Addiction to smartphone games

Using smartphone game components to create an addiction

Johan Holmgren

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Supervisor at UmU: Karin Fahlqvist
Supervisor at Compentus: Sebastian Wallius
Examiner: Thomas Mejtoft

UMEÅ UNIVERSITY
DEPARTMENT OF APPLIED PHYSICS AND ELECTRONICS
SE-901 87 UMEÅ
SWEDEN
Abstract

Smartphone games are very popular and have the highest revenue of all smartphone application categories. Some even suggest that the games can create an addiction. This addiction has however not been classified as a disorder and the components in the games that create an addiction have not been determined.

This thesis had two goals. The first was to investigate and identify addictive components in smartphone games. The second goal was to use these components to develop an addictive proof of concept smartphone game prototype. The prototype was also to be evaluated regarding usability and how well it included the addictive components.

The components in these games that create an addiction were identified using a literature study. After establishing a theoretical framework, eight different areas of addictive smartphone game components were found. These areas were further condensed into 16 guidelines of how to make a smartphone game addictive. The guidelines were used to create a prototype which later was evaluated with a supervised play test, a short interview, a usability questionnaire and a survey with questions regarding how well the guidelines were implemented.

The usability of the game prototype was regarded as good and 13 of 14 implemented guidelines received positive results in the survey. In addition to this, all test users also regarded the game prototype as fun to play and wanted to play it again. Based on these results, the implemented smartphone game prototype was concluded to be addictive.
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Chapter 1

Introduction

Information and communications technologies (ICT) have become an important part of our lives. Many people use computers every day to for example communicate, search the internet, study, play games [1] and more. Computers becoming smaller and cheaper [2] is part of the reason behind the development of smart devices connected to the Internet. [3] One type of smart device is the smartphone, a telephone with full Internet access, the possibility of easily installing new applications and with computational power. [4]

Smartphones combine the functions of media players, cameras, GPS devices and more into one. [5] These new features has led to the devices being considered small computers instead of traditional phones. [4] The features are also part of the reason that they have become popular, leading to a growing number of devices in the world. Projections in 2014 estimated that a quarter of the people in the world would use smartphones in 2015. [6]

Today smartphones are used for a variety of things. [4] Like traditional mobile phones, smartphones are used to call and text, but also for example to navigate, use social networks and play games. [1] Smartphone games are popular, which is shown by games having the highest revenue among all smartphone app categories. Games generated 90% of Google Play and 75% of the Apple App Store revenue in 2015. [7]

Smartphones are popular and have numerous benefits. Nevertheless, their many features and high availability has caused a certain dependence. This dependence has caused social problems, including obsessive use and addiction [1], which have created a mental health concern. [4] Smartphone games can be part of the reason behind this addiction. [8]

Multiple studies have been made about smartphone addiction, for instance in relation to predictive psychological factors [8, 9] and developing diagnostic criteria [5, 4]. Nonetheless, few studies have been made about the components in
smartphone games that make them addictive. This study aims to use existing theory to identify these components.

There is no consensus regarding if this type of addiction can be classified as a disorder. [10] ICT can however be enjoyable enough to create an addiction. [1] Because of this, smartphone game addiction will in this thesis be defined as creating an experience that is fun and enjoyable enough to make the user want to return.

Regardless if smartphone game addiction in the future will be classified as a harmful disorder or not, the work done in this thesis can be useful. If similar addictions are determined to be harmful, the addictive components and method of evaluation can be used to identify potentially harmful smartphone games. If not, game makers can use the same components and evaluation method to test if their game is enough fun and enjoyable to create an addiction.

The purpose of this thesis is to investigate which components in a smartphone game that are addictive. The identified components will be included in a Proof of Concept prototype game, limited by game idea and the scope of the project. The prototype will also be evaluated regarding usability and how it includes the addictive components. The results of the evaluation will be used to determine whether the prototype can create an addiction based on the definition used in this project.
Chapter 2

Problem description

In this chapter, the problem is described. This is done by first giving a background of the company at which the project was performed. Then the purpose of the research is defined. The goals of the thesis are specified before finally giving the limitations of the project.

2.1 Compentus

This project was performed at Compentus AB, an IT-company founded in 2011, with an office on the ground floor in a building in Östermalm, Stockholm. Compentus specialises in user interface design and works in web, with e-learning, web pages, IT systems, graphic profiles, digital screens and app development. The company focuses on conveying the customers wishes and making them visible in the customers’ digital environment. This is mainly done through graphical user interfaces that uses the latest technology combined with innovative IT-design.

