Games as Affective Medium

A theoretical framework for studying emotions in the context of digital games

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Master's thesis

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"The opposite of play is not work. It's depression."
Brian Sutton-Smith[1]

"The desire to play is fundamentally the desire to be."
Jean-Paul Sartre[2]

1 Sutton-Smith, 2001
2 Meszaros, I. 2012

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Master of Arts thesis abstract

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Abstract

This thesis explores emotion processes in the context of digital games and game research and proposes a framework for studying emotions and emotional individuality in the context of digital games. The focus is on the positive effects of digital games on subjective emotional experiences and well-being, and especially the differences in affective styles since individual differences in emotionality may influence the effects of playing digital games.

This thesis is formed from three parts: a literature review, a framework I have built based on the literature, and a pilot study that explores the relation of the suggested two aspects of the framework. The literature review gives an overview of the current knowledge of the emotion processes as large scale neural networks that are partly developed evolutively and partly through learning throughout life. The emotion processes are claimed to have three layers: core affects, conditionally learnt emotions, and complex emotional experiences. The positive core affect processes SEEKING and PLAY are claimed to be related to curiosity, positive anticipation, intrinsic motivation and playfulness, which are further linked to increased positive emotionality and may influence the individual's well-being. Interestingly, digital games may elicit the foundations of these positive emotional experiences.

I propose that each game has emotion-eliciting elements and that the gameplay influences the player's emotion processes which show as changes in the emotion components and result in different affective states, which may include subjective emotional experiences. The proposed framework introduces four dimensions on how games affect the player: 1) context, embodied in the game elements; 2) the player's affective style; 3) the player's emotional state; and 4) outside of the game context. Aspects of the first two dimensions of the framework, suggested three emotional game elements and two affective traits were tested in a pilot study.

The methods include textual analysis, and the pilot study was conducted with self-reports using a questionnaire that gathered data about the participants' emotional game element preferences and affective traits. The questionnaire included a modified version of the short affective neuroscientific personality scale (ANPS-S) questionnaire to gather the affective trait scores. I focused on Seeking and Play ANPS-S scores and analyzed all findings in a person-centred method.

The two proposed *Seeking* game elements divided the participants into six clusters based on their preferences. Interestingly, all participants had high or very high ANPS-S *Seeking* score, and all participants reported preferences for one or more *Seeking* related game element. This finding may indicate that the proposed two elements may be associated with the *Seeking* trait, however, this finding may also indicate that individuals who play digital games have a high *Seeking* trait or curiosity in general. All participants reported average or high ANPS-S *Play* score, however, the results varied on the preference for the Playfulness element, which may indicate the ANPS-S *Play questions* measure more social patterns than gameplay. Future studies could explore the differences between affective styles and game element preferences when aiming to understand the effects of digital games. Furthermore, there should be more studies comparing players to non-players and their affective styles and effects of digital games.

Keywords affect, affective style, digital game, emotion, emotion induction, mood

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Tässä opinnäytetyössä tarkastellaan emootioprosesseja digitaalisten pelien ja pelitutkimuksen kontekstissa, ja ehdotetaan viitekehystä emootioiden, emotionaalisen yksilöllisyyden ja pelien vaikutusten tutkimiseen. Tutkimuksen fokuksena ovat digitaalisten pelien positiiviset vaikutukset emootioihin, mielialaan ja hyvinvointiin, sekä yksilölliset erot affektityyleissä, koska yksilöllinen emotionaalisuus voi vaikuttaa digitaalisten pelien aiheuttamiin seurauksiin.

Tämä opinnäytetyö muodostuu kolmesta osasta: kirjallisuuskatsauksesta, viitekehyksestä jonka olen muodostanut kirjallisuuden pohjalta, ja pilottitutkimuksesta joka tutkii kahden viitekehyksessä ehdotetun ulottuvuuden suhdetta. Kirjallisuuskatsauksessa esitetään yleiskuva nykytiedosta emootiotutkimuksen alueella emootioista laajoina neuraalisten verkostojen prosesseina, jotka ovat kehittyneet sekä evolutiivisesti että muotoutuvat oppimisen ja aivojen plastisuuden seurauksena koko elämän ajan. Emootioprosesseilla väitetään olevan kolme eri tasoa: primäärit perusaffektit, konditionaalisesti opitut emootiot ja kompleksiset emotionaaliset kokemukset. Positiivisten perusaffektien SEEKING ja PLAY väitetään olevan kytköksissä lisääntyneeseen positiiviseen emotionaalisuuteen ja niillä voi olla vaikutuksia yksilön hyvinvointiin. Digitaaliset pelit voivat aktivoida näiden positiivisten emootiokokemusten perustuksia, mutta tämä alue vaatii lisää tutkimuksia.

Ehdotan, että jokaisella digitaalisella pelillä on emootioita herättäviä elementtejä, ja että pelaaminen vaikuttaa pelaajan emootioprosesseihin, mikä näkyy muutoksina emootiokomponenteissa. Nämä muutokset aiheuttavat erilaisia affektiivisia tiloja ja voivat ilmetä myös subjektiivisina emotionaalisina kokemuksina.

Ehdotettu viitekehys esittelee pelien neljä ulottuvuutta jotka vaikuttavat pelaajaan: 1) konteksti, joka ilmenee sisällössä; 2) pelaajan affektiivinen tyyli; 3) pelaajan emotionaalinen tila; ja 4) pelin ulkopuolinen konteksti. Viitekehyksen kahden ensimmäisen dimension osia tutkitaan opinnäytetyön pilottitutkimuksessa.

Metodologia sisältää tekstianalyysin ja itseraportointiin pohjautuvan kyselyn, jolla kerättiin dataa osallistujien pelielementtimieltymyksistä ja affektityyleistä. Kyselyssä oli mukautettu ANPS-S -osio, jonka tarkoituksena oli kerätä tietoa osallistujien affektiivisista tyyleistä. Analyysi keskittyi vain *Seeking*- ja *Play*-ominaisuuksiin, ja kaikki tulokset analysoitiin yksilökeskeisesti.

Kaksi esitettyä *Seeking* pelielementtiä jakoi osallistujat kuuteen eri ryhmään. Kaikilla osallistujilla oli korkeat tai hyvin korkeat ANPS-S *Seeking* -tulokset, ja lisäksi kaikki suosivat yhtä tai useampaa *Seeking*-pelielementtiä. Tämä voi tarkoittaa että ehdotetut emotionaaliset pelielementit voidaan mahdollisesti yhdistää yksilön *Seeking* -ominaisuuteen, tai että uteliaisuus on yleinen piirre pelaavilla yksilöillä. Kaikki osallistujat raportoivat keskinkertaista korkeampia ANPS-S *Play* -tuloksia, mutta yksilöiden tulokset vaihtelivat suuresti Playfulness-elementtiä kohtaan. Tämä löydös voi tarkoittaa, että ANPS-S *Play* kartoittaa enemmän sosiaalista pelaamista tai leikkiä kuin pelaamista. Tulevat tutkimukset voisivat kartoittaa digitaalisten pelien vaikutuksia yksityiskohtaisemmin vertaamalla affektityyppejä ja suosittuja pelielementtejä, sekä yksilöllisiä eroja pelaamisen vaikutuksista emootiokomponentteihin. Lisäksi tarvitaan lisää tutkimusta, joka vertaa aktiivisesti pelaavia ja ei-pelaajia keskenään, sekä heidän affektityyppejään ja pelien vaikutuksia.

Avainsanat affekti, affektiivinen tyyli, digitaalinen peli, emootio, emootioiden indusoiminen, mieliala

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This thesis has been a journey of curiosity, enthusiasm, learning, frustration and self-doubt, which is a description that could be given to most creative work from science to art, but also sometimes to the experience of playing games. However, as with most journeys, even this one has had and end and luckily other amazing and great adventures can begin. Since this journey of writing a thesis has truly been amazing and inspiring, which explains why it was difficult to end it and also why I cannot wait to continue to research these topics and to learn to become a better researcher.

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Abbreviations

ANPS	Affective neuroscience personality scale
ANPS-S	Affective neuroscience personality scale (short)
ANS	Autonomic nervous system
Anterior, a	Front (from Latin *ante*, meaning before)
DMN	Default mode network
Dorsal, d	Upper (from Latin *dorsum*, meaning back, used for organism's upper side)
ECN	Executive control network
FFM	Five factor model
Lateral, l	Side (from Latin *lateralis*, meaning to the side)
Medial, m	Middle (from Latin *medius*, meaning middle)
PFC	Prefrontal cortex
Posterior, p	Back (from Latin *post*, meaning after)
SN	Salience network
Ventral, v	Lower (from Latin *ventre*, meaning belly)

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1 Introduction

There is a growing amount of evidence of the positive impact of digital games. The neuroscientific research has shown that the plasticity of the brain develops based on the individual's activity, and the changes in the brain further result in changes in the behaviour (Bavelier et al., 2011). In addition, recent research findings suggest that depending on the game, the gameplay could improve recall, problem-solving speed, prosocial attitude and empathy, decision making, creativity, attention shifting flexibility, attention to details, tracking objects, vision, verbal skills, aiming at a moving target, and even intrinsic motivation (ibid.). Digital gameplay has been connected to mood induction and improving well-being as well. Playing casual puzzle games has been linked to positive results in reducing distress and negative mood, and increasing positive mood and relaxation (Russoniello et al., 2009). Similarly, problem-solving and thinking, activity in the prefrontal cortex, has been linked to reduced anxiety (Scult et al., 2017). The extensive list of potential benefits of digital games has increased the interest in the studies on games and gameplay. However, more research is needed to show how much of the digital gameplay skills are adaptable in other areas of life and what are the long-term effects for well-being. In this thesis, I will take first steps towards that research by integrating affective research and game research and building a theoretical framework to study emotions in the context of digital games.

Studying digital games potential for mood induction is important because emotion and mood related issues are global challenges that influence individuals life and well-being. Negative arousal related illnesses such as anxiety, and chronic mood disorders, such as depression, cause disability and even death. World health organization (2017) has estimated that in 2015 over 300 million people, which was 4.4% of the total world population, were affected by depression, and a similar amount of people experienced anxiety disorder. Moreover, both of these conditions are often present concurrently and are more common for females. The estimation has increased over 18% in ten years and is the largest cause of disability globally (ibid.)[3]. These numbers are alarming, and the evidence suggests that more studies need to be done in the area of distress and mood induction. Russoniello et al. (2009) call for studies that enable the development of low-

3 Over 40 million suffer from depression and over 36 million from anxiety symptoms only in Europe, although the highest risk groups are people in lower-income countries, poverty, unemployment, stressful social and life-events, chronic illness and substance abuse (WHO, 2017).

cost preventative techniques, and Christensen et al. (2009) for more affordable and customer-driven well-being services. Interestingly, digital games have shown some potential for mood induction, however, it is still unclear which game elements result in which specific effects, or if the effects are highly individual and situational.

The affective neuroscientific theory claims that the positive core affect processes are related to curiosity, positive anticipation, exploration, caring, and playfulness (Panksepp, 2004). In addition, the self-determination theory suggests that the feeling of competence, autonomy and relatedness are the main psychological needs behind intrinsic motivation and well-being (Ryan & Deci, 2000). Interestingly, gameplay may be unique in its ability to provide the fulfilment to all these needs: working towards a goal, seeking solutions, environments and resources, providing a feeling of competence, autonomy and agency. Therefore, playing digital games may answer to the foundations of positive affective experiences, which in turn may increase positive emotionality or even well-being.

The same digital games may not have same effects on each individual. There is evidence that certain affective traits are more sensitive to distress and mood disorders (Willner et al., 2013), and that individuals differ in their use of games as a coping mechanism for regulating their negative feelings (Hartmann et al., 2010). Further, different affective traits may have different game genre preferences (Hartmann et al., 2010; Borders, 2012), or even game element preferences. Therefore, the effects of the specific game elements may be based on the player's affective traits, individual preferences and situational affective states and this area needs more research. Diverse research fields approach the issue of gameplay effects, however, the lack of multidisciplinary research has resulted in the current state where the knowledge doesn't travel between the fields.

Personal motivation for this thesis was the passion to learn and understand more about the positive benefits of digital gameplay, since I had experienced, learnt and observed different individuals using games both as an emotion regulation strategy and for rehabilitation. Through my studies, I knew that affective neuroscience and cognitive sciences have been studying the underlying processes of the emotional experiences and the reactions to entertainment stimuli. This was a critical starting point for this thesis since the emotional processes are the foundation of our motivations, decisions, thoughts, moods,

behaviours, and our emotional individuality. Therefore, to start the journey to learn more about the effects of games on affective states meant I had to explore several disciplines for answers of the positive impacts of games and play.

The findings of gameplay benefits on well-being were the foundation for my original thesis focus, to study the effects that specific game elements on negative mental states. However, it became soon clear that individual games have different and unique results, and that the player's emotional state and affective traits have high impacts on these effects. Furthermore, the psychophysiological measurement technologies are not developed enough to study such effects on affective states and mood in detail. It became clear that a framework that explains how to perceive as complex phenomena as emotions in the context of games, that defines the emotion components, acknowledges the individual emotionality and different emotional states in the gameplay context, and defines emotional game elements was non-existent. Therefore, the topic of my thesis changed from measuring the effects to developing a framework how to study emotions in the context of games as the first step which would allow me to continue the research on effects of games in the future.

1.1. Research problems

The focus of this thesis is to explore how subjective emotional states and emotional individuality could be studied in the context of games. These aspects may further enable studies on the effects of digital games on emotional well-being.

I propose that each game has emotion-eliciting elements, the gameplay influences the player's emotion processes which show as changes in emotion components and result in affective states, which may include subjective emotional experiences (Figure 1.). The gameplay and these emotional experiences may further have effects on the player's well-being, however, this effect is not explored in this thesis.

In the theoretical background, I unite findings from affective neuroscience and cognitive science with game research to develop the first version of the framework, which could benefit affective game research in understanding how to perceive as an ambiguous term as *emotion* in the context of games, and how to perceive the affective individuality of the players.

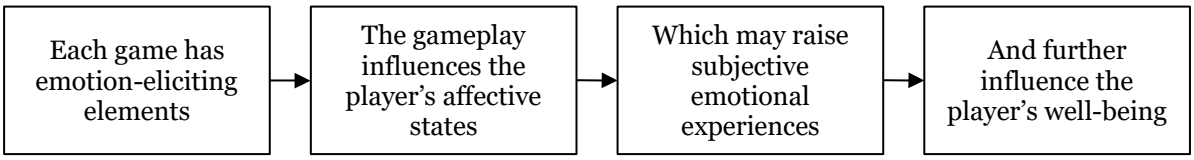

Figure 1. A simplified visualization of the potential effects of games on emotional states. This thesis studies the first aspect, the emotion-eliciting elements of games. The picture is made by the author.

After the initial design of the framework, the first step is to test the framework with a pilot study, a questionnaire, which combines qualitative and quantitative questions to measure the co-existence of affective traits Seeking and Play and the proposed emotional game elements. Secondly, the pilot study explores a hypothesis that individuals with high Seeking trait have higher preferences on problem-solving, exploring, enthusiasm and curiosity eliciting game elements, and that individuals with this trait have higher ratings in enjoyment over puzzles than individuals with lower *Seeking* scores.

1.2. Scope of the thesis

This thesis is formed from three sections: literature review, a framework I have built based on the literature review and a pilot study that explores the relation of the suggested two aspects of the framework. I focus in the individual player emotionality and game elements in the context of digital entertainment games, therefore, in the literature review, I will introduce the general understanding of affective research and the different components of the emotion processes and define the terminology in use.

I have chosen digital entertainment games because of the wide usage both in entertainment[4] and in research settings. I divide digital games into two main categories: serious games that include both persuasive games and gamification; and entertainment games. Entertainment games are often divided into casual and hardcore games, where casual digital games are easy to learn since they require no previous skills, usually are simple to access and use, easy to stop, pause and restart, and usually played in short bursts. Casual games are meant for mechanistically simple and engaging activity, and Kallio et al. (2011) claim these do not demand deep commitment. However, casual

4 Globally 2.6 billion people are estimated to play digital games (ESA, 2017).

digital games can have engaging narratives and other detailed forms of art, such as difficult logic problems or other cognitive demands.

In this thesis, games are perceived as a wide phenomenon that includes the game context, the game elements, and the player related aspects, such as the subjective emotional experience and the individual emotionality of the player. This scope is closer to the psychological studies of digital play, where games are used to study humans and human experience. However, O'Donnell et al. (2014) suggest that game studies are a multidisciplinary field, which is a more fit definition. The theoretical background of this thesis is multidisciplinary, since I aim to build understanding about games as affective medium by building bridges between game research, affective cognitive science, affective neuroscience and psychology.

This thesis is theoretical, conducted with textual analysis and the pilot study is combining qualitative and quantitative questions to gather data of the personal experiences and preferences of suggested emotional game elements. The main theories which have influenced this thesis are Panksepp's (2004) affective neuroscience theory, Ganzel et al.'s (2016) Triple allostasis theory, Ryan and Deci's (2000) Self-determination theory, Bavelier et al.'s (2011) and Gentile's (2011) dimensions of games that influence the players, and Järvinen's (2008) model of game elements.

It is beyond the methodology and scope of this thesis to produce statistically significant results or draw causal relationships between the effects of specific game elements and affective traits because the used sample size is expected to stay low. However, by combining qualitative and quantitative questions I aim to explore the coexistence between specific affective traits and emotional game elements to understand the individual variances on game related emotional experiences and general emotionality. For this, more explorative and qualitative approach is more beneficial.

It is outside the scope of this thesis to present a comprehensive perspective of the emotion theories and debates, still, the thesis will include the relevant terminology and short overview of the current theories and hypotheses of the affective sciences. The discussion about cultural and gender differences are not included since I focus on the positive aspects of games in individual emotionality and participants are expected to be

mostly from Nordic countries, therefore adding the discussion about culture or gender at this stage would make the study unnecessarily complex. Similarly, the cognitive media theorists have studied games, however these theories have been excluded because the scope is to combine the affective sciences and game research.

There is evidence of the negative effects of excessive gameplay, which may result in social and sleeping problems and reduced academic performance. However, some researchers claim that the negative effects of games may be learnt and that the environment has a critical role forming these habits, since dysfunctional family structures correlate with excessive gameplay (Bavelier et al., 2011). The excessive use and addiction to games is excluded from the discussion since I focus on the positive emotional impact of games. Moreover, addiction has been studied extensively already. Furthermore, the negative impact of playing is not included since this thesis aims to explore the positive aspects of digital gameplay, and more precisely, how to study emotions in the context of games.

In addition, even though the topic is relevant, this thesis does not focus on affective computing in gaming, or how biofeedback would change the game experience or increase well-being. Similarly, the moral problems and other decisions and behaviour during gameplay and long-term effects on the subjective feelings and mood are outside of the scope of this thesis at this stage. However, these theories, aspects and methods may become relevant and should be explored more in other studies.

1.3. Thesis structure

The thesis is divided into eight chapters, where three chapters introduce the literature. Chapter 1 introduces my personal motivation, the research problem and the scope of the thesis. The foundations of well-being, intrinsic motivation, behaviour, and play lie in the emotion processes. Therefore the literature review begins by answering the questions: what are affective states, emotions and moods, and how do emotions influence the human experience. These questions form the theoretical background based on affective sciences and further extends to the components of emotion processes.

