have no effect on player retention after the first week of gameplay. Social interaction was found to have an impact on first day retention, indicating that perhaps social interaction as a more constant, daily feature of the game can impact player retention. If weekly retention is considered, emphasising social interaction on the first day seems to have little effect. Thus, efforts should be focused more on upkeeping possibilities for social interaction, as previous research has found it to be an important factor of game engagement.

The final behavioural game engagement factor researched was skill level. The impact of first day skill level on weekly retention was found to be statistically significant: players who were better at the game on their first day were more likely to stop playing the game by the end of their first week of playing. This result is in line with previous research stating that games that are too easy are not engaging to players.

It is interesting that the connection between higher skill level and disengaging from the game is found only when comparing first day skill level and first week retention, though the results might be affected by the measures used. Still, the results could imply that matching the game's difficulty to players' skill levels is important from the very first moment, as an unideal gap between skill level and difficulty could have longstanding influence.

Furthermore, the concept of Csikszentmihalyi's (2014) flow channel would support the fact that better players quit more easily. If a player's skill level and the game's level of difficulty do not match, players get bored and disengage from the game, as it does not optimally challenge their skills. As this connection between first day skill level and first week retention is apparent, it seems important to take a game's difficulty level into account from the very first day to optimise player experience and design engaging gameplay for more skilled players as well. On the other hand, making games too difficult might create barriers of engagement for games, as defined by O'Brien and Toms' (2008).

Overall, measuring skill level by only accounting for one game mode does not seem to give the most accurate picture of players' skills or behavioural game engagement, as players kept engaging with the game despite not playing any levels on their first day. When also considering the very small effect size estimate of .14, the relationship between skill level and player retention did not seem to be very strong or reliable measure of behavioural game engagement.

The fourth and final research question of this study was "What is the relationship between agentic game engagement on the first day and player retention after the first week?" The role of agentic game engagement was studied through the second independent samples t-test, which analysed the relationships between one agentic game engagement variable and player retention after the first week of gameplay.

Agentic game engagement was measured with customisation. The results of the second t-test indicated that first day customisation of the game still had a connection with higher player retention after a week of playing. This connection was also the strongest out of the variables investigated in the second t-test. Based on these results, highlighting customisation options at the very beginning of the game could lead to higher player retention through feelings of agency and thus game engagement.

As with the first analysis, agentic game engagement was studied through only one variable. Thus, even though these results imply that first day agentic game engagement seems to matter more in first week retention than behavioural game engagement, further research is needed to investigate the differences between aspects of engagement.

6.2 Limitations

The results of this study have been presented alongside the answers to this study's research questions. However, this study has limitations that restrict the generalisation of this study's results.

The analysis in this study is solely based on data. As Phillips et al. (2014) point out, researching game engagement by only looking at data instead of having input from the players provides a lacking representation of game engagement and player behaviour. However, by only basing this study on player data, it was possible to look at a large sample of

5,000 players and their progression in the game for up to a week. Handling a similar amount of interview data, for example, would be a much bigger task for one study. The benefit of studying game engagement through data alone is also the fact that as Whitton and Moseley (2014) state, asking the engaged party about their experiences interrupts the engaging situation and makes measuring engagement inaccurate. In this study, engagement was inferred from player activities, thus not interrupting engaged behaviours. However, as Whitton and Moseley (2014) also state, engagement as an internal experience cannot be interpreted from the outside. Future research is needed to determine whether game engagement can be research in an accurate, yet non-interruptive way.

The selection of practical aspects of behavioural and agentic engagement that were researched within the data are not by any means objective selections or representative features of either asset of engagement. In practice, dividing engagement into different aspects is arbitrary. It is psychologically very difficult to conclusively say that one aspect of player actions is cognitive, and another is behavioural, for example game rewards can be seen as appealing to player behaviour, but the reason rewards are appealing can be because of affective emotions of joy or cognitive processes of wanting to learn.