2.2 Purpose of research

The purpose of this project is to investigate how a smartphone game can create an addiction in a person. Smartphone game addiction is a novel area which is not properly defined. There is no consensus regarding if this type of behaviour can even be classified as a traditional addiction. In this thesis, addiction will be viewed as creating an experience for the user that is fun and enjoyable enough to make them want to play again.

Identifying how smartphone games creates an addiction is useful for many reasons. Establishing guidelines and testing them is a step towards creating an
evaluating tool for determining whether a game is potentially addictive. This can for instance help game creators assess the chances of a game being successful before launching it. If smartphone game addiction is later judged to be a disorder, the evaluation tool could then additionally be used to test games and their potential harmfulness.

The company where the project was performed provided the game idea that was used to create the prototypes. The company wanted to increase their knowledge in apps and game development. This was to be done by investigating what creates an addiction in success stories like Candy Crush and Angry Birds. The company had no experience in game development at the time and wanted to investigate the area. This is why it was chosen to perform the project at the company.

Investigating how smartphone games create an addiction is performed by identifying addictive components in smartphone games. A prototype with modern design is also created using the identified components, as a proof of concept of an addictive mobile game.

2.3 Goals with the thesis

There are two goals with this thesis. The first goal is to investigate and identify the components in a smartphone game that makes it addictive. The second is to use these factors and create a proof of concept smartphone game prototype. In order to learn how smartphone games can be addictive, these subgoals were determined.

- Investigate what components in smartphone games that creates an addiction
- Use the identified components to develop guidelines of how to make a smartphone game addictive
- Create a prototype of an addictive smartphone game using the established guidelines
- Evaluate how well the prototype uses the guidelines and if it creates an addiction

2.4 Limitations

There are many different approaches to addiction, and smartphone games are relatively new which means that little research had been made about addiction in the area. Addiction is traditionally seen as negative or harmful. In this thesis,
2.4. Limitations

addiction is instead viewed as creating an experience that is so enjoyable that the user wants to return.

The project was also limited to using a game idea from the company, developing it in Unity\(^1\) and targeting the iPhone platform. The game idea used in this project was titled “Seniors vs. Snails” and came from Caroline who works at Compentus. This idea consisted of a battle between seniors and snails, inspired by real life seniors interested in flowers that often have to get rid of snails. In the idea, this is mirrored by seniors also having flowers. Like in real life, the snails eat the flowers and the seniors try to kill the snails. Both the snail and the senior are playable in the idea. They are however controlled differently and have both separate perspectives and goals. Seniors try to protect their garden against snails by killing them, and snails try to eat as many flowers as possible. The game ends when the snail has eaten all the flowers, the senior kills the snail or when the time runs out.

Also included in the game idea was that the game should be multiplatform but mainly focus on smartphones. On these devices, the game was to be controlled by dragging the finger on the screen. The movements of both seniors and snails were supposed to be slow. This for example meant that snails taking a bite of a flower or the senior attacking the snails should take some time.

\(^1\)A multiplatform game engine used to develop games - https://unity3d.com/
Chapter 3

Theoretical framework

Much research has been dedicated to computer games and their psychological effects on engagement and motivation. [11] The recent development of smartphone games means that there is less research in this area. As a consequence of this, the framework presented in this chapter is based on motivation in general with a focus on motivations for playing computer games. Many similarities are expected in the motivations of people who play computer games and smartphone game players since smartphones are small computers.

This thesis will not deal with the potentially negative predictors and consequences of smartphone game addiction. Despite this, the amount of research in the area merits a chapter describing some results and the motivation behind not including it in the thesis. This is the first section in this chapter.

The next section describes the theory of optimal experiences, or flow, which is a theory on how people can become happy and fully involved in life. Following this is a chapter on how to use persuasive design in order to make people perform a target action. After this comes a chapter on factors in games that motivate people. Finally, the findings of a study on motivations for playing online games are presented.