The literature review in Chapter 2 includes theories of emotions and describes emotion processes as large scale neural networks that are both evolutively developed and change

through learning. Next Chapter 3 describes the components of emotion processes that interact with each other and which can be measured, including the affective neuroscience that explains the foundations of both the individual emotionality and subjective emotional experiences.

Next follows the main two chapters which describe the aspects of emotions in games and the proposed framework. Chapter 4 explores the emotional needs and rewarding aspects of play, the subjective emotions related to gameplay, the current knowledge of the positive effects digital gameplay has on our emotional and mood states, and well-being. Chapter 5 introduces the four dimensions of the framework which are proposed to affect the player's emotions, and the three emotional game elements that influence the players experiences and the individual emotionality of the players in the context of digital games. Chapter 6 describes the used methods and the research setup for the pilot study that demonstrates the use of the framework. Chapter 7 describes the findings from pilot study. Finally, Chapter 8 explores the work and includes the conclusions and discussion over limitations and proposals for future studies.

2 Emotions

This chapter has been divided into two main topics: the definition of the emotion terminology, and the emotion theories and hypotheses. The first part defines the used terminology and the second part introduces the theoretical background of affective research to explain the concept of *emotion* in general and in relation to well-being, which is later discussed in the context of digital games in Chapters 4 and 5.

2.1. Differences of affect, emotion and mood

The meaning of the noun *emotion* is complex, challenging, and still partly undefined (Izard, 2010). However, there is also some agreement across the field of emotion research on the neural foundations of emotions (Izard, 2010), and the changes in the body related to the affective states. Similarly, most researchers agree that emotion process is involved in the evaluation of the stimuli and the situation (Keltner et al., 2014).

To study such highly complex phenomena as emotions it is important to be clear on the terminology. Izard (2010) suggests that specifying or contextualizing the terminology would reduce the semantic confusion in the field. Further, Russell (2003) proposes a new terminology and claims the ambiguous folk concept *emotion* should not be used as a scientific term, but as a topic in the field, similarly than the specific natural language concepts for emotions, such as *joy* and *fear*. Both Russell (2003) and Panksepp (2004) suggest that changes in terminology may solve some of the debates in the emotion research field. For example, affective game research has been suffering from unclarified definitions which have even influenced on the validity of the findings (Kivikangas et al., 2011). Therefore in this thesis, I aim to specify both the terminology and the level of emotion processes where the discussion is situated.

To clarify the main terminology of the text, *affect* is a hierarchically higher concept, which includes the emotion related affective states, such as moods, traits, and subjective feelings. *Mood* is an enduring affect state that has a valence and can emerge without a clear cause, can last weeks or months, however mood disorders can last even years (Scherer, 2005; Keltner et al., 2014). *Moods* are representations of the individual's current emotional state and well-being. Individual *affective styles* mark the individual

emotionality and can last years or even a lifetime (Keltner et al., 2014) and develop throughout life (Davidson, 1993; Davis et al., 2003).

Emotions are dynamic processes that have different aspects: the spatially distributed, separated, but overlapping dynamic activity of the neural circuitries (Panksepp, 2004; Panksepp & Watt, 2011, Ganzel et al., 2016; Saarimäki et al., 2016; 2018), that interact with other large-scale neurological processes to maintain attention, motivation and behaviour (Damasio, 2005; Ganzel et al., 2016). Emotion processes create the foundational valence in core affect processes (Russell, 2003; Panksepp, 2004; Ganzel et al., 2016) and evaluate the internal or external stimuli, which result in embodied responses, such as complex subjective emotional experiences (Perron & Schröter, 2016). *Emotions* are elicited from internal and external events (Panksepp, 2004; Scherer, 2005) and result in short-term changes in different emotion components that will be introduced in Section 3.1. The *emotion processes* support the individual's ability to react and adapt to situations to the current situational needs that are related to the individual's goals, and maintain their well-being. For simplicity and to clarify the area where the discussion is situated, I will use word *emotion* as a term for the topic of the text and words *subjective emotional experience* meaning the individual feelings.

However, to add the complexity, there are claimed to be three different levels of consciousness related to the emotional experiences. The subconscious, unknown *anoetic* affective states; the consciously experienced, *noetic* emotions, that are related to cognition and perception of external stimuli; and the conscious and reflective *autonoetic* emotional experiences that can be and self-stimulated and are available for verbal descriptions (Panksepp & Watt, 2011; Solms & Panksepp, 2012). The level of awareness of the internal state is important for the emotion studies relying on introspection, such as the pilot study in this thesis.

In addition to terminology, the complexity of emotion processes and phenomena demands the researchers to clarify which level the research is focused on. Panksepp & Watt (2011) claim that it is critically important to define the level of analysis and the aspects of emotion the researchers are working with to clarify the research field from unnecessary battles caused by unclear definitions. In addition, Panksepp & Watt (2011) suggest three different levels for emotion analysis: the primary, instinctual *core affect*

processes as the foundation that generates the base for all affective states; the secondary, conditionally *learnt emotions*; and the tertiary, complex *subjective emotional experiences* that are formed by the combinations of the core affect processes and higher cortical processes. These areas are further discussed in Subsection 2.2.3. and Chapter 3.

2.2. Emotion theories and hypotheses

Emotions have been studied over two millennia, first in philosophy and later in several other disciplines, e.g. Evolutionary biology, Sociology, Psychology, Cognitive science and Neuroscience. Emotion research has been dividing into different disciplines, especially during the last 40 years, and there have been several attempts to form a unified emotion theory (Buck, 1983), or to categorize different branches of emotion theories. It is over the scope of this thesis to present a comprehensive perspective of the emotion theories and the debates, therefore this section will describe the overview of the theories and hypotheses from the emotion research field that are relevant in the context of understanding the connection of emotions and gameplay.

Throughout the years emotion theories have evolved into different models and frameworks (Ganzel et al., 2016), and most theoretical frameworks have been focusing on at least one of the three aspects: feeling, motivation or evaluation (Scarantino, 2016). However, rather than focusing on one aspect of emotion processes, such as motor behaviour or subjective feelings, contemporary neuroscientific emotion models are more often large-scale functional neural networks which produce affective states in dynamic interactions (Ganzel et al., 2016).

The difficulty in comparing the theories and hypotheses is based on the fact that the terminology has been unclear (as seen in Section 2.1.), and the affective research methods have varied greatly during the last century. Some researchers have observed behaviour, others analysed verbal reports of subjective feelings by categorizing natural language emotion lexicon and others have studied the brain activity or changes in the peripheral physiology changes. In addition, some research methods have been problematic, especially natural language categorization has been criticized to be culture-specific and limited, and hard to connect to the other aspects of affective states (Russell, 2003; Panksepp, 2004; LeDoux, 2012).

The experiment design has got critique as well, for example, Nesse (1990) claims that emotions should be studied in situations because different subjective feelings and physiological reactions are present and overlapping is certain situations. Panksepp (2004) suggests that emotions should be studied with the triangulation of the experience, the peripheral physiological changes, behaviour, and neural activity, and proposes the differentiation in the levels of the analysis. Brains have both sides, the information-processing aspect and the intentionality and sentience, therefore both the brain and the phenomenal experience should be studied without forgetting the other (Solms & Panksepp, 2012). This thesis focuses on individual experiences, but future research should aim to combine findings from ethnographic to neuroimaging studies to further develop an affective game research framework.

2.2.1. The evolutionary foundation of emotions

Evolutionally the emerging and differentiation of emotions may have been crucial for survival, thrive and even consciousness. Solms & Panksepp (2012) claim that affective states are part of the phenomenal experience which is the foundation of consciousness and motivation. Another suggestion of the evolutive background of emotions and their relation to survival has been linked to the sense of pain which helps the organism to avoid tissue damage, and evokes the *fear* process so that the organism can react to the danger (Panksepp, 2004; 2007b), and depending on the type of danger, either flee, fight, cease or desist (Panksepp, 2004; Damasio, 2005). Therefore, pain has been useful for survival and in the development of attention and learning (Panksepp, 2004).

Evolution has made neurogenetic changes in both the anatomic and functional organization of the human brain and has formed nested hierarchies where different levels communicate circularly around the brain, forming different brain functions (Panksepp, 2004; Panksepp & Watt, 2011) and networks between subcortical affective circuitries and the cerebral cortex. Panksepp (2004) claims that the evolutive older parts are located in subcortical areas forming hypothalamic-limbic circuits, which is associated with affective processing; and newer brain areas, the frontal lobes, which have links to the subcortical areas and are forming the thalamic-cortical circuitry, which is similarly involved in emotional processes, these networks are introduced in more detail in Subsection 2.2.4. and Section 3.1.

2.2.2. Distinct and constructed emotions

There has been a debate between emotion theorists about the distinctive and universal aspects of emotions in the neural, behavioural and subjective experience levels and how much the environmental stimulation during upbringing influences on the individual differences. The current knowledge supports the views that the foundation of the emotion components have a biological basis and that the emotional individuality and experiences are influenced by the environmental situations throughout life.

The theories that emphasize the role of basic emotions first focused on emotional expressions and behaviour such as Darwin's and Ekman's theories (Buck, 1985). Ekman (1992) suggests that there are evolutively developed distinct emotions, such as fear, anger, sadness, joy, surprise, and disgust that can be differentiated from one another through different aspects of emotions, and further suggests that other emotions, called as mixed emotions, are combinations of these basic emotions. However, the definition and existence of basic emotions has been under debate. Some of the basic emotion categories may not be emotions after all. Panksepp (2004) claims that surprise is more a reaction to a situation which may result in subjective emotional experience, but a surprise is not an emotion itself. Similarly, Panksepp (2004; 2007a) suggests disgust is a basic sensory affect, not a basic emotion. However, disgust is associated with socially constructed complex moral emotions (Panksepp, 2007a), still, these are not basic emotions either.

The distinct emotion theories have faced criticism. The distinct affective neural circuitry models are criticized especially since empirical findings do not support discrete emotions, however, the empirical evidence does support dynamic and coordinated processing in the emotion related regions (Ganzel et al., 2016). In addition, Panksepp & Watt (2011) claim that there are 'basic emotions' only on the subcortical level. Panksepp (2004) claims that these subcortical core affect primary-processes are significant components for creating the diversity of emotional variance of valence and arousal and work as a foundation for the subjectively experienced feelings. Panksepp (2004) claims that in the lower processing level all emotional activity generates physiological reactions as well as behavioural readiness in interaction with different neural areas. Moreover, the evidence shows that spatially distributed and overlapping dynamic activity in the neural circuits has distinctive activation for different emotions in certain degree (Panksepp,

2004; 2007b; Panksepp & Watt, 2011; Saarimäki et al., 2016), and the basic emotion neural activation is consistent across individuals (Saarimäki et al., 2016). The recent neuroimaging results revealed that basic emotions have both specific activation areas and large connectivity patterns across the brain (Saarimäki et al., 2016; 2018). Therefore, the level of distinctiveness is more complex than the natural language concepts of subjective emotions, and the distinctiveness may vary depending on the aspects of emotion components in the discussion, such as different neural processes or peripheral physiological reactions.

Emotional behaviour has cultural differences in intensity, accents of emotions, emotion regulation and interpretation (Keltner et al., 2014). In addition, Mauss & Robinson (2009) claim that learnt behaviour from the surrounding culture, gender, and individual differences in expressiveness build on the variation, and therefore facial movement should not be assumed to have a direct link to the individual's emotional state. Moreover, Barrett (2006) claims there is not enough coherent evidence to map basic emotion categories to specific responses, especially on a self-report level. These claims conflict with the universalist view of distinct emotions that the emotional muscular expressions and recognition of these expressions are common across cultures. However, recent research findings suggest that different emotion related physiological feelings are represented in the somatosensory system similarly across cultures (Nummenmaa et al., 2018). This finding supports the theories of the biological foundation of subjective emotional feelings, which still leaves open the possibility for the cultural differences in the communicative aspect of emotional behaviour and signalling.

To sum up, the discussion in this debate has been partly on different levels and aspects of emotion analysis and may have been a result of the unclear terminology, which has further fed the debates. Panksepp (2007b) suggests that the conflict has been mostly philosophical between internalist and externalist views of emotions, and calls for more research to combine the different research efforts. Still, researchers should define the used terminology and research area to map the area of study. In this thesis, I follow the view that the different aspects of emotion components may have different levels of distinctiveness than others. Therefore, having evidence of a distinct emotion in one emotion component does not indicate that this results in repeatable output in other components of emotions or in other situations. I follow the view that there are

individual differences in the evolutively developed physiology, forming affective traits (explored in Section 3.3.). However, I also suggest that the cultural differences in the intensity, accents and interpretations of emotional expressions, the semantic emotion concepts and the different methods individuals use for emotion regulation are learnt from the surrounding culture and developing throughout life, and further generating new neural changes through neuroplasticity. The understanding of the biological and constructed emotionality and individuality of the emotional experiences is critical in the context of affective game research as well and for the development of the framework to study emotions in the context of digital games. Since digital games are one type of stimuli.

2.2.3. The affective neuroscience emotion system theory

The diversity of human emotional experience has a foundation in the neural activity. Panksepp (2004) suggests that emotions are complex phenomena which are built in the activity of the interconnected neural networks, which questions the distinct emotion debate that often focuses on specific aspects of emotions, such as muscular movements, or unnecessarily groups both neural analysis with behaviour or with subjective experiences.

There are at least three categories of subcortical affective processes: the homeostatic drives, such as thirst; the sensory affects, such as feeling the coldness of the water; and the instinctual-emotional neural networks that provide tools for the organism to satisfy the needs (Solms & Panksepp, 2012). This subsection focuses on the instinctual-emotional category.

Panksepp's (2004) affective neuroscience emotion system theory claims that the affective neural functions work in three levels: core affects are the primary-processes, learnt emotions are the secondary, conditionally *learnt emotions*, and the tertiary, complex *subjective emotional experiences*, such as shame and revenge, are formed by the combinations of the core affect processes and higher cortical processes (Panksepp & Watt, 2011). The *primary-process core affects* are evolutionarily pre-wired subcortical and instinctual emotional processes, that are epigenetically reshaped. These *core affect processes* are potentials of the brain, tools for the individual to react and adapt to the situations, and form the foundation that generates the base for all affective states, and

influence in the construction of the more complex emotions and personality (Panksepp, 2004; Panksepp & Watt, 2011).

The complex emotional experiences are thought-related states, the phenomenal feelings that we are able to verbally name and discuss (Panksepp, 2004)[5], and that arise in interconnection with the neocortex and subcortical areas (Panksepp, 2004; Panksepp & Watt 2011; Solms & Panksepp, 2011). Most of all, cortical regions do not generate emotions but influence the experiences by inhibiting and regulating the subcortical input (Panksepp, 2007b).

These three emotional levels are partly separated neural processes and partly inseparable in their overlapping connectedness (Panksepp & Watt, 2011). The emotion processes have circular causation in a bottom-up and top-down manner. The primary-processes influence the learnt emotion behaviours and further on the tertiary-processes. The top-down connections from tertiary-process higher cognition to secondary-process regulates the emotional states and secondary-process influences on the conditioned responses in the primary-process level (Solms & Panksepp, 2012).

All levels of emotion related activation interact with each other, some of this activation is subconscious, and some activation reaches the consciousness (Panksepp, 2004), this internal processing results into reactions and behaviour which often creates new events in the environment and new stimuli. Furthermore, the brain circuits that are involved in emotion processes have extensive plasticity throughout life (Panksepp, 2004). Similarly, Bavelier et al. (2011) claim individuals are constantly learning from the environment and changing their behaviour, which influences the neurological changes.

The affective neuroscientific theory introduces seven core affect primary processes, three negative: RAGE, FEAR, and PANIC/GRIEF; and four positive: SEEKING, CARE, LUST, and PLAY (Panksepp, 2004; 2007b; Vytal & Hamann, 2010; Panksepp & Watt, 2011). To clarify the terminology, Panksepp (2004) uses capitalized terms for differentiating the discussion related to the circuitries from the natural language emotion concepts, therefore I will follow this suggestion in this thesis. Only the most

5 See more detailed discussion about the complex emotion categories in Section 3.4.

relevant core affects for gameplay are described here in more detail, and LUST is excluded from the discussion in this thesis since it is rarely present in digital games.

Positive core affects

Positive core affect processes have a positive valence, are rewarding and support the approach tendency. SEEKING core affect process activates connections to find cues and predict rewards (Panksepp & Moskal, 2008; Panksepp & Watt, 2011), and moderates exploring (Panksepp & Moskal, 2008). SEEKING is the circuitry for desire and wanting, it combines the internal needs and external opportunities and mediates appetitive excitement, positive anticipation, goal-directed curiosity, motivation, and influences the other affective core processes (Panksepp & Watt, 2011). For example, exploring and searching for more resources, such as finding new information for survival, going to the nest, and finding safety are rewarding activities (Panksepp, 2004).

The need to seek is pleasurable, which makes exploration intrinsically motivational, and further, the act of exploring, rather than achieving the goals, is the key to satisfaction and fulfilment (Panksepp, 2004), which explains why reaching a goal does not always feel as satisfying as the journey of pursuing the goal (Panksepp & Watt, 2011). In contrary, in some studies seeking and finding are listed as the activity and enthusiasm as the resulting emotion (Keltner et al., 2014), which is still similar to Panksepp's (2004) motivation and positive anticipation aspects. SEEKING core affect is interesting in the context of games since gameplay provides opportunities for these emotions through the explorative activities, such as solution seeking in a pretend play format. Sections 4 and 5 will focus on positive anticipation, curiosity and other emotions related to digital games in more detail.

PLAY core affect process generates the urge to play, and energetic interaction with objects, abstractions and others. PLAY is associated with positive and energetic social engagement with peers (Solms & Panksepp, 2012). Panksepp & Watt (2011) claim that this process is linked to the subjective feelings of complex emotions of fun and joy, and linked to behaviours of playfulness and laughter. PLAY elicited playfulness is used to learn social skills, rules and behaviour, however, PLAY system is not studied much, yet it may be the foundation for humour and conversations, which could be an abstract

version of the physical social play behaviour (ibid.). In the context of digital games PLAY and SEEKING are very interesting core affects and may have a high correlation to specific gameplay emotions and preferred game elements, and may be central for the enjoyment of gameplay. Sections 4 and 5 will focus on games and emotions in more detail.

The last positive core affect is *CARE*, which is hypothesised to be the instinct to care for others, help, nurture and the foundation for empathy which helps the individual to notice and respond to needs and distress of others, especially children (Panksepp, 2004). *CARE* is linked to the subjective complex feelings, such as love and affection (Panksepp, 2004; Panksepp & Watt, 2011), and may have a link to behaviours such as nurturing and helping others. I will focus more on SEEKING and PLAY than CARE in this thesis, since CARE may be more relevant for research in the area of empathy and gaming. Similarly, CARE related activity could be relevant for studies using games with simulation or nurturing elements, such as farming RPGs and city building, or any games that have in-game social elements, such as collaboration with game characters or other players, or other social gameplay situations.

Negative core affects

Negative core affects are reactions towards stressors that are unexpected or unwanted stimuli. The first negative core affect process is RAGE which is linked to the protection of the body (Solms & Panksepp, 2012), and can be aroused by competition, constraints, and frustrations, which in turn generates irritation and provokes anger, although well developed emotion regulation in adult humans can suppress and modulate anger (Panksepp & Watt, 2011). On contrary to other negative core affects, RAGE elicits approach tendency towards the stimuli or a substitute object. Games elicit different types of RAGE related complex emotions, however, certain game elements may decrease the negative out-of-game context related subjective feelings and increase the player's positive emotionality and relaxation. Researchers interested in the connection of anger and aggression in gameplay could study this core affect in more detail.