No psychological process exists in a vacuum, but in order to research and discuss psychological concepts, choices of how phenomena are examined must be made. The choices of features examined were made based on the available data and being able to research specific components of engagement in relation to the theoretical background of school engagement. If the theoretical basis for this study was, for example, flow theory or self-determination theory, the aspects of engagement studied would have been very different.

The results of this study are limited to just data in the mobile gaming sphere. If this study utilised interviews or self-evaluation instruments, affective or cognitive game engagement could have also been studied. Player motivation was intentionally left out of this study as motivation cannot be inferred from the outside. Further research should consider contributions from players to evaluate their engagement, especially when trying to build generalised instruments for measuring game engagement.

The results are also limited by the research design of this study which was causal comparative. Causal comparative research is often limited by the lack of random samples. The sample of 5,000 players researched in this study, however, was a random sample of

players who started playing on a random day, which makes the results of this study slightly more generalisable. The sample of players was not representative of all players who started on that day nor was it representative of all the players in the game. Additionally, no demographic information of players was used, so the impact of background factors such as age, location or internet quality cannot be considered when comparing differences in players.

Another limitation of causal comparative research, as defined by Brewer and Kubn (2012) is that causal comparative research cannot state cause-and-effect relationships between variables, as the research setting is not experimental and there are no repeat measurements. Therefore, it cannot be concretely stated that player activities on the first day of playing caused player retention after the first day or first week. What can be said is that there was a relationship between behavioural and agentic game engagement variables and player retention at the two times studied. The causal relationship would have to be proven with further research.

The ethical aspects of this study and the ethics of the use of this study's results are also important to consider. In a conference proceeding paper, Seif El-Nasr and Kleinman (2020) summarise ethical issues of using data to drive game development decisions. Using data to study player behaviour can aim to keep players playing for longer. Focusing on maximising retention can cause addiction and uncontrolled playing habits. This is an important ethical consideration of this study, as the results of this study can be interpreted as outlining game features that maximise player retention. However, the hope is that the results of this study can be used to inform better game design for the players' benefit.

7. Conclusions

The aim of this study was to research the impact of behavioural and agentic game engagement aspects on player retention. This was done by defining game engagement as a four-dimensional concept and further analysing two of these dimensions: behavioural game engagement and agentic game engagement. The analysis of these dimensions was performed by statistically examining 5,000 players in a free-to-play mobile game on their first day of gameplay.

This study is theoretically based on looking at game engagement as a four-dimensional concept. However, only two of those dimensions were explored in this study. As Phillips et al. (2014) point out, this study's understanding of engagement is limited, as the study was conducted without considering all aspects of engagement. However, by defining game engagement as a four-dimensional concept, game engagement could be inspected from a new point of view in this study. Especially the point of view of agentic game engagement is a new concept that could be further studied in future research. More research is needed to examine whether game engagement can be conceptualised as four dimensions, as well as how each dimension can be measured.

The results of this study indicate that behavioural and agentic engagement factors predict player retainment to some degree. First day player behaviour seemed to have more impact on first day player retention than it did on first week player retention. However, first day player behaviour still had a connection to player retention after the first week of playing. Thus, the importance of player experience on the first day of playing can be noted. The effect size estimations of this study were however medium at best, so further research is needed to concretely prove the impact of first day engagement behaviour on player retention.

The findings of this study can inform future research into game engagement. The potential of agentic game engagement is untapped, and research into how agentic game engagement can affect players would be very interesting. For example, games that are being developed in beta or open access, where players get to influence the direction of game development, would be excellent research topics on player agency.

In addition, the findings of this study can outline future directions for gamified solutions in many fields. In school contexts, gamified or game-based learning could benefit from

highlighting learner agency to get learners more engaged. Additionally, highlighting the importance of different aspects of engagement could be beneficial for gamified solutions in medical care for rehabilitation and mental health, serious games, and informational games, for example.

Besides behavioural and agentic game engagement, affective and cognitive aspects of game engagement should be studied to better understand the individual differences between all aspects of engagement. Ideally, the four aspects could be succinctly defined and researched as complementary elements of engagement, that together form the experience of game engagement.

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