3.1 Addiction and dependence

Addiction has traditionally been associated with substance abuse, and has been defined as “a pathologic condition that one cannot tolerate without the continuous administration of alcohol or drugs”. The term addiction has since evolved into also being applied to behavioural addictions, such as addictions to gambling, Internet, games, smartphones and social networks. [5]
### 3.1. Addiction and dependence

Table 3.1: Table with diagnostic criteria from DSM-5 and ICD-10 used to diagnose addiction. The table shows which diagnostic tool includes which criteria in the diagnosis.

<table>
<thead>
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<th>DSM-5 Substance use disorder</th>
<th>Pathological gambling</th>
<th>ICD-10 Alcohol dependence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strong desire/compulsive use</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Development of tolerance</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. Withdrawal symptoms</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4. Loss of or reduced control</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. Increasing neglect of activities</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6. Continued use despite physical risks</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7. Neglect of responsibilities</td>
<td>X</td>
<td>X*</td>
<td></td>
</tr>
<tr>
<td>8. Continued use despite causing problems with family and friends</td>
<td>X</td>
<td>X*</td>
<td></td>
</tr>
<tr>
<td>9. Great deal of time spent related to the substance or activity</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Use despite knowledge about negative consequences</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Craving</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Use to escape from problems</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>13. Returns after losing to get even</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>14. Lies to family and friends about the extent of use</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15. Has committed illegal acts to finance activity or substance</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>16. Relies on others to provide money for activity or substance</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

* Adapted from one criteria in DSM-5 into two criteria in the table

One way to diagnose addiction is using the criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM). However, the DSM-5 (the fifth edition of DSM) only includes pathological gambling as the first behavioural...
disorder unrelated to substance abuse. [12, 13] Even though Internet Gaming Disorder is included in section III of DSM-5 as a condition warranting further research, it is not yet included as a separate disorder. [12] This has led to adapting criteria from similar conditions in the DSM being the most common practice in diagnosing technological addictions. [14]

Criteria to diagnose technological addictions have been constructed from both the DSM criteria for substance dependence (included in Appendix A), and the DSM criteria for pathological gambling (Appendix B). [14] These criteria have been adapted to study addiction related to video games [14], Internet [15] and smartphones in relation to social networks and games. [8] Another way to diagnose addiction is using the criteria from the International Statistical Classification of Diseases and Related Health Problems (ICD), published by the World Health Organization (included in Appendix C). [16] A summary of the criteria used in these diagnostic systems can be seen in Table 3.1.

There is however a debate on whether Internet addiction is an independent disorder. The debate extends to all behavioural addictions, which means that it also is related to other technological addictions. Neither of the two common diagnostic tools used for diagnosis of addictions include technological, media or Internet-related addictions as disorders. It has also been suggested that there isn’t enough scientific evidence to support including Internet addiction as a disorder in the next version of ICD, ICD-11 (the eleventh edition of ICD). This is partly due to the fact that Internet can be used as a delivery system for other impulse control dysfunctions. [10] Following from this is that addictions to the Internet and addictions on the Internet must be clearly distinguished. [17]

3.2 The theory of optimal flow

Aristotle concluded that men and women seek happiness above all else. According to Csikszentmihalyi [18], this conclusion still holds true. Yet, we still do not know what happiness is or how to achieve it. In Csikszentmihalyi’s book Flow: The Psychology of Optimal Experience [18], he summarizes decades of research on the subject of joy and creativity in what he calls flow - the process of total involvement in life. The book presents general principles on happiness and how to reach it.

The principle of flow is based on the notion that happiness is not something that just happens, but instead must be cultivated. He also states that happiness cannot be found by searching for it consciously. Instead, one must strive to control one’s consciousness and achieve optimal experiences. By doing so, multiple optimal experiences add up to a sense of participation in deciding the contents of life. Flow is the basis of the theory of optimal experience, which is something we make happen.
3.2. The theory of optimal flow

Csikszentmihalyi differences between pleasure and enjoyment. He comments that pleasure is a passive feeling of contentment that is important to the quality of life. Nevertheless, it does not bring happiness. What contributes to happiness is instead enjoyment; meeting a requirement or satisfying a need while also achieving something unexpected. Enjoyable events contribute to growth, making a person more complex. [18] The theory of optimal flow suggests that ICT (Information and Communications Technologies) can be so enjoyable that users will try to maintain that state of high enjoyment even at high costs. This supports the notion that ICT can be addictive in the sense of enjoyment. [1]

To reach the state of ultimate enjoyment, to reach flow, Csikszentmihalyi mentions that there are some basic steps of enjoyment that need to be followed. These steps were developed by collecting data over 12 years from thousands of respondents. These steps are: a challenging activity that requires skill, the merging of action and awareness, clear goals and feedback, concentration on the task at hand, the paradox of control, loss of self-consciousness and transformation of time.