The second negative core affect is FEAR process, which generates the freeze or flight response by activating both subcortical and perceptual sensory circuits (Panksepp, 2004), and is linked to the need to protect the body (Solms & Panksepp, 2012). FEAR

process activity is elevated in anxiety and distress (Panksepp, 2004). Similarly than in RAGE related complex emotions, also FEAR related emotional states may be elicited in different game elements, however certain game elements may decrease the negative emotions from out-of-game contexts, such as anxiety and distress which are linked to increased fear responses (Davis et al., 2003), and further increase positive emotions and relaxation. In addition, certain game elements may elicit enjoyable fear responses in a safe pretend play environment. The research on anxiety and tension could focus on this core affect in more detail.

The third negative core affect is *PANIC/GRIEF* process, which is linked to social attachments, and activates when the individual is left alone or has an intolerable distance to their social group (Panksepp, 2004). *PANIC/GRIEF* is linked to the subjective complex emotions of loneliness and depression, further, it is speculated to be behind the panic attacks (Panksepp, 2010). All research that studies gameplay effects on sadness related mood problems could additionally focus on the *PANIC/GRIEF* related neural activity and complex emotions.

The affective neuroscientific research has faced criticism. Currently, some of the *core affect* research findings are from the non-human animal studies and therefore may not adapt to humans (Panksepp, 2004). Barrett et al. (2007) argue that the human brain is different in size, structure and organization, having specific neuron types, more neurons and connecting axons than other mammalian brains, which makes the cross-species assumptions problematic especially on simpler rat brains. Similarly, LeDoux (2012) claims that core affect on humans is speculative until there is more empirical evidence. This criticism underlines the need to question the assumptions on humans until more evidence has been gathered.

In addition to Panksepp, other emotion researchers have theorised around the term core affects as well. Psychological constructivism perceives the concept of core affects as two-dimensional affective neurophysiological states that are similar to mood (Russell, 2012), have hedonic valence and arousal tone (Russell, 2003), and are available for consciousness (Barrett, 2006). Panksepp's (2004) core affects are an anoetic primary neuronal activity that works in interaction with large neural networks and act as the foundation for the complex emotional states. Whereas Russell's (2003) and Barrett's

(2006) core affect concept is a consciously accessible mental state, feeling components which direct attention, motivation and information processing during intense activation, and form the foundation for subjective emotional episodes and moods. In contrast, Barrett et al. (2017) suggest that evolutively developed and valenced core affects produce the subjective phenomenal and reported emotions. These concepts have similarities, and both Barrett (2006) and Panksepp (2006) suggest that their view of core affects could solve the debate of distinct and constructed emotions. However, Panksepp (2007b) criticises that the constructivist view of core affects is conceptual, hypothetical and still missing neuroscientific evidence.

To conclude, the knowledge of the emotion processes and pathways is still incomplete, and more studies are needed to evaluate the hypothesis of *core affects* on humans, and finding the link on how core affects are related to the individual emotionality, the learnt and more complex subjective emotional experiences, including the experiences and effects related to digital games. Section 3.2. will explore the individual affective styles and Section 3.3. the complex tertiary emotions in more detail.

2.2.4. Emotions as network of processes

Neuroscientific emotion theories are network and emotion process theories, where affective states are considered to be intertwined in subjective experience, physiology and in the neural functions. Emotion processes interact with other large-scale neurological processes to maintain attention, motivation and behaviour (Damasio, 2005; Ganzel et al., 2016) and regulate emotions such as negative arousal or distress (Ganzel et al., 2016). The emotion processes influence reasoning and decision making to enable adaptation to the surrounding situation (Damasio, 2005), by evaluating the internal or external stimuli, which result in embodied responses, such as complex subjective emotional experiences (Perron & Schröter, 2016). Therefore, the emotional states are actually systemic states which direct and control the other cognitive functions (Saarimäki et al., 2018), such as attention, wakefulness, neurochemicals, hormones, and memory formation.

The pathways of human emotions are still not well understood (Purves et al., 2001), still, in addition to specific brain areas, the neuroimaging studies confirm few large scale networks and pathways. The emotion processes related to the subcortical limbic

networks have multifunctional processing in both negative and positive states, and simultaneously interacting dynamically with other large scale networks (Ganzel et al., 2016). The three important networks that are linked to emotions processes are Executive control network, Default mode network and Salience network (Parsons, 2017).

The executive control network (ECN) is located in the medial prefrontal cortex (mPFC) and upper cingulate cortex (Saarimäki et al., 2016), and includes processes related to complex mental operations, such as planning, decision making, emotion regulation, and motivation which are necessary during gameplay as well. The input feed for ECN is formed by subcortical areas: salience input from the amygdala, arousal intensity from thalamus and hypothalamus; and from cortical areas: processed visceral information from insula and the memory from the medial temporal cortex (ibid.). More cognitively demanding action increases activation in the executive control network and decreases activation in default mode network and salience network (Parsons, 2017), which is highly relevant detail for the future studies focusing on the effects of problem solving related game elements.

The default mode network (DMN) is associated with thoughts related to self and is possibly integrating information about the internal state with memory and salience of the situation in interaction with CEN (Ganzel et al., 2016). Further, neuroimaging techniques have revealed that specific patterns of different emotions can be seen in DMN, which supports different emotions together with other brain processes from subcortical, sensory and somatomotor areas (Saarimäki, 2018). Furthermore, Saarimäki et al., (2018) claim that the distinctive activity has a connection in the emotion components of evaluation, sensation, motor behaviour and experienced emotional states. These claims suggest that the DMN connects the different components of emotions at the neural level and is important network for emotion related processing.

The salience network has been associated with the evaluation aspect of emotions. The salience network (SN) orients attention, memory and information processing in the direction of the most relevant information (Ganzel et al., 2016), and switches the activity between ECN and DMN (Ganzel et al., 2016; Parsons, 2017). Similarly, Ganzel et al. (2016) suggest that all affective states related systems are overlapping with emotion

regulation processes and large-scale brain networks, such as the evaluative salience network.

The emotion processes influence other cognitive functions. Panksepp (2004) proposes that emotions are generated in connection with the neural self-representation system to sustain and guide the behaviour through different value-coding mechanisms that provide salience processing. The somatic marker hypothesis argues that emotions influence the attention, decision-making and goals, and add meaning to the internal and external situations to enable our adaptation and survival in the situation (Damasio, 2005). Furthermore, Panksepp (2010) claim the intrinsic values tell the individual about their status of survival, as the general positive affect reflects safety and well-being whereas the negative affect expresses situations of discomfort and reduced state of survival.

These three networks are the core of emotional brain processes. Barrett (2017) claims the default mode, frontoparietal and salience networks are a dynamic model that creates multi-sensory representations of the situation in interaction with other brain areas and support allostasis. Moreover, the introduced findings support the view of emotions as complex dynamic processes, which should be studied using clear terminology and comparable methodologies to reduce the ambiguity of the term *emotion*.

All in all, the emotion processes are an evolutively developed evaluation systems that indicate the internal and external states for the individual and influence the attention, memory, motivation, information processing and behaviour, coordinates the bodily responses, and create the embodied and multisensory emotional experiences.

2.2.5. Emotion processes and well-being

Salience network (SN) is critical in the context of wellbeing. Especially the negative affective states generate activity in SN (Ganzel et al., 2016). The stressors trigger the response to threat (Russoniello et al., 2009; Keltner et al., 2014; Ganzel et al., 2016), which increases the allostatic load, and the future accumulating stressors further increase the negative mental state (Ganzel et al., 2016). Eventually, the peripheral bodily responses signal back to the allostatic network (ibid.). However, if the processing

crosses categories the default mode network is activated for self-reflection, which results in mental states such as subjective emotional experience and further supports allostasis[6] to regulate the state (ibid.).

The interconnectedness of neural networks related to emotion clears the picture on why negative mental state influences on behaviour, thoughts and well-being. Research findings show that chronic stress influences normal executive functions including working memory span, attention, planning and inhibition (ibid.). Ganzel et al. (2016) propose that the salience network and DMN are part of *Triple allostasis theory* which connects core affect, DMN and salience network for emotion regulation. *Triple allostasis theory* suggests that undesirable negative stimuli draw attention, and foremost, the undesirability makes the stressor intrinsically salient (ibid.). Ganzel et al. (2016) claim that stress and salience processes have overlapping brain functions from prefrontal cortex to brainstem, and further claim that negative core affect and stress based distress are constructed identically, that both are the result of allostasis, and moreover, the negative core affect and the avoidance tendency result from the salience process.

Therefore, stress and depression are connected physically and psychologically which underlines the need for new interventions that help to manage the allostatic load and to reduce stress and improve mood which would have implications on stress-related disorders such as depression or other diseases (Russoniello et al., 2009). These findings give interesting directions for research on the effects of games and game development.

To conclude, the current affective sciences consider affective states generated in the dynamic interaction of large scale neural networks that work in interaction with other processes. Moreover, these affective states manifest the internal status of the individual's well-being and are therefore crucial for the research of the short and long term emotional effects of digital games.

6 Allostasis is a process to regulate the body's needs and resources (Barrett, 2017). The allostatic theory is a conceptual framework for a stress process that regulates the responses for the situation, however, unmanageable stressful situations build up the allostatic load, and eventually the body reacts with neurochemical adaptation, which in turn generates potential for physical and mental illnesses if their HPA feedback loop is not working efficiently (Russoniello et al., 2009).

3 Components of emotion processes

This chapter continues to introduce the theoretical background of affective sciences focusing on the measurable components. The chapter has been divided into four topics: the list of measurable components related to emotion processes, the first component of the human brain that forms the foundation for other components, and the two most relevant components for the framework: Individual emotionality and Subjective emotional experience.

3.1. List of components

The affective states are embodied and revealed in the different components of emotion processes, however, there are a variety of views on what these components are. Different researchers have listed their view of components of emotions depending on their research field. For example, Mauss & Robinson (2009) claim there are four types of components: physiological changes, motor behaviour, behavioural tendencies, and subjective experience. Similarly, Izard (2010) includes the subjective emotional experience as an aspect of emotions. Lang et al. (1993) include behavioural aspects and a more defined physiological component, peripheral-physiology to the list.

In contrast, Panksepp (2004) suggests that the four aspects of emotions are neural activity, the peripheral physiology, behaviour and the subjective experience. In addition, Saarimäki et al. (2016; 2018) present a list of neural systems, motor expressions, emotional evaluation, subjective experience and bodily sensations as the five different components of emotions. Further, in Scherer (2005) view, emotions are multi-modal and constructed from the activity of five emotion components: neurophysiological system regulation (central and autonomic nervous system), evaluative cognitive information processing[7], motivational action tendencies through executive control, motor expressions in the somatic nervous system, and the subjective experience. In addition, Barrett (2017) suggests five components: feeling, facial movements, vocal acoustics, autonomic nervous system changes and action. However, Russell (2003) suggests a different list of components, such as affective quality, core affect, appraisal,

7 Scherer (2005) claims that evaluations are situated in the cognitive component, and neurophysiological component is linked only to bodily symptoms. However, from the cognitive science perspective all brain activity is part of cognition, including emotion processes, therefore emotion processes are intertwined with other cognitive processes and this view will be used in this text.

physiological changes, expressions, instrumental action, subjective conscious experience, emotional meta-experience and emotion regulation.

These different suggestions of components of emotions indicate that the topic of specific components may raise some disagreements, however, multiple similar aspects have been mentioned: neural activity, peripheral physiology, motor behaviour or expressions, the subjective emotional experiences and the behaviour. Therefore, I have combined the components of emotion processes into a list of five, which is most usable in the context of digital games and affective studies:

1) The first component is the *brain*. The neurophysiological component includes neuroanatomy, neurochemistry, and neurodynamics (Panksepp, 2004), and both subcortical and cortical activity (Panksepp, 2004; Saarimäki, 2016). This component defines the individual emotionality and includes all activity and information processing in the brain, such as emotion processes and regulation from salience network, default mode network and executive functions, and all activity related to the other components. This component is usually studied with methods such as electroencephalography (EEG), functional magnetic resonance imaging (fMRI) or positron emission tomography (PET).
2) The second component is *peripheral nervous system* (PNS), physiology, showing responses such as the autonomic nervous system (ANS) activity. This component includes the peripheral-physiological changes and responses, which can be measured with methods such as electrodermal activity (EDA) on the skin, and cardiovascular activity such as blood pressure and heart rate (Lang et al., 1993; Cacioppo et al., 2000; Scherer, 2005; Mauss & Robinson, 2009).
3) The third component is the communicative *motor expression*, such as vocal, facial and posture expressions. This component is usually studied with observations, such as video ethnography, or measuring facial or other muscle movements. Research shows that expressive motor behaviours and more complex behaviour are learnt schemas and can have variability across individuals, and are affected by the development, environment and culture (Mauss & Robinson, 2009; Keltner et al., 2014).
4) The fourth component is *behaviour* or behavioural tendencies. This component is usually studied with observation, interviews and self-report methodologies.

The reactions for situations are partly related to learnt behaviours based on environment and culture and partly to the individual affective styles, therefore it is suggested that different affective types have different reactions to emotional states (Lang et al., 1993; Mauss & Robinson, 2009; Davis & Panksepp, 2011).

5) The fifth component is the *subjective emotional experience*. The conscious subjective experience can be available for verbal description. This components includes Panksepp's (2004) complex tertiary level emotions and is similar to Russell's (2012) concept of emotional meta-experience. This component can be studied with interviews and self-reports, and with mixed methods by simultaneously measuring the other components. A sub-category for this fifth component is the somatosensory bodily sensations and feelings.

The components of emotions processes are massive areas of inquiry. The amount of components and variables in emotion processes results in difficulties in comprehensive measurements of emotional experiences (Scherer, 2005). Therefore, several research teams have focused on studying purely one or two components. Still, studying only one emotion component is not enough to understand emotions, but should be studied in context as a phenomenon including the whole brain and body (Barrett, 2017). Both individual and few combined components can be measured successfully, but more mixed methods may reveal more about the individual experience than focusing on a single component at the time.

Emotion measurement technologies have limitations. Panksepp (2007b) claims that measuring autonomic physiology cannot be expected to distinguish emotions, and moreover, neuroimaging does not reveal the neurochemical or neuronal level activation which is why neuroscientific affective research cannot be studied without invasive methods which require non-human animal studies. Neuroimaging[8] technologies, such as fMRI, do not yet support the differentiation of activity in human subcortical areas, even if cortical distinctions are now possible (Panksepp, 2007b; Saarimäki et al., 2016).

8 Neuroimaging technologies have limitations for measuring emotional states. As a method functional magnetic resonance imaging (fMRI) has limitations for participants movement and voxel sizes, and is more suitable for measuring sensory affects than emotional states (Panksepp, 2007b). Further, electroencephalography (EEG) measures only the surface of the cortex. Furthermore, the neurochemicals may be more crucial for affective states than action potentials, which cannot be studied with the current imaging technologies, similarly as the slower activation frequencies (ibid.). Therefore, Panksepp (2007b) recommends PET scanners for measuring emotional states since it has longer temporal resolution. However, even fMRI has certain limitations, the new wearable fMRI scanners have potential for game related research that requires movement.

Moreover, it is difficult to connect the subcortical activity to the behavioural layers since the cortex enables unique, complex and subtle strategies for behaviour, such as learning and formation of cultures (Panksepp, 2004). Therefore, it is critical for researchers to define which areas they are focusing on in their studies, especially to enable other studies that continue to map out the links between the different components. To clarify the position, this thesis introduces only for the first and fifth component, since these are the most relevant components for designing the first versions of the framework that considers the relationship of digital games and emotional effects. The next sections will discuss these two components in more detail.

3.2. Affective neuroscience of emotion processes

To study the effects of gameplay on as complex phenomenon as emotions, it is important to acknowledge and include the description of the neurophysiological foundation of the emotion processes, especially because brains and the neural foundations of emotions are regularly excluded from affective game research. Still, excluding brains from the research is understandable for reducing complexity and certain research techniques have been unreachable for their excessive costs. This thesis pilot study will not use brain imaging methodologies, however describing the affective neuroscience behind the emotional game experiences is an important foundation for Chapters 4 and 5.

The individual differences influence the uniqueness of the experience and responses, even if the stimuli are similar (Purves et al., 2001), meaning that one individual's gameplay experience does not indicate how another person would experience the same game. Therefore, positively exciting gameplay experience for one may feel indifferent or scary for another which underlines the importance to map out the differences of the individual emotionality of the participants in the studies. Further, the differences in the experiences may be visible in the neural anatomy and activity as well.

Neuroimaging techniques have revealed at least six brain areas that are activated during emotional processing, both cortical and subcortical areas (Kober et al., 2008). All cortical areas are related to emotional processing, especially the medial prefrontal cortex (mPFC) upper cingulate cortex, sensory cortex, and somatomotor cortex (Kober et al., 2008; Mauss & Robinson, 2009; Saarimäki et al., 2016). The frontal cortex is

associated with the executive control processes such as emotion regulation, problem-solving, planning and decision making (Damasio, 2005), including re-evaluation which is an effective coping strategy (Gross & John, 2003).

The medial prefrontal cortex (mPFC) is important for goals and approach-withdrawal tendency, self-representation, rewarding experiences and empathy (Davidson & Irwin, 1999), awareness and integration of the internal state (Saarimäki et al., 2016) by combining the automatic affective information of the physiological state. The mPFC is activated during the observed experiences of others, which is linked to the ability to empathize and understand emotional pain of others, and activate similar areas than Theory of Mind (Bruneau et al., 2012). Theory of Mind explains the human ability to attribute the mental states for others, which is a critical skill during mentalizing activities, such as imagination and play, including digital gameplay.

The mPFC receives inputs from several subcortical areas (Davidson & Irwin, 1999). The subcortical areas, such as amygdala, thalamus, hypothalamus and basal ganglia have been highlighted as relevant for emotional processing (Panksepp, 2004). The subcortical areas have different types of brain connectivity patterns, such as hypothalamic-limbic circuitry and thalamus-cortical circuitries (ibid.).

The hypothalamic-limbic brain circuitry is formed from rich interconnections of hypothalamus and amygdala. This circuitry is associated with forming the foundation for the core affects, valence, and salience activation, and creates readiness for the brain processes that would be appropriate for the situation. The hypothalamic-limbic system has more overlapping in emotion related activity that the cortex, therefore limbic areas may be responsible for salience processing and arousal that are common for all emotions and further give input for the frontal cortex (Saarimäki et al., 2016), and are included in larger networks, such as executive control network, salience network and default mode network described in Subsection 2.2.4.[9]

Positive emotions, especially “anticipatory positive affective state”, is linked to the limbic system, particularly ventral striatal dopamine systems (Burgdorf & Panksepp, 2006). Dopamine and nucleus accumbens activation are both central for goal-directed

9 In addition, subcortical upper brainstem and limbic structure, and neocortex are involved with the different levels of consciousness (Solms & Panksepp, 2012).

behaviour, wanting feeling, and reward when the goal is reached (Panksepp, 2004). As previously stated, positive anticipation, wanting and exploration have been linked to the SEEKING process.

Amygdala

Amygdala is in the core of the emotional processing network. Amygdala determines the emotional salience and the relevance of the situation (Ganzel et al., 2016; Saarimäki et al., 2016). Recent findings have linked amygdala activation to both positive and negative valence in emotional experiences, such as happiness, sadness, anger and being afraid (Bechara et al. 1995), and shown amygdala as an important structure for recalling emotional situations, attention, perception, emotional learning, and emotion inhibition and regulation (Phelps & Davidson, 2005).

Different emotional profiles can have different physiology and levels of activation in amygdala, for example extremely altruistic people have langer and more active amygdala and likewise psychopathic tendencies correlate with a smaller and less active amygdala (Rosenberg et al., 2013). These tendencies have been mapped also in gameplay behaviour and emotional experiences. The players who have larger or more active amygdala react similarly empathetic both in games and in real-world settings resulting in feelings of increased guilt for aggression in games, and the players may refuse using unjustified violence in digital games (Hartmann et al., 2010). These findings of individual differences suggest that the individual player experiences could be differentiated with more studies with mixed methods of self-reports, neuroimaging and observations.

Hypothalamus

Hypothalamus is located in the lower part of thalamic structures, which controls arousal, and signals to the autonomic nervous system (ANS) and the hormonal system through the pituitary gland. Hypothalamus is affected especially by negative arousal, negative mood and distress, such as anxiety and sadness. Negative stimulus activates a response in hypothalamus-pituitary-adrenal (HPA) system in the brain, which increases the cortisol[10] production (Panksepp, 2004; Russoniello et al., 2009; Willner et al., 2013). Cortisol influences the metabolism, cognitive and emotional functioning, and immune

10 Cortisol is important for survival in stressful situations, it employs the energy usage for bodily resources, and simultaneously is interacting in the subcortical brain that normally would regulate the emotional load (Panksepp, 2004).

system[11] (Russoniello et al., 2009), which explains why chronic stress makes the individual feel sick.[12] The HPA system activates the sympathetic branch of the autonomic nervous system (ANS) that controls the behaviour to fight or flight, increases heart rate and blood pressure and decreasing digestion and suppression of the immune system (Keltner et al., 2014), and other changes in physiology to respond the threat (Russoniello et al., 2009; Ganzel et al., 2016) which in turn increases the allostatic load and negative affective state (Ganzel et al., 2016).

Research findings suggest that playing specific casual digital puzzle games can reduce stress and increase relaxation (Russoniello et al., 2009). These findings are interesting in the context of gameplay effects on emotions. Still, more research is needed on the topic to understand which game elements create which effects.

In conclusion, emotions activate large scale neural networks, pathways and circuitries. Acknowledging the neural foundations of emotions should give a stronger foundation for the affective game research, enable the future studies that link game elements to individual experiences, and further, enable findings that are translatable to other research areas.

3.3. Individual emotionality

There are differences in individual emotionality, how sensitive individuals are for rewards, pleasant or unpleasant stimuli and different affective states. Similarly, there are differences in what each individual is finding interesting or rewarding. Affective research has been able to link the most frequently experienced subjective emotions to lateral brain activity, such as, individuals who experience recurrent positive emotions and have an approach tendency have more activation in the left frontal lobe also in neutral and resting states compared to individuals that have withdrawal tendencies. These asymmetries for approach and withdrawal can be measured already from a ten-month-old child (Davidson, 1992). However, Barrett et al. (2007) criticise that the individual's temperament predicts the experience more than the electrical stimulation of the brain and that individuals have large differences in size of the cortex and the

11 Immune system network help to fight the disease and triggers the behaviour that is needed for healing, including sleep, withdrawal, inhibiting social behaviour and exploration (Russoniello et al., 2009).
12 However, even if laboratory results suggest that cortisol production is increased when the individual faces stressors, the cortisol fluctuations are harder to define in complex situations outside of strict laboratory settings and the findings have been contradictory in the field studies (Hedman, 2014).

connectivity. Still, the individual differences influence the high variety of emotional experiences.

The affective styles are both genetic and develop throughout the individual's life. Therefore, the reactions for situations are partly related to learnt behaviours based on environment and culture and partly to the individual affective traits, which result in individual affective styles that have different reactions to emotional states (Lang et al., 1993; Mauss & Robinson, 2009; Montag & Davis, 2018). These differences are called affective styles (Davidson, 1993), or personality traits (Davis et al., 2003).

To understand the individuality in affective styles researchers have developed different frameworks to measure the differences in affective traits and personality. The Five-Factor Model (FFM), or Big Five personality traits, is a personality framework that has been frequently used in both game research and psychological studies. The FFM's physiological and genetic basis is supported by research (Davis & Panksepp, 2011), and validated across cultures (Bean & Groth-Marnat, 2016). The FFM maps personality over five categories based on natural language emotion lexicon adjectives. The theoretical personality traits are *Extraversion*: energy and enthusiasm; *Agreeableness*: altruism and affection; *Conscientiousness*: constraint and control of impulse; *Emotional stability*: negative emotionality and nervousness; and *Openness*: originality and open-mindedness (Hofstee et al., 1992).

In comparison, Davis et al. (2003) have designed a psychometric self-report tool called Affective Neuroscience Personality Scale (ANPS), which is based on the evidence of the six subcortical core affect processes PLAY, SEEKING, CARE, FEAR, RAGE, and PANIC/GRIEF (which were introduced in the Subsection 2.2.3.). The basic positive core affects SEEKING, CARE, and PLAY construct the general positive affect and behaviour (Davis et al., 2003):

1. *Exploration*: curious, exploring, striving for solutions, positively anticipating new experiences, feeling being able to accomplish (self-esteem).
2. *Playfulness*: having fun, humour, laughing, happy and joyful, playing games.
3. *Caring*: like to be needed, nurturing, drawn to children and animals, or others in need, feeling affection to care and help.

The basic negative core affects FEAR, RAGE and PANIC/GRIEF construct the general negative affect and behaviour (Davis et al., 2003):

4. *Fear*: feelings of anxiety, tenseness, weakness, worrying, rumination, sleeping problems, and problems with decisions.
5. *Anger*: easily irritated and frustrated that lead to anger, hot-tempered, expressing anger, long-lasting anger.
6. *Sadness*: feeling lonely and distress when alone, crying often, thinking about loved ones.

The ANPS model correlates with the Five-Factor Model in the following aspects: *Openness to experience* correlates positively with *Exploration*, *Extraversion* correlates positively with *Playfulness*, and *Agreeableness* is positively correlated with *Caring* and inversely correlated with *Anger* (Davis et al., 2003). Similarly, *Emotional stability* is inversely correlated with *Fear*, *Sadness* and *Anger* (ibid.). Further, Davis et al. (2003) hypothesise that individuals may combine the subjective negative feelings related to fear and sadness in self-reports, and speculate that openness to experience could show the activity of SEEKING core affect process. Interestingly, the affection towards problem solving, positive anticipation and self-satisfactory action are associated with SEEKING as well (Panksepp & Watt, 2011). These suggestions propose that exploration, problems solving and positive anticipation are important aspects of subjective emotional experiences for affective game research and the scope of this thesis.

However, the correlation with *Extraversion* and *Playfulness* may result from the questionnaire setup, which was based on the assumption that *Playfulness* correlates with social fun, such as joking and physical play, and therefore only these aspects are included inthe questions while excluding for example solitary play and gameplay related topics.

In addition, the ANPS scale has shown a correlation with mood disorders and well-being. Lower points in *Playfulness* and *Extraversion* scales have a correlation with negative affective disorders, such as depression (Davis et al., 2003). Therefore Davis et al. (2003) hypothesise that the higher activity with PANIC/GRIEF core affect process

may be behind the development of depression. In general, mood disorders have reduced positive affect activity, such as SEEKING core affect process, and increased negative activity, such as PANIC/GRIEF core affect process, that expresses neural affective imbalances that result in experiencing psychological pain (Panksepp, 2004). These findings are important to the aspects of what effects of playing games on emotion and mood induction and further, well-being.

In sum, individual emotionality has variety, and different affective styles influence the experiences and the interpretation of stimuli, creating unique situations. The individual differences cannot be excluded from the studies that aim to understand the effects of games on affective states, including subjective emotional experiences. Therefore the affective traits should be included in the framework in this thesis.

3.4. Subjective emotional experience

The subjective emotional experience, the complex tertiary level emotional states, are hypothesised to be formed in the interaction of neural circuitries and large scale neural networks and develop through learning and adaptation to the environment. The subjective emotional experiences, the feelings and emotional thoughts form an extensive part of the human experience of life, influencing our behaviour, decisions, thoughts, cognitive processing and well-being. Emotions both enhance or impair cognitive processes, such as perception, executive functions and recall (Dolcos & Denkova, 2014).

The interconnectedness and circular interaction between the different affective processes suggest that there could be innate families of emotions that are related and functionally attached (Panksepp & Watt, 2011). Further, similarly experienced conscious subjective emotions seem to have a similar neural basis (Saarimäki et al., 2016; 2018). Saarimäki et al. (2016) mapped reported emotions to distinct categories based on their spatial location in the neural activity detected in fMRI:

1) *Anger*: furious, displeased, fierce, angry, cranky, annoyed
2) *Fear*: restless, nervous, anxious, frightened, frantic, afraid
3) *Happiness*: joyful, happy, merry, cheerful, delighted, pleased
4) *Sadness*: sad, unhappy, sorrowful, heavy-hearted, depressed, gloomy.

The basis of the visualization (Figure 2) is on the affective neuroscientific theory and the theory of individual affective styles which claim that the positive and negative core affects would be on the foundation of more complex subjective feelings. The negative core affects, such as FEAR, RAGE, and SADNESS[13] processes may be behind distress, anxiety, and sadness symptoms, and long term mood disorders (Panksepp, 2004). Further, it has been hypothesised that consciously experienced feelings of rejection, loneliness, sadness, shame and guilt may be complex, but subtle outcomes from the interaction of the fundamental SADNESS circuitry, and elaboration in the higher neocortical processes (Panksepp, 2004; Panksepp & Watt, 2011). In addition, the positive core affects SEEKING, PLAY and CARE are linked to the reward-system (Panksepp & Watt, 2011), and further, SEEKING has been linked to positive anticipation, enthusiasm, exploration, curiosity and problem-solving. These positive emotional states are potentially activated by gameplay and relevant for the affective game research.

Interestingly, the positive and negative affects are shown in lateralized brain activity, which has been linked to the approach-avoidance tendency[14], which is the most simple level of emotion (Panksepp, 2004). The approach tendency and positive emotions have been associated to sequential left side activity (Mauss & Robinson, 2009; Willner et al., 2013). Similarly, subjective emotions, such as desire, compassion, enthusiasm, rewards, happiness, are linked to the left prefrontal cortex. Further, negative affects, including subjective emotions, such as fear, shame, sadness and anxiety and the withdrawal tendency are processed laterally more on the right side of frontal cortex (Mauss & Robinson, 2009; Willner, 2013). Furthermore, the activity is lateralized in the subcortical areas as well (Mauss & Robinson, 2009). The right side of amygdala has higher activity when the stimulus is negative and left side activity with positive stimuli (Dolcos & Denkova, 2014). In addition, Panksepp (2004) speculates that biofeedback techniques could be used to increase the left side arousal. These suggestions are interesting for both affective computing and affective game research.

13 The original circuitry was named PANIC/GRIEF, however Davis & Panksepp (2011) started to use SADNESS for the ANPS questionnaire, which is why I will use this term for this thesis.
14 However, Mauss & Robinson (2009) claim that the findings that the frontal brain asymmetry in electroencephalography (EEG) has link to avoidance-approach motivation more than valence, for example, anger and worry have been linked to higher left side activation on frontal areas, since both have approach tendency. Further, measured resting-state activity with EEG is different in the left frontal cortex in individuals who have depression compared to healthy individuals.

GENERAL POSITIVE AFFECT

CARE	PLAY	SEEKING
Love, Affection, Empathy, Caring	Joyful, Happy, Having fun, Playfulness, Silliness	Enthusiasm, Positive anticipation, Interest, Curiosity, Feeling of being able.
Nurture, like to be needed and help others, notice the distress of others	*Humour, play, playing games, social interaction, laughter*	*Exploring e.g. environments, information or object, striving for solutions, problem solving*

GENERAL NEGATIVE AFFECT

ANGER	SADNESS	FEAR
Irritation, Frustration, Envy, Anger, Cranky, Annoyed	Sadness, Loneliness, Distress when alone, Shame, Guilt, Embarrassment	Anxiety, Tense, Worry, Fearful
Expressing anger physically or verbally, impulsive, hot-tempered	*Crying, withdrawal, seeking comfort, passive.*	*Freeze & flee, withdrawal, rumination, problems with sleep and decision making, social problems*

Figure 2: The emotional processes form positive and negative general affect and result in complex emotional experiences. The core affects are marked with capital letters. Under each core affect is a list of complex emotions hypothesised to be linked to this core affect. However, these more complex emotions may be results of multiple core affects processes in interaction with dynamic neural networks, still, for visualization purposes more simplistic view is used. In cursive are examples of behaviours suggested to be related to the complex emotions. This visualization is speculative, and interpreted by author from studies by Panksepp (2004), Davis et al. (2003), Davis & Panksepp (2011), and Saarimäki et al. (2016).

In conclusion, the subjectively experienced emotions are complex emotions that result from the large scale neural network activity and are hypothesised to form based on the activity in the subcortical core affect processes. For this thesis, the visualization in Figure 2 brings together the suggested baseline positive or negative neural activity, the subjective emotions, and the behaviours which can be inquired with a questionnaire. The area of complex subjective emotions will be further combined to a list of gameplay related subjective emotions and the emotional game elements in Chapter 5.

4 Emotions and games

There is a growing amount of evidence of the positive impact of digital games and different academic fields study the benefits and effects of gaming. Neuroscientific research has shown that the brain is changing based on the individual's activity, and the changes in the brain result in changes in behaviour (Bavelier et al., 2011). This phenomenon and feature of the central neural system is called neuroplasticity. Recent research findings suggest that depending on the game elements, the gameplay could improve recall, problem solving speed, decision making, creativity, attention shifting flexibility, attention for details, tracking objects, vision, verbal skills, aiming for moving target, prosocial attitude and empathy, and even intrinsic motivation (Bavelier et al., 2011). It is still unclear how well digital games can develop different skills and behaviours. Moreover, the findings suggest that the individual differences of the players have an impact on the experience and the effects of the games.

In addition to the cognitive exercise, there are reportedly many good reasons to play for the emotional well-being, such as experiencing positive emotions, relaxation, reducing stress and improving mood (Russoniello et al., 2009). The extensive list of potential benefits of digital games has increased the interest towards the studies on effects of gameplay, however, more research is needed to show how much of the digital gameplay skills are adaptable in other areas of life and what are the long term effects for well-being.

Research findings have shown that active game players have different brain functions than non-players, such as enhanced problem solving and creativity, and persistence in front of failures (Granic et al., 2014). However, it is unclear whether players are more creative in general or if playing improves their creative skills (ibid.). Therefore more studies should be performed comparing active players with non-players.

The effects of games can be studied from several different perspectives, however, as it has been shown in the previous sections the affective processes and the subjective emotional experiences are complex phenomena. Now diverse research fields are approaching the issue of gameplay effects, however, the lack of multidisciplinary research has resulted in the current state where the knowledge doesn't travel between

the fields. Frome (2007) claims the gaps between the research fields result in difficulties to build holistic understanding of how games create emotions, which in turn might result in overlooking certain emotion types. Further, affective game research has suffered from ambiguous definitions, which have even raised questions on the validity of some of the findings (Kivikangas et al., 2011).

To close the gaps between the fields and to be able to study and measure the effects of game elements on emotions, it is important to describe the relevant theories behind emotion processes, emotion components and individual emotionality of players. This work has been done in Chapters 2 and 3 of this thesis. However, this is a short and simplified attempt. For example, Yannakakis et al. (2011) raise concern on applying emotion theories to games and players, since the majority of these theories are not developed for or tested with interactive media and call for empirical studies for validation. However, this thesis tries to reach a small portion of this gap by combining different research fields, but more research is needed for building bridges between the fields. The following Sections will introduce the emotionality of gameplay with two topics: emotions and playing and how these emotions may be linked to positive emotional experiences and well-being.

4.1. Rewarding aspects of gameplay

Individuals may report different reasons to play in general. However, all humans play partly because of the same reasons, play is a joyful, motivating and intrinsically rewarding activity. Play is a way to be and engage with the world, understand the world, express oneself, have fun, and enjoy life (Sicart, 2014). Play activity is overlooked in many aspects of life, however, play may be a critical part of human well-being. In general, Brown & Vaughan (2009) claim playing correlates with the individual's experience of happiness and meaningful life. Interestingly, digital games may provide fulfilment to the foundations of positive affective experiences and basic needs, which in turn may increase positive emotionality.

Digital games are hypothesised to have positive effects in activating reward areas. Research findings suggest that interactive gameplay activates the reward related brain circuits (Cole et al., 2010; Kätsyri et al., 2013), and release dopamine and opioids similarly than during eating and sex, or watching pictures of food or sex (Kätsyri et al.,

2013). However, playing digital games activates reward circuits more than mere watching video of gameplay (Cole et al., 2012). These findings suggest that games create pleasurable experiences similarly than real-world activities.

Digital games may fulfil some psychological needs. The self-determination theory (SDT) suggests that fulfilling the basic psychological needs for competence, autonomy and choice, sense of security and relatedness nurtures and elicits intrinsic motivation, and correlates with the reported daily well-being, and experience of happiness, *eudaimonia* (Ryan & Deci, 2000; Deci & Ryan, 2008). Intrinsic motivation is a self-satisfactory activity, the tendency to seek challenges and explore which results in a healthy, active, curious and playful individual, which influences on the well-being (Ryan & Deci, 2000; Deci & Ryan, 2008). Similarly, digital games create frequently feelings of flow (Isbister, 2016), which is a feeling of an engaging physical and emotional presence and a sense of control (Ryan et al., 2006), and results in positive emotions, such as curiosity, excitement, challenge and triumph (Isbister, 2016).

The descriptions of the self-determination theory and the concept of flow have many similarities and indicate a connection to different emotional states. I speculate that the self-determination theory and the concepts of flow are linked to Panksepp's (2004) SEEKING and PLAY core affect processes and related complex emotions. The positive core affect process SEEKING is claimed to elicit positive anticipation, enthusiasm, curiosity, focused attention, goal-directed activity and intrinsic motivation and activates reward pathways, and PLAY is associated with behaviours such as social play and complex emotions of playfulness and joy and similarly experienced as a rewarding activity. Interestingly, gameplay may be unique in its ability to be an intrinsically rewarding activity that provides fulfilment to all these needs: problem-solving, working towards a goal, exploring solutions and environments, seeking for resources and providing feelings of competence, autonomy and agency.

All in all, humans play games because playing is intrinsically motivating and rewarding activity, which elicits different types of affective states, including complex subjective emotional experiences, such as happiness, joy, positive anticipation, enthusiasm, curiosity, and feelings of competence, autonomy and agency in a safe format of pretend

play. These reasons to play games are fundamentally important for building the framework for studying emotions in the context of digital games.

4.2. Subjective gameplay emotions

Games elicit different affective states which may result in changes in different emotion components, including subjective emotional experiences. Digital games provide context to experience also different complex emotions, such as domination, aggression, nurturing, loss, shame and anxiety which may further develop the player's skills in these areas (Granic et al., 2014). For example, the empathetic reactions are similar both in games and in real-world settings, making more empathetic players more likely to feel increased guilt for aggression in gameplay and they may refuse of using unjustified violence since they consider also virtual violence as moral action (Hartmann et al., 2010).