A challenging activity that requires skill
A large part of optimal experiences are reported to have happened with action sequences that are bound by rules, performed towards a goal and requires the appropriate skills. These activities require focus and cannot be performed without the skills needed. Games are an example of activities that have been designed for this very purpose. How enjoyable an activity is depends on its complexity. Enjoyment comes when the complexity of the task is equal to the individual’s capabilities.

The merging of action and awareness
When a person uses all their necessary skills in an activity, their focus is completely on the task at hand. This means that in an optimal experience, people are so concentrated that the activity almost becomes automatic. This is the basis of the term flow - a description of what seems like an effortless performance. This does not mean that the performance is effortless, the activity often requires either physical or mental effort.

Clear goals and feedback
This total focus is only possible to achieve when the goals are clear and you receive immediate feedback. Clear goals are not always obvious in all activities, meaning that to achieve flow you must be able to set clear goals for yourself. Feedback is also important to know that you have reached your goal.

Concentration on the task at hand
As mentioned earlier, flow includes being totally focused on the current activity. This allows a person to forget negative aspects of one’s life, having no place for information that is not relevant at the moment. The total concentration is an important aspect of flow, improving the quality of the experience by not letting through irrelevant thoughts.
3.3. Persuasive design

The paradox of control
Flow includes a sense of control. When experiencing flow you do not need to actually be in full control of everything. But there is an element of perceiving full control and not worrying about losing it. There is also a danger of becoming addicted to the sense of being able to control an enjoyable activity. This means that by trying to exercise control over certain situations, you actually lose control of yourself.

Loss of self-consciousness
Earlier steps mention focusing on the current task and filtering out unnecessary information. This can lead to a loss of the sense of self, which can be characterised by a feeling of being one with the environment. A person that experiences flow does not lose the self but rather the consciousness of the self. This also does not mean that the person loses control, instead they are often very much in control.

Temporarily losing the sense of self seems to be enjoyable and allows for the self to grow. Being so focused that we feel connected with our surroundings lets us expand who we are. The author explains this by a person in flow having to do her best. Increasing her skill and losing the sense of self means that when regaining the feeling of independence, her new self is different than before.

Transformation of time
An ordinary effect of achieving flow is the loss of the sense of time. The time experienced seems to have no correlation to the actual time that passes. For a person experiencing flow, this can mean that hours seem like minutes. The opposite, where for example seconds feel like minutes, can also be true but is less common.

Only activities where time is an important factor improves the estimation of time. This has to do with keeping track of time becoming a skill necessary to perform the activity well, which makes the activity more enjoyable. It is not determined whether the loss of the sense of time is to do with the intense concentration or if it contributes to the enjoyment of the activity.

3.3 Persuasive design

In 2009, BJ. Fogg created a model [19] to understand the drivers of human behaviour. He called the model the Fogg Behaviour Model [19], in which he proposed that behaviour is a product of the three factors motivation, ability (or simplicity) and triggers. This means that to make a person perform a target behaviour, you must make sure that the person is sufficiently motivated, has the ability and is triggered to perform the target behaviour. Additionally, all three factors must happen at the same time for the behaviour to be performed. [19]
Fogg has visualised this model by creating a figure with motivation as the vertical axis and ability as the horizontal axis. An illustration of this figure can be seen in Figure 3.1. A trigger is represented by the star and the dotted line is an illustration of an increased likeliness to perform a behaviour. The action line is a representation of the boundary that needs to be crossed in order for a trigger to lead to a behaviour.

Figure 3.1: Graphical representation of the Fogg Behavioral Model with motivation on the vertical axis and ability on the horizontal axis. The star represents a trigger and the dotted line indicates an increased likeliness for the user to perform the target behaviour. The action line represents a boundary over which a trigger can lead to a behaviour.

3.3.1 Motivation

When designing for motivation, the goal is to raise the motivation levels of the users. Fogg outlines three different motivational core pairs which he suggests affects motivation. The three pairs are pleasure/pain, hope/fear and social acceptance/rejection. [19]

Pleasure/pain
3.3. Persuasive design

The first core motivational pair according to Fogg is pleasure or pain, which is supposed to be a primitive response. This is the only core motivator whose effect is immediate.