Shinkle (2005) claims that some gameplay generated emotions may be sometimes more performance related than "narratively" created, such as fear or panic during scary a gameplay situation might be related more to the fear of losing the character's life and fear of having to start again than the fearful situation. I claim that Shinkle (2005) focuses on the subjective emotional experience level and is ignoring the possibility that individuals can have complex emotional experiences where the fear of losing resources, a thrill of fear, and withdrawal or fight for survival may co-exist.

The experienced emotions can be complex, and some game elicited subjective emotional experiences can last for years. Players have reported strong emotions which they have remembered for years after a game character's death, or after losing companions that they have spent time with during the game, such as *Planetfall* (Shinkle, 2005; Isbister, 2016). *Planetfall* (Infocom, 1983) is a classic example of an emotional and sadness eliciting gameplay experience (Isbister, 2016). Similarly, Isbister (2016) describes that players have reported experiencing feelings of social responsibility during *The Walking Dead* (Telltale games, 2012) and *The Wolf Among Us* (Telltale games, 2013), where the player has to solve moral problems. Since these experiences are remembered they may influence the player's life and their perceptions of themselves long after the play sessions are finished.

There is no comprehensive list of the effects of games on affective states, nor a list of all emotion-eliciting game elements, there is no complete list of potential subjective emotional experiences evoked by games. It would be difficult to make a comprehensive list of emotions in games, since each individual player and each individual game may create unique experiences and effects. In spite of the challenges, some lists of gameplay emotions exist. Perron (2005) claims that the prototypical gameplay emotions are interest, enjoyment, worry, fear, anger and frustration. These prototypical emotions are on the level of subjective experience and natural language concepts. Still, the listed subjective emotions seem to have similarities to Panksepp's (2004) affective neuroscience theory's core affects, and with the hypothesised subjective emotional experiences visualized in Section 3.4., such as interest, curiosity, joy, fear and anger. In contrast, some studies have linked frustration to anger, and worry to fear category (Davis & Panksepp, 2011; Saarimäki et al., 2016).

It is possible to form a foundation for a list of gameplay related emotional states based on the affective sciences, however, it can be even questioned if it is necessary to map emotional experiences related purely to games, since games could be perceived as a type of stimuli that results into the same variety of subjective feelings than other interactive media related stimuli.

Järvinen (2008) introduces different studies and models that in total describe over 50 categories for pleasure and enjoyment in games, such as fantasy, narrative, challenge, fellowship, discovery, beauty, immersion, problem-solving, competition, social interaction, comedy, and a thrill of danger[15]. Järvinen's (2008) list has been influential for this thesis, however, it is not useful as a whole from the perspective of affective sciences, since these different categories have multiple different topics that are related to abstract categories, such as emotions related to self, others, events or objects, or subjective emotional experiences, game sub-genres, or specific elements of games. Therefore I have formulated a simplified list based on the affective sciences in the literature review, and especially Panksepp's (2004) affective neuroscience theory of core affects and hypothesised tertiary-level emotions, Saarimäki et al. (2016) distinct emotions categories, Davis et al. (2003) and Davis & Panksepp's (2011) complex

15 Read more detailed descriptions from Järvinen, 2008.

subjective emotions, Deci & Ryan's (2008) self-determination theory, and Perron's (2005) and Järvinen's (2008) lists of game-related emotions. This simplified list includes nine gameplay related categories of subjective emotional experiences.[16]

1. *Feeling of enthusiasm, interest and curiosity.* This category is linked to approach mentality and *Seeking* which is associated with positive anticipation, intrinsic motivation, curiosity, problem-solving and exploration. The Seeking related complex emotions may be intrinsically rewarding and include a wanting feeling. This category is linked to behaviours such as exploring the environment, seeking resources, and striving for solutions for intellectual challenges, such as mysteries, puzzles or other problems. This category is related to goal-directed activity, working and reaching a goal, such as trial and error behaviour, that preseed the pleasure of insight and discovery and feeling of accomplishment.
2. *Feeling of playfulness*. This category is linked to approach mentality and *Play* which is associated with playfulness, amusement and joy, and further, humour, laughter, happiness, comedy, and silliness. The feeling of play is related to the different types of play, playing with object, physical, social and imaginative play, including playing to be someone else, somewhere else, and learning about oneself through the imaginative actions and rules. Playfulness may be present both in the game or outside of the game contexts with other players, for example, playful competition or collaboration. This category is closely linked to the first category of *Seeking*.
3. *Feeling of caring*. This category is linked to approach mentality and *Care* which is associated with nurture, empathy, helping others, like to be needed, and further linked to a higher tendency for collaboration with others. Järvinen's (2008) concept f*ortunes of others*, wishing good or bad for others, such as social fairness may be related to this category.
4. *Feeling of fear*. This category is linked to withdrawal tendency and *Fear,* which is associated with subjective experiences of worry, anxiety, tenseness, and feeling scared. Some players may like to be afraid and experience the thrill of danger, and for them fear may be an exciting and positive experience during gameplay. Whereas some players react to fear by hiding and fleeing or quitting the game

16 I have removed from the list the reactions to situations, such as surprise, relief, and disgust, since they are not long lasting affective states, and since some researchers do not consider these as *emotions* (Panksepp, 2004; Davis & Panksepp, 2011).

session or feel satisfaction when seeking for safety.

5. *Feeling of sadness*. This category is linked to withdrawal tendency and *Sadness,* which is associated with distress and hopelessness. Games can elicit sadness in gameplay situations by losing objects, or characters that the player has developed an attachment to.
6. *Feeling of anger*. This category is linked to approach mentality and *Anger,* which is associated with frustrations, irritations, hot-temper and a feeling to want to harm something or someone. Reasons for wanting harm may be born through unfair situations, need for survival or for feeling the need to protect something. This category may have links to the complex subjective experiences of wanting to feel powerful and dominate others and may be further linked to excessive competition, however, competition can be a playful experience as well.
7. *Feeling of satisfaction and happiness*. This category is linked to the rewarding feelings of wanting and liking, which other positive emotion categories elicit as well.
8. *Feeling of Agency*. This feeling is linked to the ability and autonomy to influence the game world with one's actions and may be linked to self-expression, creativity and use of imagination.
9. *Feeling of Accomplishment and Competence*. This feeling is linked to the performance and virtuosity in the gameplay, achievements, and the relationship with the game world. This category may be linked to Seeking category's goal-directed activity, and further linked to the frustrations and disappointments when the trial of achieving a goal fails. A subcategory of social achievement may be linked to subjectively experiences complex emotions of shame and pride, for example, the pride of winning.

This list of complex emotion categories is still the first version of the emotions related to games, and I acknowledge there may be different complex emotions that are not yet in this list, and that these categories could be divided into more detailed differentiation in the future. Further limitations of this list are related to the dimensions of each category, for example, the dimensions of arousal, valence, or reward are currently excluded, as well as complex emotions such the uncertainty of suspense which is a common experience during gameplay.

The different elements of a game, the context outside of the game and the player's individual emotionality and emotional state influence the players experience related to these emotion categories. Moreover, the player can experience a complex emotional phenomenon where many of these categories are present simultaneously. This list could then be further improved with research that focuses on individual players and measures the differences and changes in the emotion components during and after playing different types of games.

4.3. Gameplay and well-being

In the previous sections it has been shown that games influence the player's emotional state and experience. However, Bavelier et al. (2011) claim that the current discussion over effects of games can be compared to the discussion about the effects of food, and call for more defined discussion over the effects of digital games. Games are not simplistically good or bad, harmful or beneficial, but have a potential for multidimensional effects (Gentile, 2011), and the effects and the benefits of games may be combinations of the specific characteristics of the individual player and the game (Bavelier et al., 2011). Still, there is no agreement on the systematic descriptions of gaming quality or effects, nor which are appropriate conditions for each effect (Järvelä et al., 2014). Therefore, more systematic approaches are needed.

Gameplay elicits emotional experiences through both the game content and the outside of the game situation, such as the social aspects. The changes to emotional states are real when the individual is experiencing fiction, however, a healthy individual evaluates the stimuli as non-real, which has effects on the subjective emotional feelings and behaviour (Russell, 2003). The human brain processes the gameplay related stimuli as any other stimuli from real life; however, as in all pretend play, gameplay also provides a secure context for experiences in ways that real life cannot.

Gameplay may engage deep emotional processes, such as fear or a need for survival, which are rarely activated in safe real-life environments. However, fear may be unpleasant in real life, whereas during gameplay fear may be experienced as pleasant, and this experience may induce anxiety by narrowing the players' attention (Järvinen,

2008). The effects of the pretend[17] and mentalizing aspect of games on well-being needs still more research, however, there are similarities to the use imagination to play through different versions of situations in real life, which is our way of understanding the world and methods for planning our actions.

Digital gameplay may stimulate neural activity that improves mood. Especially playing a preferred game has a causal relation to improved mood and increased positive emotions (Granic et al., 2014), therefore it is important to understand which game elements the individuals prefer. Gameplay can even trigger extreme positive emotions (McGonigal, 2011). Further, some findings suggest that games may also decrease negative emotions and mood as well. Reinecke (2009) claims that as interactive media games are a cognitively absorbing environment which stops or reduces the player's negative thoughts, such as rumination, and may support recovery from negative stress. Furthermore, game elicited positive emotions may decrease the effects of negative emotions, increase positive emotionality, and work as drivers for inspiration and well-being (Granic et al., 2014). Moreover, McGonigal (2011) claims that active problem solving, searching for hidden objects, specific goals and the demand for improving skills in digital games could provide stimuli for activating reward related neural areas. The reward systems are critical for individual well-being, therefore, the possibility of hyperactivating the reward pathways with digital gameplay is interesting, since there areas are under-stimulated during sadness related mood disorders.

Research findings suggest that playing casual digital puzzle games can reduce stress and improve mood, which indicates potential mood and stress-related intervention and prevention techniques (Russoniello et al., 2009). The findings show that different type of casual entertainment games: sequencing puzzle game, crossword puzzle game and a pinball arcade game generate specific changes in reducing heart rate, cortisol levels, and negative mood, and increased positive mood and relaxation (ibid.)[18]. These findings suggest that problem-solving related games may improve well-being, however,

17 The neural processing related to pretence in digital gameplay requires the ability to understand the experiences and mental states of others, called Theory of Mind. Theory of Mind and pretend play are both associated to the same brain areas that participate in consciousness and awareness of self and others, and it is still unclear which is the most basic process, mentalizing or pretence (Whitehead et al., 2009).

18 The left prefrontal cortex alpha activity is consistent with mood increase on psychological reports and heart rate results were consistent with decreased physical stress, and increased autonomic nervous system relaxation (Russoniello et al., 2009).

additional studies are needed to map the individual differences and the specific game elements which may influence the results.

Other recent research findings have shown that high activity in the executive functions, that is associated with the complex mental operations such as attention, planning, decision making, thinking, adapting to new situations, problem-solving and emotion regulation in dorsolateral prefrontal cortex, might work as "a buffer against worsening anxiety" (Scult et al., 2017)[19]. In addition, challenging gameplay has been associated with higher arousal and more positive emotions and enjoyment compared to less challenging gameplay (Nacke & Lindley, 2008). However, Cole et al. (2012) hypothesise that gameplay may inhibit "controlled information processing" by activating subcortical automatic systems that focus on immediate goals, or reduces the default mode network activity when the player focuses on the gameplay. These findings suggest that indirect activation with challenging gameplay, goal-directed activity and rewarding experiences may be a working strategy to improve emotion regulation and mental well-being with games.

In addition to the effects on emotions, playing puzzles with open-ended problems, where the player has to solve problems with experimentation and failing may develop problem-solving skills (Granic et al., 2014). Similarly, playing strategic and role-playing games have been linked to improved problem-solving skills (ibid.). Moreover, experimenting and failing, trial and error may increase also persistence, since players report interest, joy, excitement and optimism when facing challenges and failure outside of gameplay situations as well (ibid.). All in all, playing digital games may answer to the foundations of human affective experiences, which in turn can increase positive emotionality and well-being. In addition, Granic et al. (2014) suggest that there is a possibility that games just make the players happier people.

4.3.1. Emotion regulation with games

Daily hassles, such as health or financial worries, and other demands are one of the most significant sources of distress (Reinecke, 2009). Moreover, individuals have a need

19 Scult et al. (2017) measured the effects of memory based math problems, visual stimuli that had both positive and negative valence, and guessing-game on the activity in prefrontal cortex. The participants who had higher risk for mental disorders had higher amygdala activity on threat and reduced reward activity, however, they were less likely to form anxiety seven months later if they had high activity in PFC during problem solving.

to alter, change or transform their emotional state (Russell, 2003). Still, there is large variability between individuals on how they manage or experience distress.

Digital games do not have most of the ordinary world's stressors, which influences on the experience, and makes games an inviting activity. Individual players may have multiple different reasons to play, such as escaping from the stress and mundane life, or pursuing experiences that normal life cannot provide (Ermi et al., 2005; Ryan et al., 2006). Interestingly, research findings have shown that individuals use consciously different types of entertainment, including games, for mood and emotion regulation (Granic et al., 2014; Reinecke, 2009; Järvinen, 2008). Especially stronger emotional coping style, less social support, and a habit of seeking relaxation and feelings of control and mastery correlate with the use of digital games for recovery (Reinecke, 2009).

Digital games are used for negative affect and distress related recovery and emotion regulation after stressful situations (Reinecke, 2009). Borders (2012) claims that players use games as a stimulus for affect incongruent content or valence, for example, to experience positive excitement when feeling sad or relaxation when feeling distressed. In contrast, Järvinen (2008) suggests that players search for emotions and moods from gameplay and that players seek games that either inhibit or exhibit their excitatory homeostasis, that individuals play games either for relaxation or excitement. In addition, Reinecke (2009) suggests that players seek aspects of escapism, relaxation, and feelings of competence and control.

Interestingly, digital games are effective for emotion and mood regulation (Hartmann et al., 2006; Borders, 2012). Acceptance and problem solving have been linked to emotion regulation and re-evaluations of situations which have reduced negative affect and symptoms of depression (Aldao & Nolen-Hoeksema, 2010). Furthermore, several studies have shown that even when gameplay is increasing physiological arousal the players report relaxation effects, which may be caused by the psychological detachment from daily negative affect (Reinecke, 2009). In addition, problem-solving related game elements have been shown to increase relaxation and positive mood already in Section 4.3.

More research is needed to understand the benefits of games in emotion and mood induction. Granic et al. (2014) suggest more temporal studies to define the gameplay effects, improvements on mood and the temporal effects to understand as well which aspects of games result in negative effects. Temporal studies are needed as well to understand if players use games for emotion regulation strategies, such as coping, or only report this goal after playing or after experiencing positive feelings during gameplay (ibid.). Moreover, it is still unclear if certain affective types benefit from games more than others or if the content of the game content should be different for different affective types. Still, digital games may provide a safe and effective environment to experience and practise emotion regulation strategies.

5 Affective game research framework

This chapter introduces the first version of the suggested framework for studying emotions in the context of games. The framework is designed based on the literature review of Chapters 2–4 including affective sciences, game related rewards, subjective emotions and research findings related to increased well-being. The framework includes four dimensions of digital games that influence the effects on emotional experience. In this thesis, I describe only aspects of two dimensions of the framework in more detail; the proposed three emotional game elements and the individual emotionality of players.

5.1. Dimensions of digital games

Digital games have at least five dimensions that influence the effects that playing has on brains and thereafter, behaviour: the "*Content*, *Context*, *Structure*, *Mechanics*, and *Time spent playing*" (Bavelier et al., 2011; Gentile, 2011). In contrast, Järvinen (2008) suggests three game element categories which influence the player experience: the systemic elements which include components and the environment; the behavioural elements which include player behaviour and mood; and the compound elements which include rules, goals, game mechanics, interface and the theme. These different approaches are further discussed in this Section.

Gentile (2011) claims that the *Content* is missing a standard definition. *Content* often includes a theme and narrative aspects, which in turn prime the player's emotionality for example to prosociality or aggression (ibid.). In contrast, Bavelier et al. (2011) see the *Content* as a broad dimension, which I suggest, includes four of Järvinen's (2008) game elements: rules, goals, components and environment. Similarly, Yannakakis et al. (2011) suggest that the *Content* includes reward systems and rules, narrative, and game environment and levels. However, Yannakakis et al. (2011) include mechanics, visual elements, such as maps and viewpoint of a camera, and audio and music into the concept of *Content*, which are missing from the other models.

Similarly to *Content*, the dimension of *Context* is not well defined, but includes in-game contexts of rules, goals and clues for problem-solving (Gentile, 2011). In contrast, Bavelier et al. (2011) consider the concept of context a social one, which includes both in-game and outside of the game social contexts, such as playing alone or together and

competing or collaborating. However, for Järvinen (2008) context is only gameplay patterns: where, when, and why the game is played. Here Järvinen's (2008) context has similarities with Bavelier et al. (2011) and Gentile's (2011) *Time spent playing* dimension which considers the length of the play session and patterns of playing.

The player experiences contexts both outside of the game and in the game, however, I perceive both in-game and outside of the game contexts wider than only social aspects or gameplay patterns. Therefore, I prefer to divide the concept of *Context* into in-game context, such as rules and values that are embodied in the content and game elements; and to the outside of the game context, such as the social aspects. Therefore, I follow Gentile's (2011) view, where the in-game *Context* is formed by rules, goals and clues, and suggest another category, *Outside-of-game context*, which includes the social aspects and play patterns. Dividing the context into two creates two more easily measurable dimensions. Further, I perceive that Järvinen's (2008) aspect of why the game is played belongs to another dimension of individual *Affective states* since the motivations to play are linked to the individual's current emotional state, as well as their game element preferences.

The concepts of *Content* and in-game *Context* dimensions are intertwined. The in-game *Context* and the included in-game values and rules that are fundamental for the effects on emotions, such as the presence of a problem or conflict. Sicart (2014) claims rules define the context of play, mediate and enable play and define the level of freedom in play. Similarly, Lindley (2003) suggest that rules define the boundaries for the player's actions, however, the player does not have to explicitly know the rules in order to play but to learn the interaction patterns of the game. In Järvinen's (2008) theoretical model rules both specify the constraints of the game and the goals of the game, and are embodied in the game elements. I perceive the *Context* the most critical aspect for the framework and build the framework on Järvinen's (2008) suggestion of the defining aspect of rules that are embodied in the game elements. Therefore, I have made the in-game *Context* the main dimension which is represented by the game's content.

The dimension of *Structure* is the interface, visual layout and spatial dimensions for Bavelier et al. (2011), and on-screen information that gives psychological meaning to the gameplay for Gentile (2011). These are similar to Järvinen's (2008) user interface

concept. I suggest that the dimension of *Structure* includes the information architecture and visual design of the game which makes the game playable and understandable, which may be similar to Gentile's (2011) term psychological meaning. However, I suggest that the whole game content is involved in forming meaning. Therefore, from the perspective of a game, *Structure* is part of the content and the game components, since *Structure* represents the *Context* for the player similar to other components.

The dimension of *Mechanics* has been described with conflicting views by neuroscientists and game researchers. For Gentile (2011) and Bavelier et al. (2011) *Mechanics* mean the game controls. Bavelier et al. (2011) claim *Mechanics* are the controls that train different motor, balance, and coordination skills. However, Järvinen (2008) considers *Mechanics* as the player actions and interaction with the game, the activity of playing the game. In addition, Isbister (2016) claims that the player's actions are never just actions in interactive media, they have consequences and are interesting choices for the player. Through their actions, the players learn about themselves (Isbister, 2016), which influences their emotional experience. Based on this view, game mechanics are different types of game behaviours, such as seeking, finding, planning, collecting, caring, moving, building, and destroying.

I consider that the dimension of *Mechanics* has two perspectives, from the player's perspective mechanics are action and behaviour as Järvinen (2008) suggests, and from the game design perspective, the mechanics are part of the game system as controls that define how the player can interact with the game content. However, since the rules define the potential actions and behaviour in the game and the boundaries for the controls I have added *Mechanics* as a subcategory of *Context*.

Based on the discussion in this chapter, and the literature review, I propose that the emotional gameplay experience is formed from the combination of variables from four different dimensions: the in-game *Context* which is embodied in the content; the player's individual *Affective style* and situational *Affective states,* and the player's *Outside-of-game context*. These four dimensions form the proposed framework for studying emotions in digital games (Figure 3). This Section defines shortly all of the suggested dimensions of the framework, however only the *emotional game elements* from the in-game *Context* dimension and the individual *affective traits* from the

Affective styles dimension are discussed further in this Chapter and included in the pilot study and the analysis.

1) Each game has certain in-game *Context,* which is embodied in the content that the player processes similarly than other stimuli they encounter in real-life settings. This *Context* dimension incorporates both Gentile's (2011) *Context:* rules, goals and clues, and content*:* theme and narrative, and Järvinen's (2008) systemic elements: components and environment, and the compound elements: rules, goals, game mechanics, interface and the theme. The *Context* includes three main subcategories: *Rules*, *Components*, and *Mechanics*.
    a) *Rules* impact all aspects of the game and the player's emotional experience. Rules define the values and goals of the game, the potential actions, situations and the emotional contexts for the player, such as boundaries for the actions, decisions and focus of attention. Rules define the emotional game elements, such as challenges, problems, clues, values, and social, moral and survival aspects that may trigger affective states. Rules are embodied in the game *Components* (Järvinen, 2008) and *Mechanics*.
    b) *Components* are objects, agents, environments, narrative, theme, and the structure of the game (Järvinen, 2008). The components are the artefact aspect of the game representing the rules and the emotional game elements to the player. Objects, agents and environment represent the physical context and narrative and the theme represents the immaterial context of the game. The structure includes the information architecture, user interface, and visual and auditory feedback which makes the play playable, usable and understandable.
    c) *Mechanics* are the in-game activity and actions (Järvinen, 2008) from the player's perspective, and controls from the game system perspective.

2) An individual player has specific *Affective style*, individual emotionality and player mentality. The individual player's *Affective style* influences the processing of the *game elements*, and *outside-of-game context,* and the changes in the *Affective states* resulting in unique emotional experiences. The *Affective styles*

may influence the game and play preferences and the differences in the effects of playing games.

3) The individual player has different situational *Affective states* before, during and after the gameplay session. The *Context* dimension elicits activity in the emotion processes, which result in changes in different emotion components, including subjective emotional experiences. The *Affective states* dimension includes Järvinen's (2008) behavioural element of player mood. The gameplay may influence the affective states also after the play session is finished. The player may have a specific emotional state prior to gameplay, such as a feeling of distress. In addition, the player may have certain emotion regulation or feeling goals for choosing a specific game; they may wish for exciting or relaxing experience from the gameplay.

4) The player has specific *outside-of-game context*, which includes Bavelier et al. (2011) and Gentile's (2011) Time spent playing dimension: the length and frequency of the play sessions. I have further included the social play context in this aspect. The social playing modes, such as playing alone or together, together online, or someone watching the play (Bavelier et al., 2011; Gentile, 2011). It is difficult to separate the subjective experience related to in-game or outside of the game contexts. Still, each study should map the situational differences which may influence the results, especially in field studies. Particularly studies that explore the social situations related to gameplay should consider this dimension.

I suggest that the effects of games are formed in combination of the four dimensions in the framework: each player's individual affective style, outside of the game context and the situational affective states as well as the in-game context. The framework suggests that each game has elements that elicit affective states during the gameplay session and activate changes in the emotion components that may result in subjective emotional experiences and feelings. These subjective emotional experiences may further influence the individual's well-being after the gameplay session is finished.

In the next two sections, I continue to explore the first version of the higher level emotional game elements and consider the individual emotionality in the context of digital games. The framework is based purely on textual analysis at this stage and, therefore, after the initial design of the framework, the first step is to test it with a pilot study.

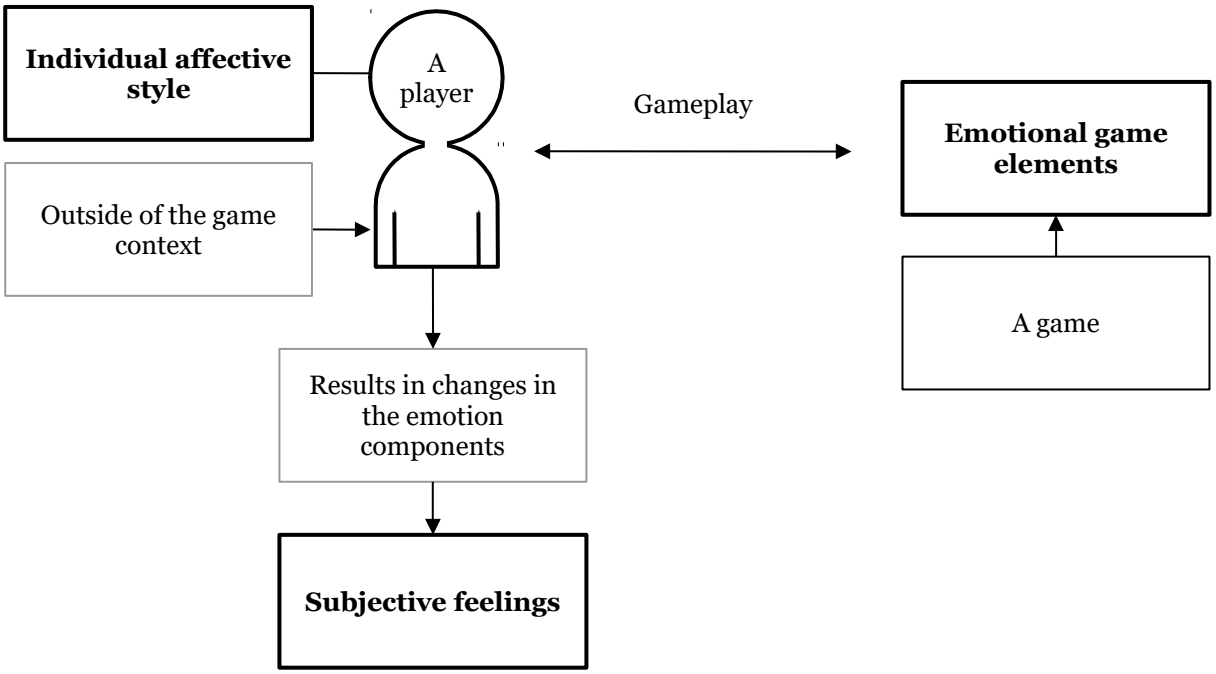

Figure 3. Affective games research framework. Visualization by the author. The bold line and font marks the topics of the dimensions which are explored in the pilot study. The visualisation by the author.

5.1.1. Three emotional game elements

Research findings show that different games elicit different effects, furthermore, a single game may not generate the same effects nor only positive effects on every individual. The same game element may have different emotional effects on different players. It is unclear which game elements influence which specific effect on emotions, or in which extent the effects are individual and based on the situation, different affective traits, emotional states, and preferences of the game elements. Therefore, to study the effects of games, it is critical to define the game elements to be able to measure the game's effects on player experience and emotions (Järvinen, 2008).

The game elements are a subgroup of the *Context* dimension. The elements are defined by the rules and become tangible objects for the player through game components (Järvinen, 2008) that represent the contexts and the rules. The rules define the boundaries, values and emotional contexts for the game. Therefore, rules impact on all aspects of the game as well as the player's emotional experience. The emotional game elements are specific aspects of games that may elicit emotional experiences. Especially challenges, problems, clues, mysteries, and social, moral and survival aspects may trigger affective states and could be aspects of emotional elements. In this Section, I suggest three positive game elements that will be explored with the pilot study in this thesis.

The suggested three emotional game elements (Table 1) are based on the *Seeking* and *Play* related subjective gameplay emotions which were introduced in Section 4.2. and have their foundation in Panksepp's (2004) affective neuroscience theory, Saarimäki et al. (2016) emotions categories, Davis et al. (2003) and Davis & Panksepp's (2011) complex subjective emotions, Deci & Ryan's (2008) self-determination theory, and Perron's (2005) and Järvinen's (2008) lists of game-related emotions.

The first two elements are based on the complex emotion category Feeling of enthusiasm, interest and curiosity which is related to *Seeking* and associated with positive anticipation, intrinsic motivation, problem-solving and exploration. I suggest that the game scenarios that elicit curiosity, intellectual challenge, problem-solving, planning, searching for resources and exploration of the environment could elicit SEEKING related activity and related complex emotions. The *Seeking* related game elements may generate positive emotionality, and similarly, as other situations which increase positive emotions and decrease negative emotions, these elements may improve the individual's well-being also through gameplay.

The third element is based on the subjective gameplay emotion category Feeling of playfulness which is linked to amusement and joy and humour, laughter, happiness, comedy, and silliness. This feeling may be connected to imaginative play[20] such as

20 Using imagination in digital games may be closely linked to a human need to use imagination to play through different versions of situations in real life, which is our way of being and understanding the world. The neural processing related to pretence in digital gameplay requires the ability to understand the experiences and mental states of others, called Theory of Mind. Järvinen (2008) claims that Theory of Mind is used similarly to understand the game system. Theory of Mind and pretend play are both

playing to be someone else and somewhere else. Playfulness is a more problematic element that the suggested Seeking elements, since playfulness may be present both in-game and outside-of-game contexts. Still, even if this element is more difficult to define, it has potential for the mood induction aspects.

In-game emotional element	**Description**	**Proposed subjective emotional experience linked to the element**
Intellectual challenge	The element of intellectual challenge includes problem solving, such as a puzzles, logic problems or mysteries that challenge the player's thinking. The level of abstraction varies in different games. The puzzles and problems can be visuospatial, auditory, verbal, rhythmic or narrative, tactic or strategic, and may include social or moral aspects. The puzzles and problems may demand to find, arrange or complete a sequence or pattern with words, pictures, movements or numbers, or to gather information or insight for reaching a solution.	The element of intellectual challenge is proposed to be linked to the subjective emotional experiences of categories 1: Feeling of enthusiasm, interest and curiosity; 7: Feeling of satisfaction and happiness; 8: Feeling of Agency; and 9: Feeling of Accomplishment and Competence. The element of intellectual challenge may elicit intrinsically rewarding activity which activates the reward pathways. This element may be linked to SEEKING core affect process and Seeking trait, and the complex subjective emotional experiences suggested to be linked to these.
Exploration	The elements of exploration include more goal oriented exploration, such as seeking for resources, such as information, agent, or an object; seeking for safety and the way home; and exploring the boundaries of	The elements of exploration are proposed to be linked to the subjective emotional experiences of categories 1: Feeling of enthusiasm, interest and curiosity; 7: Feeling of satisfaction and happiness; 8: Feeling of

associated to the same brain areas that participate in consciousness and awareness of self and others, and it is still unclear which is the most basic process, mentalizing or pretence (Whitehead et al., 2009).

	the game. In addition, exploration may be less clearly goal oriented, such as wandering and exploring the environment, or exploring to learn about environment, social rules or an object.	Agency; and 9: Feeling of Accomplishment and Competence. The elements of exploration may elicit intrinsically rewarding activity which activates the reward pathways. This element may be linked to SEEKING core affect process and Seeking trait, and the complex subjective emotional experiences suggested to be linked to these.
Playfulness	The first version of the element of playfulness includes humor and comedy, such as acting silly during the gameplay; social play, such as playing games together with others; and imaginative play, such as playing to be someone else, somewhere else, and learning about one-self through the imaginative actions and rules.	The elements of playfulness are proposed to be linked to the subjective emotional experiences of categories 2: Feeling of playfulness; 7: Feeling of satisfaction and happiness; and 8: Feeling of Agency. The elements of playfulness may elicit intrinsically rewarding activity which activates the reward pathways. This element may be linked to PLAY core affect process and the complex subjective emotional experiences suggested to be linked to this process.

Table 1. The three emotional game elements. Proposed by the author.

The suggested three emotional game elements are the first version to consider emotions in the context of digital games in more detail through affective sciences. Each element has specific aspects that will be explored in more detail in the pilot study and analysed in the Chapter 7.

5.1.2. Individual emotionality and gameplay

Game players are not a homogenous group, the variety in the individual affective styles as well as player type, playing practices, the variety of digital games, and culture influence the experience of playing a game. The individual differences may further influence the game element preferences, subjective emotional experiences and the effects of gameplay.

Hamari & Tuunanen (2014) support the view that different player types experience gameplay differently and demand more research on defining the player type and affect trait relationships for enabling better long term effects with games. Based on the literature review I claim that affective gameplay experience or the effects of games cannot be studied without mapping the participants individual differences in emotionality, therefore this Section focuses on the individual emotionality and differences on the players in the context of digital games and focus especially on findings related to the *Seeking* trait, which was introduced in Section 3.3. There are fewer studies on the *Play* trait, therefore this Section focuses on *Seeking*.

The individual differences in affective styles have an effect on the motivations and behaviour during gameplay. The game choices are continuity of the individual differences, for example, the need for competition correlates with choosing games that provide competitive gameplay (Hartmann & Klimmt, 2006). Similarly, the willingness to pretend play may be linked to individual traits (Järvinen, 2008). In addition, higher empathy in fiction is linked to a preference for games with elements that feed the imagination, such as presenting characters feelings (Hartmann & Klimmt, 2006). Ryan et al. (2006) suggest that digital games are intrinsically motivating because they support the basic psychological needs of the self-determination theory. However, people experience intrinsic motivation only when the activity is interesting for the individual (Ryan & Deci, 2000). This supports the need to map the participant's individual emotionality and the preferences on game elements.

The trait theories claim that individuals have traits that are stable and have temporal and situational consistency, that mark the action tendencies for the individual (Hartmann & Klimmt, 2006). Borders (2012) argues that digital game preferences have been repeatedly linked to the personality traits of the Five Factor model (introduced in

Section 3.3.). In the previous studies, Extraversion has been linked to preferences for violent and action content, and for content which has demanding cognitive processing (Borders, 2012). In contrast, other studies suggest that introverted, caring, friendly, unconventional, and creative participants with high emotional self-control are more likely to prefer games that demand cognitive processing rather than action (ibid.). In addition, Conscientiousness has been linked to non-shooter action and puzzle preferences (Zammitto, 2010; Borders, 2012), and may indicate the need for planning and organizing that are associated with this trait.

Openness has been linked to a positive correlation with a preference for puzzle and role-playing content (Borders, 2012)[21]. Moreover, Agreeableness and Openness have been correlated with adventure content (Zammitto, 2010; Borders, 2012). The adventure content often provides narrative, exploration, and challenges for intellectual curiosity, and puzzles support both analytical thinking and planning and are linked to experiencing intellectual challenges rewarding (Zammitto, 2010). These findings are consistent with the Davis et al. (2003) Affective neuroscience personality scale findings that Openness correlates with *Seeking* trait, such as exploration and problem-solving tendencies. Since some individuals have an impulse to explore, question and solve problems (Panksepp & Watt, 2011), these impulses may be present in gameplay styles as well[22].

These findings are interesting in the context of digital games, intrinsic motivation, positive emotionality and the effects on well-being. Positive emotionality, curiosity, positive anticipation and enthusiasm have been shown to be correlated with *Seeking* trait, *Openness to experiences,* and an approach mentality, and linked to the enjoyment of questioning, exploration, problem-solving and intellectual challenges. Therefore, I speculate that individuals with a higher need to explore, question and solve problems may experience games with *Seeking* related elements more rewarding and prefer games which provide these elements. Moreover, these individuals may report more positive feelings and experiences related to game elements associated with *Seeking* and may

21 In some findings there have been gender differences in the participants preferences, females have preferred cognitive processing aspects and males action and strategy aspects (Borders, 2012).
22 For example, the Need for Cognition scale measures the individual's interest and enjoyment of intellectual challenges and the need to understand "how things work" (Cacioppo et al., 1984). Moreover, the Need for Cognition scale may have a correlation with affective trait *Seeking* (Davis et al., 2003).

experience these elements more relaxing than individuals who have other affective styles.

Mapping individual player's affective traits are crucial for the development of the affective game research framework to explore the links between the affective traits of *Seeking* and *Playfulness* and preferences towards the suggested emotional game elements. This pilot study is the first step to understand the individual emotional player types. Davis et al. (2003) offer Affective neuroscience personality scale (ANPS) for researchers for characterizing "the emotional profiles" of the participants. Therefore, I will use ANPS in the pilot study to explore the emotional traits of the participants. Still, the future studies should focus on to map the player types and the affective styles and study the effects during a gameplay situation of each individual type.

6 Methodology and setup for pilot study

The experienced emotions are complex states and unique, subjective experiences, which creates difficulties for measuring these states and experiences systematically. Moreover, the personal, subjective and unique emotional experiences may be difficult to define and compare between individuals without understanding the individual differences.

Measuring emotions has currently three disciplines: the behaviour, the evaluative and articulative affective language, such as self-reports, and the evaluation of the reactions in physiology (Cacioppo et al., 2000), including neural activity. Usually, subjective emotional experiences are differentiated through measurements on some of the emotion components. However, measuring the emotion components, even the neural activity, does not clarify the individual's subjective emotional state, since the internal experiences cannot be measured directly in humans for ethical reasons (Panksepp, 2004). Moreover, none of the psychophysiological methods reveals which subjective emotional experience the participant has, therefore the participants should to asked to report about their feelings and experience (ibid.). Therefore self-reports are a common method for studying human emotional experiences.

Many emotion researchers support using qualitative methods for studying individual experiences. Mapping emotional heterogeneity demands an understanding of the individual differences with qualitative studies or mapping the similarity of the answers (Barrett et al., 2014). Hedman (2014) suggests small sample sizes for understanding the individual differences instead of combining the results to statistical average and claims that statistical analysis is not suitable for the complexity of emotional experience and variety on individuals. Statistical results become flat when combined, which does not compare to the dynamic and highly variable individual results or the individual's experience (ibid.)[23]. Therefore, small sample sizes and person-centred approach in analysis reveal the complexity of the individual differences. Since this thesis focuses on the subjective experiences and individual emotionality, the pilot study follows the discipline of self-reports to gather data of the individual experiences. The opportunities and limitations of self-reports are described in Section 6.1. in more detail.

23 For example, combined skin conductance responses might not result in any statistically significant correlation (Hedman, 2014). However, one reason for unclear results and correlations may be that the participants affective traits are not usually taken into account in the physiological measurements.