**Hope/fear**
Hope or fear is the second core motivational pair and is related to anticipating a possible outcome. Hope is expecting something positive, and fear is expecting something negative.

**Social acceptance/rejection**
The third and final core motivational pair is social acceptance or social rejection. This is a combination of our social behaviour and controls for example the clothes we wear.

3.3.2 Ability

Designers must make behaviours easier in order to increase the user’s ability to perform the behaviour. For this purpose, Fogg developed a framework with six parts of simplicity. [19] All parts are related and if one part fails, simplicity is lost meaning that the behaviour is not simple to perform for the user.

**Time**
For a target behaviour to be simple, the user must have the time to perform the behaviour.

**Money**
If a user’s resources are limited, a target behaviour that costs money is not simple.

**Physical Effort**
Behaviours that requires physical effort may not be simple depending on the user and the situation.

**Brain Cycles**
The user’s cognitive resources are limited. If a user is already required to focus on something, a target behaviour that requires hard thinking is not simple.

**Social Deviance**
A target behaviour that deviates from social norms is no longer simple.

**Non-routine**
A behaviour that is not routine to a user is not simple.

3.3.3 Triggers

When having achieved necessary motivation and ability, a trigger is needed to tell the user to perform the behaviour. Fogg outlines three types of triggers.
3.4 Malone’s factors for intrinsic motivation

In 1981, Malone investigated what was so captivating about computer games. The purpose was to identify motivating factors in games to be able to use these factors in learning. After first reviewing existing theories about motivation and learning, he then performed a series of empirical studies. The goal of these studies was to find out what people like about computer games. The studies resulted in a preliminary theory about designing environments that are both interesting and educational.

In his investigation, Malone makes a difference between two different types of motivation. The first kind of motivation he calls extrinsic motivation and is dependent on external reinforcement. This kind of motivation has been observed to actually decrease motivation to perform an action over time. The second kind he calls intrinsic motivation - when a person chooses to take an action without external rewards. Malone chose to focus on intrinsic motivation and suggested a theory on instructional design based on the previous theories and his own studies.

The theory consists of three major kinds of motivation - challenge, fantasy and curiosity. [21]

3.4.1 Challenge

The first kind of motivation consists of creating a challenging environment. An environment can only be challenging for a user if there is an uncertainty if
the goal can be achieved. This means that the environment needs to have a
good, which in turn can be made uncertain in different ways. There must be
a distinction between toys and tools in relation to reaching the goal, and the
user’s self-esteem can be affected by whether the goal is met or not.

Goals

The concept of a game implies that the game has an objective, or goal. Goals
are important to make an environment intrinsically motivating. One example
is Malone’s survey in which games were rated. Based on this study, goals were
found to be the factor that had the strongest correlation with preference of a
game. For the goal to be motivating it should also have certain characteristics,
described below.

Firstly, the motivation can be increased by making the goal personally meaning-
ful. A task with relatable parts can be both more interesting and understandable
than a similar task which is not relatable.

Most games have a fixed goal that can be highlighted, for example with the
use of visual effects. Other games or activities can instead have emergent goals
that are determined by the interaction between the person and the environ-
ment. Both types of goals can be motivating but emergent goals need different
boundaries. There needs to be a structure for users to easily determine goals
at the appropriate difficulty level for environments with emergent goals to be
motivating. This is necessary to avoid users choosing tasks that are either too
simple or too complex. In both types of goals, they are only motivating if there
is some kind feedback on the performance of the user.

Uncertain outcome

A goal can only be motivating if there is an uncertainty to whether the goal can
be reached or not. In his studies, Malone identified four ways to make achieving
the goals uncertain. This can be done by using different levels of difficulty, using
goals on multiple levels, hidden information and using randomness. [21]

A variable difficulty level means that the difficulty of the game can be adjusted to
fit the player. Many computer games can be played at different difficulty levels
which can be adjusted in three different ways. Either the difficulty is adjusted
continuously according to how the player performs in the game, chosen by the
player or set to the overall skill that matches the player. A variable difficulty
level makes it possible to adjust how hard the game is to fit the player.