Game research uses both quantitative and qualitative methods, as well as mixed methods (Lankoski & Björk, 2015), ranging from observations to self-reports and physiological measurements, similarly, as emotion research. Lankoski & Björk (2015) suggest using qualitative methods to form categories and abstractions from the data and further generating explanations and descriptions of the phenomena. However, Bavelier et al. (2011) call for more multimethod approaches for studies of gameplay effects, including neural and psychophysiological measurements, where both immediate and long term effects would be studied, because the surveys that rely on "self-reports and retrospective assessments" result in limited data. Therefore, the formed categories and abstractions in this thesis should be further explored with quantitative and mixed research methods in the future.

6.1. Self-reports

The subjective emotional experience can be measured via introspection, such as interviews and self-reports. Self-reports can capture aspects of subjective experiences (Mauss & Robinson, 2009; Nogueira, 2014), such as player experience (Nogueira, 2014). Further, introspection supports the distinction of subjective emotional experiences, even if it may not provide knowledge of the causality of emotional processes (Panksepp, 2004).

Studying emotions with the self-report method has limitations. The methods that are based on introspection may result in inaccuracies through mental biases, such as self-report fallacy, reporting bias and social desirability effect, and misunderstanding of the used scale. In addition, there are individual differences in the ability to emotional self-reflection. There is a variance in the ability to report the emotional states, such as alexithymia, and in the awareness of the emotional state, and the willingness to tell the state (Mauss & Robinson, 2009).

There is variance on the awareness to the internal feelings, however, Damasio (2005) claims that humans are often aware of their emotional state since this ability enables individuals to adapt to the surrounding situations. Similarly, Solms & Panksepp (2012) claim that the higher consciousness requires the ability to reflect one's own state and declaration of the state, the subjective feelings, that can be studied verbally. However,

the individual can be conscious of the feeling state without being aware of being "sad" or reflecting the causal relations to the feeling, still, the affective states influence other cognitive processing even if the individual is not aware or have a memory of the state (Solms & Panksepp, 2012). Moreover, emotion processes have also the subconscious, *anoetic* states (Panksepp & Watt, 2011; Solms & Panksepp, 2012) on a level that the individual cannot verbally report (Izard, 2010), and most of the affective processing is done unconsciously[24] (Panksepp, 2004). Therefore not all affective states are accessible for awareness, but the complex tertiary-level emotional experiences, moods and feelings are more likely to be accessible to self-reporting.

Still, one central limitation for self-reports lies in the output of the verbal report, the language. There are individual differences in the amount of active descriptive emotional words. The words, context and study format can all influence the responses (Parsons, 2017). The subjective emotional lexicon hierarchy has superordinate and subordinate levels, the superordinate level defines the valence and the core affects, whereas the subordinate level includes the natural language emotion categories which are language specific. Therefore it is crucial to define the used language of the study, which in this thesis is English.

Another issue with self-reports is vacillation, that a participant cannot decide between the options (Kahneman, 1992). Similarly, measuring emotions with alternatives of fixed-responses has disadvantages of priming participants, or forcing them to choose the closest alternative, therefore it is important to provide a possibility for open responses (Scherer, 2005) and design the questionnaires and interviews with care. In addition, some participants may be consciously misleading in their answers or are primed by leading questions (Russell, 2003).

Self-reports have temporal issues on recall which may result in unreliable results. Several researchers have reported that self-reports lose reliability over time. Therefore it is preferable to interview or use questionnaires during or immediately after the event (Mauss & Robinson, 2009; Hedman, 2014). Longer time after the event results also in responses that have a more co-existent extreme valence (Russell, 2012). For the pilot study, the temporal limitation is not problematic, since the study does not measure any

24 However, human participant's physiological changes can be simultaneously measured with other technologies (Panksepp, 2004).

specific event, but ratings of situational propositions and emotional preferences in general. To sum up, self-reports have limitations, however, the method is still effective for understanding the individual experiences and differences, and the complexity of the emotional experiences.

6.2. Research setting

The pilot study aims to measure the participants affective traits *Seeking* and *Play*, and the individual preferences of the proposed three *emotional game elements*: 1) intellectual challenge, including trying to solve hard puzzles, planning solutions and wondering the encountered mysteries and secrets; 2) exploration, including exploring the game world and the game's boundaries; and 3) playfulness, such as silly in-game behaviour, humour and social play. The intellectual challenge and exploration elements are proposed to be related to *Seeking* trait and Playfulness element to *Play* trait.

Second, the pilot study explores the coexistence of liking the proposed Seeking related game elements and the scores of the *Seeking* trait and Play related game element and *Play* trait. Studying the coexistence is necessary to understand if the game elements and the ANPS-S questionnaire results are useful methods to study the individual differences in player emotionality and does this connection indicate any differences in the individual player preferences and enjoyment of these emotional game elements. I suggest that high curiosity or high scores in the *Seeking* trait co-exists with the preferences on proposed *Seeking* related game elements, and that the individuals would have in general higher ratings in enjoyment over problem-solving and exploration than individuals with lower *Seeking* scores.

6.2.1. Recruitment of the participants

The recruitment process was conducted through social media channels in groups representing serious games, neurogames, game designers and developers, Aalto university game design students, and the Finnish chapter of the International Game Developer Association (IGDA). The questionnaire was free to access and accepting responses for one week during October in 2018. The consent to use the data was asked in the introduction of the questionnaire, and each participant has given consent for using their data for research purposes by answering to the questionnaire.

6.2.2. Questionnaire

The pilot study is conducted with a questionnaire made in an online tool, combining both open-ended and fixed questions. The questionnaire starts with demographic questions of age and gender and is further categorized into three sections: the gameplay patterns, the preferred emotional game elements, and the individual affective traits.

The gameplay patterns section includes three questions about the frequency to play games and social gameplay habits:

1) The frequency to play digital games in general, which the participants rate in the scale of: I rarely play games, I play occasionally, I play several times a month, I play every week and I play every day.
2) The frequency to play games during an unfinished game they enjoy, which the participants rate in the scale of: I rarely play games, I play occasionally, I play several times a month, I play every week and I play every day.
3) The social gameplay habits: collaborating with others, competing against others, playing single player games alone, playing single player games together, playing multiplayer games, which the participants rate with a 1–5 Likert scale, where 1 is equal to I dislike this a lot and 5 is equal to I like this a lot.

The emotional game elements section includes questions about the preferred emotional game elements, which the participants rate with a 1–5 Likert scale, where 1 is equal to I dislike this a lot and 5 is equal to I like this a lot. The *Seeking* elements are an intellectual challenge: thinking about intellectual problems, trying to solve hard puzzles, planning solutions and wondering the encountered mysteries and secrets; and exploration: exploring the game world and exploring the boundaries of the game. The *Playfulness* element includes social play, using imagination to play to be someone else or somewhere else, and acting silly during the gameplay.

The final section of affective traits includes the modified shorter affective neuroscientific personality scale questionnaire (ANPS-S) (Pingault et al., 2012; 2013), which I extended with eight Seeking questions from the original ANPS questionnaire (Davis et al., 2003) for gathering more detailed Seeking trait data. In the affective trait section the participants rate propositions of different situations with Likert scale of 1–4, where 1 is equal to strongly disagree and 4 is equal to strongly agree. The Likert scale is different in

this section from the other areas of the questionnaire since both the original ANPS (Davis et al., 2003) and the ANPS-S (Pingault et al., 2013) questionnaires use the scale from one to four.

The data is analysed with a person-centered approach since I am interested in the variance between individuals and the potential clusters the data reveals. The findings will influence the development of the framework as well as forming a future hypothesis for the next stage of the research in the area of positive emotional effects of digital games.

7 Findings from pilot study

The questionnaire had 48 replies in total, where one participant did not answer all the questions and was excluded from the analysis. The used sample size for the analysis was therefore 47. The reported gender diversity was almost equal between 21 female and 25 male, and then there were two participants who reported their gender as other. The participants' age was on a scale of 18–45 years. One participant was 18–24, twenty participants between 25–30, the majority of the participants, 22 in total were between 31–40 years, and four participants between 40–45. The age didn't seem to have an effect on the frequency to play, 51% of the participants reported playing digital games daily, 34% reported playing weekly and 12,7% reported playing several times a month. Moreover, 27% of the participants reported that the frequency to play increases when they are in the middle of an interesting game that they enjoy, however, this group does not include the participants who already play daily. During the unfinished game situation the frequency to play increases from playing every week to multiple times a week or even daily play, and from monthly play sessions to daily play or even "playing many hours for a few days in a row" or "anytime I can".

7.1. Seeking and Play traits

The data from the modified ANPS-S section of the questionnaire vary greatly. The pilot study measured but did not analyse the other traits in the ANPS-S questionnaire than *Seeking* and *Play*, however, the *Care* and all negative traits had higher variance than the traits in the focus. The results are complex since no single individual had exactly the same affective style results.

Interestingly, the ANPS *Seeking* trait scores were in general high or very high in the pilot study, where 70% of the participants had the top 25 percentile of the scores and in total 21% of the participants had the highest 10 percentile of the scores. The results are similar between the individuals in this sample and therefore no clear clusters were formed from the *Seeking* scores. In total 56% of the participants reported they like a lot to investigate and probe problems and rate themselves highly curious, and 54% reported enjoying a lot to explore their surroundings in real-life. These findings indicate that curiosity towards problems and exploration is a common characteristic for this sample of participants in everyday settings. These findings from the pilot study support

previous research by Davis et al. (2003) where *Seeking* trait has been linked to the exploration and problem-solving tendencies.

The sample size in the pilot study was small which may have affected the reliability of the findings, still, the results may indicate that *Seeking* trait is high in general for those people who enjoy digital games, but more research is needed to understand if curious people are actually drawn towards digital games or if games develop a curious mindset, and to compare players and non-players. It is also possible that bigger sample sizes contradict these findings. In addition, more studies are needed to further understand the effects of digital games on individuals who have high or low *Seeking* trait scores.

The findings from the pilot study show that most participants have mediocre to very high ANPS-S *Play* trait scores. In total 48% of the participants had their scores in the top 25 percentile and 14% of the participants had the top 10 percentile of the scores. The pilot study participants have more variance in *Play* trait than *Seeking* trait. Interestingly, even though 52% of the participants report that they play games every day, this high frequency to play games did not associate to any specific *Play* trait score. These findings indicate that the *Play* trait needs clearer definitions and considerations for the gameplay context. *Play* trait may have to be considered as a wider phenomenon which include both the in-game and outside of the game contexts, such as the player's attitude towards the digital gameplay and social play aspects. However, the sample size was low and more studies should explore the *Play* trait in the context of digital games and compare the *Play* trait between players and non-players. Moreover, it is possible that the ANPS-S questionnaire may not be a correct method alone to study play in the context of digital games since it focuses on the social aspects, joy and humour, and excludes enjoyment of solitary gameplay or imaginative play during gameplay.

Seeking trait is higher than *Play* trait in this group of participants and there is a low indication of some interconnection between these traits (Figure 4). Still, more research is needed to understand the relationship between these traits in the digital game context. I suggest that the results from the pilot study indicate that both *Seeking* and *Play* traits may be useful measurements of individual emotionality, especially after more definitions for the context of digital games. However, these traits are not specific enough to differentiate the players in more detail. Therefore, also game specific measurements

are needed to understand the individual differences, such as emotional game elements. In addition, more research is needed to study the other traits to map holistic affective styles of active players that can be also compared with people who play less or do not play at all.

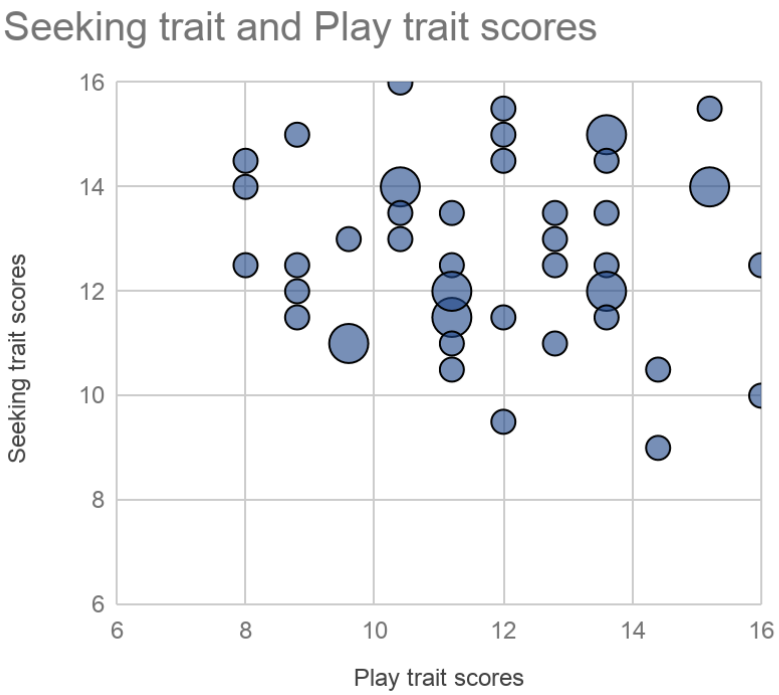

Figure 4: A scatter diagram of the Seeking trait and *Play* trait scores. The circles represent the participants scores and the bigger size of the circle indicates that two participants had the same results. Figure is made by the author.

7.2. Emotional game element clusters

The framework proposes three emotional game elements, two *Seeking* elements and one *Playfulness* element. The two *Seeking* elements are an intellectual challenge: thinking about intellectual problems, trying to solve hard puzzles, planning solutions, and questioning the encountered mysteries and secrets; and exploration: exploring the game world and the boundaries of the game. The *Playfulness* element includes social play, acting silly during the gameplay, and using imagination, such as playing to be someone else or somewhere else. The data from the questionnaire was analysed in a person-centred method with Two-step cluster analysis to reveal natural clusters based on how much the participants reported liking the *Seeking* and *Playfulness* elements.

Seeking elements

The two *Seeking* elements divide the participants into clusters. Two aspects of the intellectual challenges: trying to solve hard puzzles and thinking about intellectual problems divide individuals into different clusters more clearly than other suggested aspects of the element, therefore these two aspects were analysed together with the exploration element. The results show six clusters of participants based on their reported enjoyment of the *Seeking* elements, which have been visualized in grouped scatter diagrams in Figures 5 and 6.

The first cluster (1) is the biggest in size (51%) and represent individuals who reported a high preference for all *Seeking* elements: intellectual challenges, exploration and their aspects. The second cluster (2) represents a smaller group of participants (14.8%), who reported a high preference for problem-solving and other intellectual challenges. These individuals dislike the free exploration of the game world or are neutral towards it. The third cluster (3) is the second biggest (17%) and represents participants who report high preference on both intellectual problems and exploration, similarly than the participants in the first cluster (Figure 5), however, the participants in this cluster dislike hard puzzles (Figure 6) which differentiates them from the first cluster. The fourth cluster (4) is only 10.6% in size and represents the participants who report a high preference for exploration of the game world and the game's boundaries, however, these participants are less likely to enjoy being challenged intellectually and dislike trying to solve hard puzzles.

There were two outlier clusters, both including only one participant, the fifth cluster (5) that represents a participant that reports a preference for exploration and hard puzzles but is neutral towards intellectual problems; and the sixth cluster (6) which represents a participant that enjoys hard puzzles but dislikes other intellectual problems and exploration. These findings suggest that there are differences in how much individuals enjoy even different aspects of the *Seeking* elements related to problem-solving and exploring. However, the individual interpretation of the questions may have influenced the results.

The pilot study results support the findings from previous studies done outside of the digital game context, which have shown a correlation between *Seeking* trait and

problem solving and curiosity in general. Panksepp & Watt (2011) claim that some individuals have an impulse to explore, question and solve problems and Zammitto (2010) claims intellectual curiosity is linked to experiencing intellectual challenges rewarding. Moreover, Davis et al. (2003) have shown a correlation between ANPS *Seeking* trait and FFM Openness, and Borders (2012) has shown a correlation between FFM Openness and preferences for puzzle and role-playing content and exploration. However, ANPS traits and specific game elements have not been measured before in the digital game context to my knowledge.

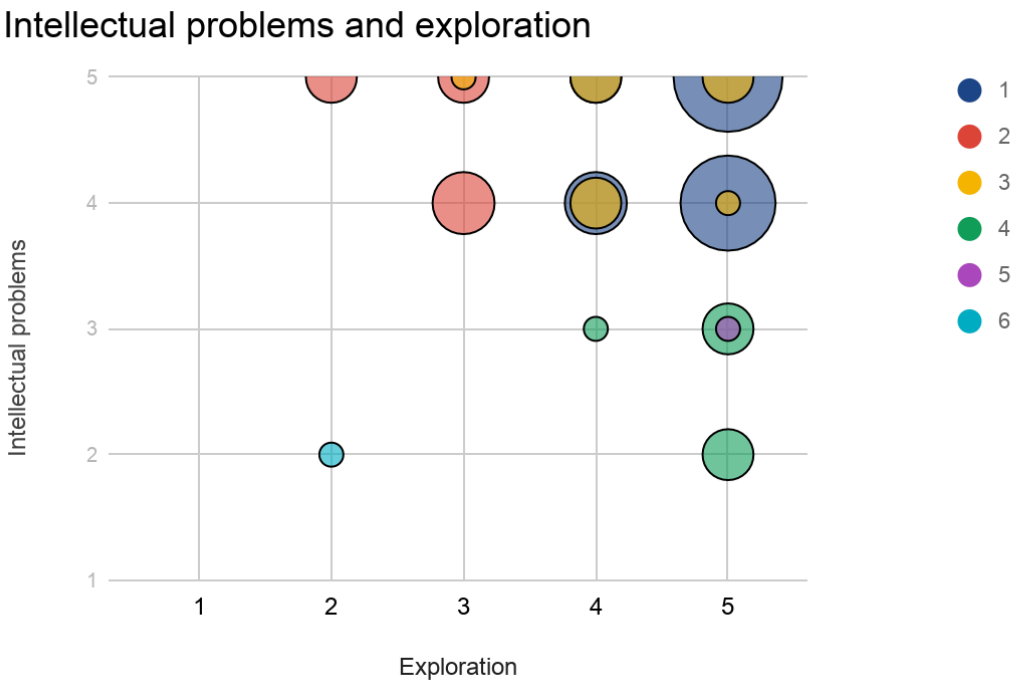

Figure 5: A grouped scatter diagram of the main six clusters based on the data of the participants preferences of the proposed *Seeking* related game elements: thinking about intellectual problems and exploration. The cluster 1 represent individuals who like all seeking elements, the clusters 2 and 3 both like intellectual problems with different preferences to exploration. The cluster 4 represents participants who prefer exploration. The cluster 5 is here similar to the cluster 4. The cluster 6 represents here a participant who does not like exploration nor intellectual challenges. The circles represent the participants ratings and the size of the circle indicates the amount of participants who had the same rating. The figure is made by the author.

However, the more detailed clusters in Figures 5 and 6 show that individuals with similar *Seeking* trait scores have different preferences and emotional experiences related to specific *Seeking* game elements and aspects of these elements. Therefore, all *Seeking* elements cannot be mapped into one game element. However, the sample of

participants did not include individuals with lower *Seeking* trait scores. More research is needed to test the hypothesis again with individuals who have lower levels of curiosity to understand if ANPS *Seeking* trait has any correlation with the enjoyment of the emotional game elements. Still, the findings from the pilot study indicate that individuals like similar things both in real-world settings and in digital games, and that it may be useful to measure the *Seeking* trait with ANPS questionnaire in the context of games.