Malone states that good computer games have different levels of goals. These
goals on different levels mean that a user can be challenged even if they are
certain of achieving a goal on one level. The different levels can be of at least
two kinds, where some games use the same type of goal as earlier but with
3.4. Malone’s factors for intrinsic motivation

varying difficulty. Other games instead uses the previous goals of the game and makes improving them a goal on a higher level. This can mean solving the problem more quickly or using fewer steps. By doing this, the user optimises their mental procedures. This is often the focus of games where the goal is to get a high score or finish in the quickest time.

Another motivational feature that makes reaching the goal uncertain is hiding information from the player. The information is then selectively revealed which makes reaching the goal uncertain. Hiding information from the player and revealing it successively can awaken curiosity and make the activity more challenging.

Randomness is the final way of making the goal’s reachability unknown. This can be seen in gambling but is also possible to use in other activities to heighten interest. The randomness comes from introducing processes that determine the success of the player, where the results cannot be determined beforehand. This keeps the players guessing and makes the game more interesting.

Toys vs. tools

By analysing motivation in the form of challenge, there is an important distinction to make between toys and tools. Malone [21] defines both as systems but with different purposes where toys are used on their own without an external goal. Tools are instead defined as systems used in order to reach an external goal. This means that the demands on the two systems are mostly opposites in relation to the subject of challenge. A tool does not need to provide a goal since it is designed for achieving a goal. Reaching this external goal is also uncertain, which means that the tool should be both reliable and efficient. Malone asserts that a good game is intentionally made difficult to make it more challenging.

Self-esteem

One reason that challenge is captivating is that it can affect a person’s self-esteem, according to Malone. Success can improve the self-esteem and failure can lower it. Failure can also make a person less interested in an activity. The relation between challenges and the self-esteem means that activities meant to be motivational should include different levels of difficulty. An adjustable difficulty level leads to the user being able to adapt the level to their ability. Feedback should also be presented in a way to make the smallest possible negative impact on self-esteem.
3.4.2 Fantasy

Fantasy is a way of making an environment more interesting. The fantasies can be both of physical objects or of social situations. Malone defines two different kinds of fantasies, intrinsic and extrinsic. [21]

Intrinsic and extrinsic fantasies

Extrinsic fantasies depend on the skill of the user, but the skill does not affect the fantasy. An example of this is taking instructions overlaid with simple gamification elements. In this example, the player could work towards an imaginary goal or avoid a made up disaster by answering questions correctly. The same fantasy could be used in multiple situations since the skill is independent from the fantasy.

Intrinsic fantasies are instead fantasies where the fantasy and the skill has an effect on each other. A common way of doing this is to present problems in terms of fantasy elements. Malone makes the claim that intrinsic fantasies are more interesting and more instructional than extrinsic fantasies. Intrinsic fantasies are also said to often give an indication of how the skill could be used in real life. Simulations are examples of intrinsic fantasies that can improve real life skills.

Cognitive aspects of fantasy

The cognitive aspects only apply to intrinsic fantasies. Intrinsic fantasies can provide metaphors which can help a person use old knowledge to understand new things. The potentially vivid images used in intrinsic fantasies can also help the user to better remember the situation.

Emotional aspects of fantasy

One thing that possibly makes fantasy interesting in computer games is potentially fulfilling emotional needs of the player. The needs of the player are very difficult to determine, which means that an ideal game should be able to fulfil a broad range of needs. Malone also supposes that games who include fantasies which are emotionally involving, like destruction or competition, are more likely to be popular than other games. There is also the question of which fantasies to support. Malone raises the question of whether computer games which can induce aggressive fantasies also makes the user more aggressive in real life.
3.4 Malone’s factors for intrinsic motivation

3.4.3 Curiosity

An environment should neither be too complicated nor too simple in relation to the user’s knowledge. If done correctly, the environment can be new and surprising while at the same time still understandable. Malone states that an optimally complex environment in general will let the user have expectations about what will happen. These expectations should however sometimes not be met.

Challenge and curiosity have many similarities. Challenge demands an optimal level of difficulty where curiosity demands an optimal level of complexity. These optimal levels depend on adapting the environment to the user’s conditions. Feedback is also necessary to keep the user informed. In spite of these likenesses there still exists reason to keep the types separate. Challenge is supposedly coupled with self-esteem unlike curiosity. Similarly, the following cognitive models of curiosity are unrelated to challenge.