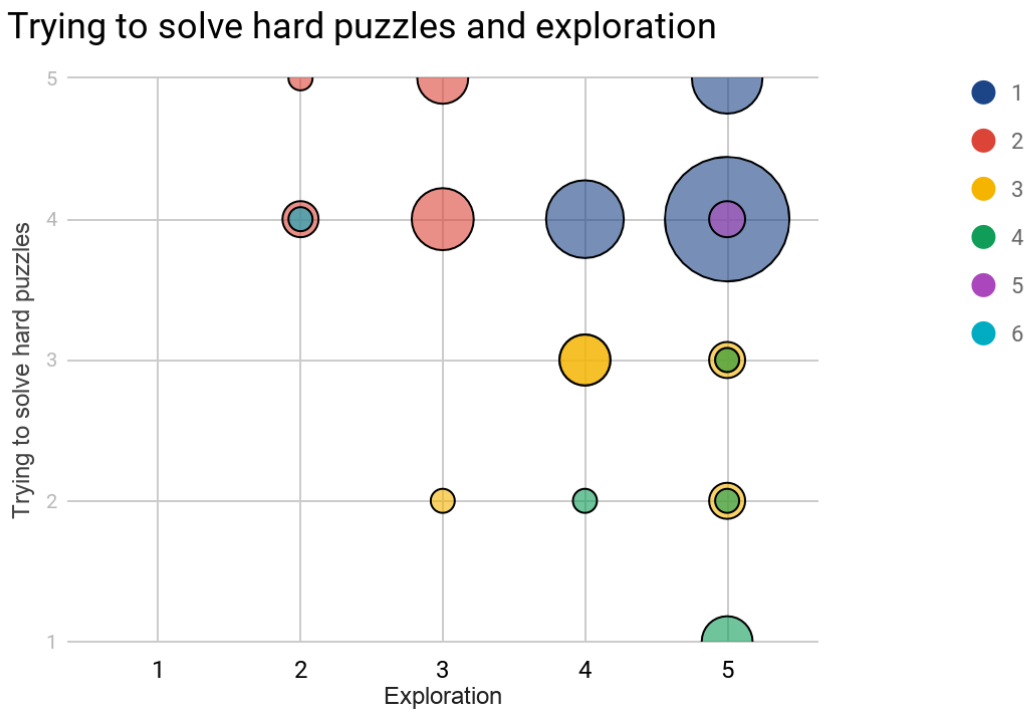

Figure 6: A grouped scatter diagram of the main six clusters based on the data of the participants preferences of the proposed *Seeking* related game elements: trying to solve hard puzzles and exploration. The clusters include the same individuals than in the Figure 5. The cluster 1 and 2 are here similar to the Figure 5, however, some participants in the cluster 2 like less hard puzzles than other kind of problems. The participants in the cluster 3 are less interested or even dislike trying to solve hard puzzles compared to reported enjoyment of other intellectual problems. Similarly, the participants in the cluster 4 dislike trying to solve hard puzzles compared to other problem solving. The clusters 5 and 6 are an opposite to the participants of the clusters 3 and 4, since these individuals report liking hard puzzles more than other problems. The circles represent the participants ratings and the size of the circle represents the amount of participants with the same rating. The figure is made by the author.

I hypothesised that high curiosity or high scores in the affective trait *Seeking* co-exists with the enjoyment of the proposed *Seeking* related game elements. The findings from

the pilot study support the hypothesis since a coexistence of high or very high *Seeking* trait scores and the preferences for the proposed *Seeking* game elements was found (Figure 7), which may indicate that the proposed game elements could be associated with the *Seeking* trait.

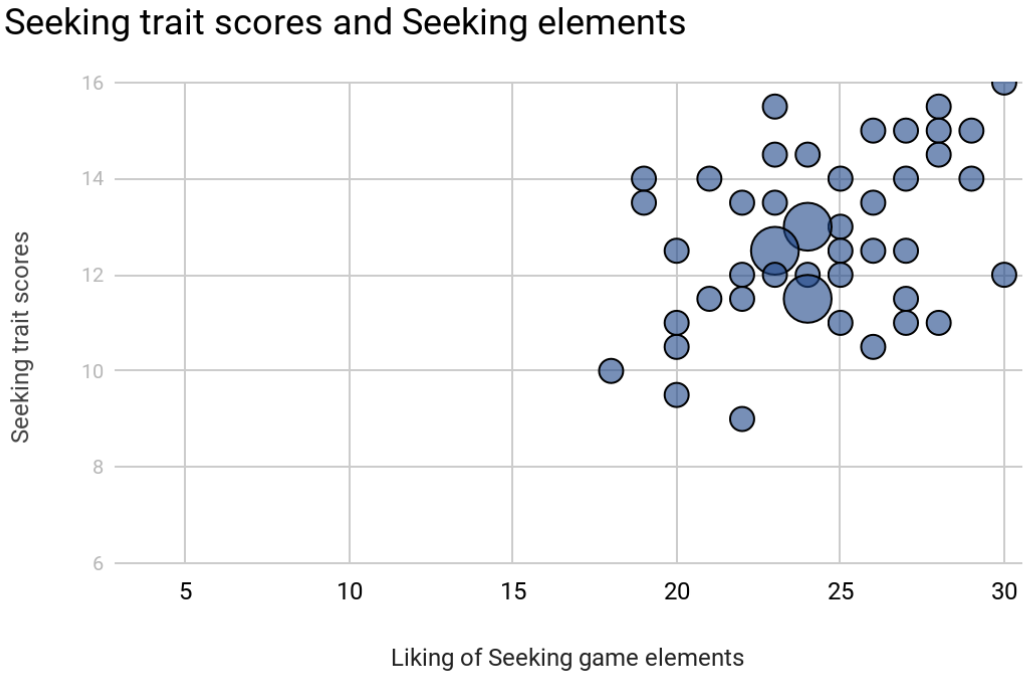

Figure 7: *Seeking* trait scores by rated liking of *Seeking* game elements. The circles represent the participants scores and the size of the circle represents the amount of participants with the same score. The figure is made by the author.

Furthermore, it is unclear how stable these findings are temporarily within the game context since gameplay preferences may change over time and situations, therefore more observational, long term and mixed methods research should be conducted. Furthermore, both problem solving and exploration as well as other *Seeking* elements should be studied more in the context of digital games and continue to measure the effects of these elements on positive emotions for different affective styles during and after the gameplay sessions, as well as comparing the affective styles and results between players and non-players.

Playfulness element

The feelings towards the suggested *Playfulness* game element varied greatly between participants. Compared to the findings related to the *Seeking* trait and *Seeking* game

elements, there were no clear findings of coexistence between high *Play* trait scores and liking the Playfulness element (Figure 8). However, a single aspect of Playfulness element: using imagination during gameplay may have some correlation with high scores in *Play* trait (Figure 9), but these aspects need more studies. These findings show that the suggested aspects of the *Playfulness* element cannot be combined into one game element and more studies are needed to clarify the definition and aspects of the *Play* trait and playfulness related elements in the digital game context. It is possible that the *Play* related subjective emotional experiences and behaviour should be considered also as an attitude towards playing, therefore also the outside of the game context should be taken into consideration in the future studies.

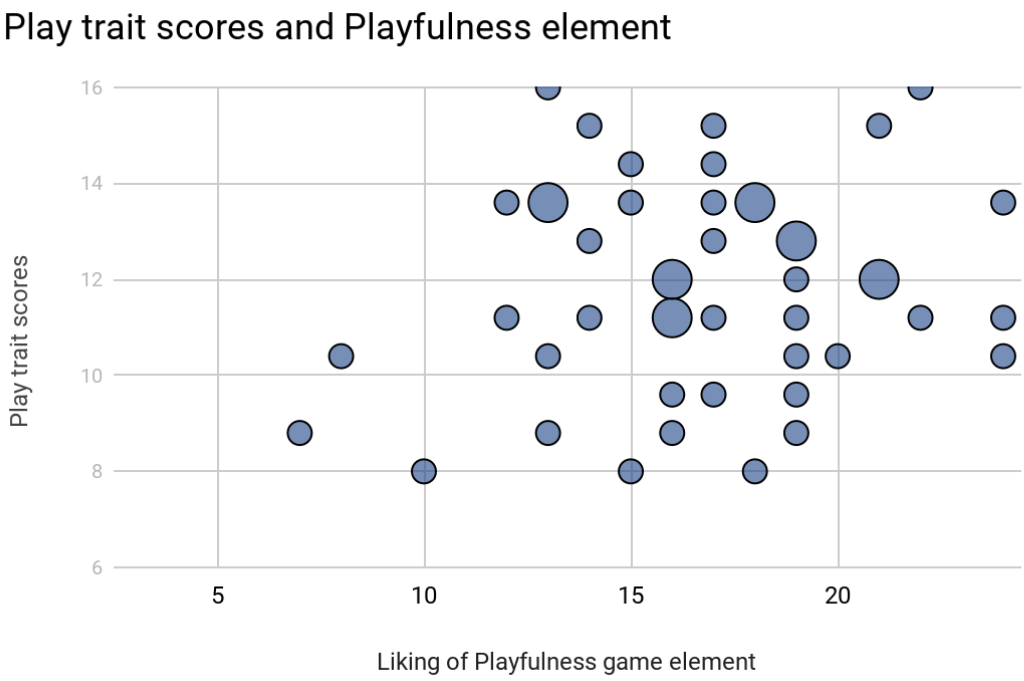

Figure 8: *Play* trait scores and rated liking of *Playfulness* game elements. The circles represent the participants' scores and the bigger size of the circle marks that two participants had the same score. The figure by the author.

The ANPS trait by Davis et al. (2003) relates *Play* trait with social fun, such as joking and physical play, and is excluding imaginary play, such as roleplay, or gameplay in general. However, in the play and gameplay literature imaginative play is seen as a key aspect of play and enjoyment of playing, therefore, I have added this aspect to the suggested *Playfulness* element. However, the ANPS-S *Play* trait questions were not developed to measure digital gameplay or playfulness in the digital game context, but

the playfulness, humour, and social play aspects in everyday life, which may have affected to the results of the pilot study. Further, these findings may indicate that the ANPS-S questionnaire may not grasp the essence of play or playfulness in the context of digital games.

All in all, the proposed framework suggests that the dimensions of individual emotionality and affective states influence how much the individual likes specific game elements, and further, that these individual preferences would influence the effects of games. The pilot study explored the coexistence of liking the proposed emotional game elements and the individual player's *Seeking* and *Play* traits to test if the elements and ANPS questionnaire could be used to explore the individual player emotionality in the digital game research.

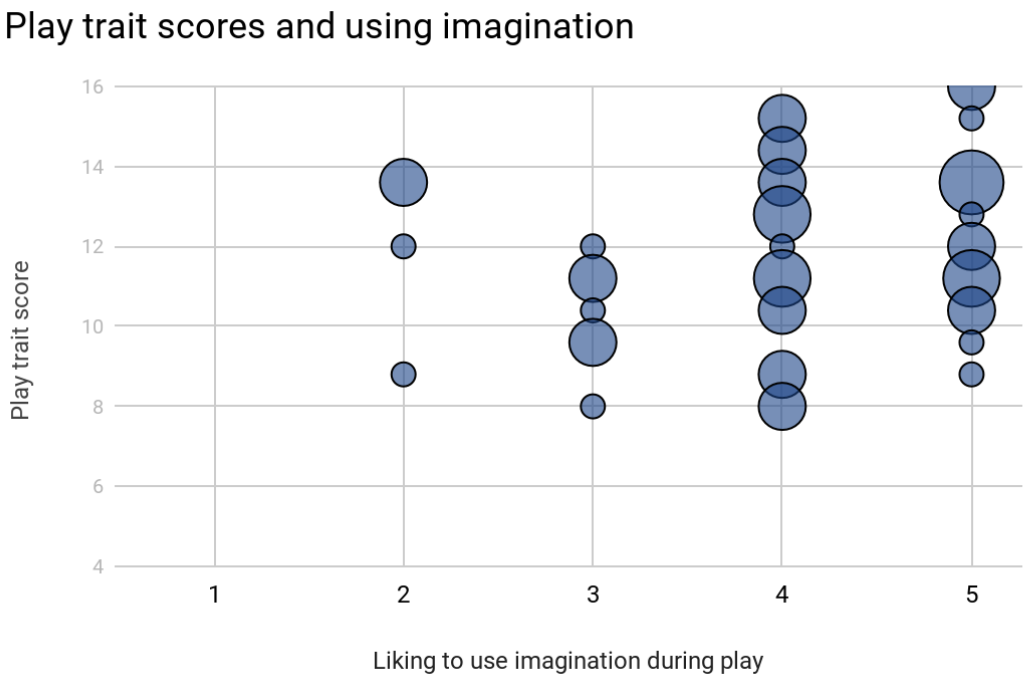

Figure 9: The *Play* trait scores and liking to use imagination during gameplay. The circles represent the participants scores and the size of the circle represents the amount of participants with the same score. The figure is made by the author.

The findings of the pilot study indicate that ANPS based trait measurement may be relevant in affective game research context. However, simply measuring one or two traits does not result in a detailed understanding of the differences of the individual emotionality in the context of the dynamic and complex activity of playing digital games.

Therefore, comparing affective styles including all six ANPS traits to the individual preferences of emotional game elements may be a successful way to differentiate players. Still, more definitions are needed for the suggested emotional game elements, and aspects of Playfulness and Intellectual challenge elements may have to be divided into more than two elements. Moreover, new emotional game elements should be formulated based on affective sciences and further test the elements with mixed methods to define them in more detail. Based on the results of the pilot study, I suggest that studying and mapping the emotional individuality and emotional player types through trait and element mapping would further support the studies of the emotional effects of digital games.

8 Discussion

The research findings in the literature review suggest that digital games have the potential to become an effective emotion and mood induction method. Especially problem solving and curiosity related activity have been shown positive results for improving emotional states. In addition, multiple emotion theories suggest that individuals with different affective styles experience situations differently, and have differences in their emotional reactions and preferences. Several researchers have proposed that understanding the individual differences would be relevant in the context of games and effects of games as well. Together these findings and suggestions formulated the approach I took and carried throughout the thesis.

With this thesis, I aimed to explore how emotions and individual differences could be perceived and studied in the context of digital games. I approached this goal first in the literature review with an overview of the current knowledge of emotions from the perspective of affective neuroscience, cognitive science and psychology, defining the terminology and the five components of emotion processes that describe how emotions can be studied in general. I explored the current knowledge of individual emotionality, the complex subjective emotions, the emotional needs and rewarding aspects of playing games, and the gameplay effects on the subjective emotions. This work was relevant for making a preliminary list of gameplay related subjective emotions that enabled the initial design of a framework for studying emotions in the context of digital games.

The proposed framework introduces four dimensions of games which may influence the player's affective states, including the subjective emotional experiences. The dimensions of affective traits and the in-game context, which I narrowed to three emotional game elements for simplicity, were explored in more detail. The current state of the framework has a potential to differentiate individuals in relation to liking or enjoying of the emotional game elements and with ANPS measurements the individual affective traits. The explored two aspects of the framework affective traits and emotional game elements have a potential to give insight of the individual emotionality and liking of emotional game elements which would further help to differentiate the effects of digital games on emotions and well-being in the future. Developing and testing the framework further may enhance mapping specific player types that could benefit from different

game elements. Mapping specific benefits for player types could further influence the therapeutic game development in the future.

The proposed three emotional game elements were tested with a pilot study. The pilot study demonstrated how the framework could be used for measuring aspects of emotions in the context of digital games. With the pilot, I compared ANPS traits *Seeking* and *Play* to the individual preferences of the suggested two Seeking elements and one Playfulness element.

The findings of the pilot study supports the preliminary hypothesis that individuals with higher *Seeking* trait would prefer curiosity eliciting game elements, such as intellectual challenges and exploration. Moreover, the findings indicate that individuals like similar things both in real-world settings and in digital games. However, the more research is needed to measure this aspect against individuals who have lower levels of curiosity and non-players to understand if the *Seeking* trait has a correlation with the enjoyment of the proposed emotional game elements.

The findings from the pilot study indicate that mapping the two dimensions of the framework; the affective traits and emotional game elements may be a successful way to differentiate players in more detail in affective game research context. Based on the findings, I suggest that affective sciences should be used as a foundation for emotional game research and for formulating the emotional game elements. I propose that comparing the affective styles and traits to both preferences of the contexts, such as emotional game elements, and the player behaviour during gameplay are crucial aspects in studies that aim to understand the player types and the emotional effects of digital games. However, more mixed method studies are needed for detailed definitions and mapping the framework's emotional game elements.

The framework and the pilot study have limitations. The emotional game elements in the framework are based on the simplified list of the complex subjective emotions in Section 4.2. which is based on the literature of affective sciences and game research. This list of subjective gameplay emotions currently excludes situations related to different emotional experiences, such as the different reward categories or complex emotions such the uncertainty of suspense and excitement related to positive

anticipation which are common experiences during gameplay. Moreover, the list could be further developed with mixed methods both mapping the individual experiences and the changes in the individual player's emotion components during gameplay. This work could help to evaluate the list itself and differentiate more emotional game elements for the framework.

A limitation for the pilot study was the self-report methodology, which relies on introspection, that may have altered the results. The pilot study could have had more open-ended questions to deepen the Likert-scales with explanations of individual experiences. Another limitation of the pilot study was that the used ANPS-S questionnaire was developed from the same Panksepp's (2004) affective neuroscience theory which I have used to formulate the gameplay related subjective emotions and the emotional game elements. This may have influenced the results of the pilot study. However, the list of the complex emotions is based on multiple sources and the ANPS traits have been shown to have a correlation with other models, such as Five factor model as well. Therefore, there should be a reliable theoretical background and evidence to use Panksepp's work as one of the key theories. Still, the proposed categories and abstractions in this thesis should be further explored with in-depth interviews and mixed research methods in the future.

More research is needed to explore the effects of the framework's dimensions on individuals and the differences between frequent players and non-players, especially in the aspects of the *Seeking* trait, but also to explore other affective traits in the digital game context. In addition, more correlational studies and bigger sample sizes could be used to explore the complex clusters of the framework's dimension affective styles in game research with the full Affective neuroscience personality scale. Future studies could explore the individual differences in the effects of different in-game and outside-of-game contexts on the emotion components, such as the subjective feeling states, neural activity, and peripheral physiology.
Mapping the relevance of each dimension to the emotional effects of digital games would benefit the development of the framework. This could in turn influence the future development of better games for well-being.

When looking back to the beginning, this thesis has not been a direct journey. During

the process of writing I learnt that the framework to study the emotional effects of games was nonexistent, therefore I switched my thesis focus from measuring the effects to design a preliminary version of such a framework. However, aiming to explore the ways to study emotions, combining different research fields and forming even a preliminary version of a framework for affective game research was still an ambitious goal, which is simple to perceive after the work has been done. Still, trying to do something difficult and to combine the different research fields was motivating and increased my enthusiasm to seek more answers. As a learning process, this thesis has increased my understanding on the emotion theories from the cognitive, psychological and neuroscientific perspectives, how emotions and playing are deeply intertwined neural activity and the complexity of digital gameplay as a stimulus. As often with learning, after writing this thesis I know more about how little I still know of the different aspects of emotions, methods, and the effects of digital gameplay. There is still much to learn and explore, which I hope I can continue to do one day.

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