Sensory curiosity

Sensory curiosity, like the name implies, has to do with attracting attention through the senses. This can be done with different stimulus of the senses, like changing the light or using sound. Computers provide many possibilities for sensory stimulation and these effects can be used for different purposes. Malone outlines decoration, fantasy enhancement, rewards and representation systems as possible uses for these effects.

Cognitive curiosity

Another model is cognitive curiosity which does not deal with the senses. Cognitive curiosity is instead related to changing and improving mental models and knowledge structures. Here, Malone claims that people are motivated to bring completeness, consistency and parsimony (meaning frugality or the sense of being economic) to all their cognitive structures. This means that it is possible to arouse a person’s curiosity by giving information that makes their knowledge either incomplete, inconsistent or unparsimonious. By doing this, the person is motivated to learn more in order to improve their knowledge structure. A similar approach is to show a person inconsistencies in their existing knowledge. Malone writes that good teachers can be seen as systematically using these methods to teach their students.

Informative feedback

One method in order to make environments complex in an interesting way is to use feedback. This feedback should be surprising in order to engage the
curiosity of a person. This can be done either by randomness or by hiding information. To make an environment instructional, the feedback also needs to be constructive. Constructive feedback in this case means that the person needs to be shown both that they lack certain knowledge and how to obtain it.

### 3.5 Motivations for playing online games

Yee published an article in 2006 with the title “Motivations for Play in Online Games”. [22] The article was based on an earlier article by Bartle which identified four approaches to playing Multi-User Dungeon games. The four types of players identified by Bartle were achievers, explorers, socialisers and killers. [23] In Yee’s article, he argues that the assumptions made by Bartle when creating this model never had been tested empirically. Even though Bartle’s player types are said to be well known, they had never been shown to be independent player types. Bartle also assumed that the different player motivation types would suppress other types of play motivation which also never had been tested.

In order to create an empirically tested model for player motivation in online games, Yee created a survey with 40 questions regarding player motivation components. He focused on Massively-Multiplayer Online Role-Playing Games (MMORPGs) and gathered over 3000 responses by spreading the survey on MMORPG Internet forums. The results from the survey were analysed and from this, Yee gathered that player motivation consists of three main components. All the components from the study were divided into one of these main components. Yee’s results also showed no suppression of play motivation types on others which means that players can be motivated by multiple things at once.

In addition to examining player motivation, Yee’s study also included a version of Young’s questionnaire [15] of diagnosing problematic Internet usage. This was done to determine which components of the game were most predictive of addiction or problematic usage. In Yee’s study, escapism was shown to be the most predictive component of addiction. The other predictive components were hours played per week and advancement. Yee suggests that these predictive factors could be an example of pre-existing depression or other mental problems being common in users developing problematic usage.

The three main components from the study were achievement, social and immersion. These main components, their subcomponents and their characteristics are described below.

#### 3.5.1 Achievement

This component has three main motivational areas. Players who were motivated by achievement could firstly strive for advancement. This would mean that
they want to gain power and quickly progress to gather symbols of wealth in the game. By gaining power and collecting symbols of wealth they could also achieve a higher status.

The second motivational area is mechanics. The players driven by the mechanics of the game are interested in optimising their character’s performance. This is done by analysing the rules and structure of the game and using this knowledge to improve their character.

The last area of motivation is competition. Players motivated by competition want to challenge others and win to show domination.

3.5.2 Social

The social main component also has three main areas of motivation, the first of which is to socialise and talk to other players. Players who want to socialise are often interested in helping other players, which also could lead to these players making friends.

Social players could additionally be motivated by forming connections with others. The goal of these connections is to make more personal friendships, where more personal information is shared. These players could use self-disclosure and giving or receiving support in order to create these personal relationships.

Finally, players motivated by social interactions could also be interested in teamwork and working together with a group. The goal of this is to collaborate with the group in order to achieve something together.

3.5.3 Immersion

The third and last main component contains four areas of which players could be motivated. Discovery is the first area, where players want to explore the game with the goal of finding new things that no one has found before.

The second motivational area in immersion is role-playing. These players immerse themselves by creating an in-game character, including a background story, which they then use for role-playing with other users. From this interaction with other players, an improvised story is created.

Players who are interested in immersion can also do this by focusing on their character and its appearance. This is called customisation and means that the player uses available colors, styles and accessories to change their character’s look.

Lastly, escapism is the final immersive area of motivation. Players who are driven by escapism use the game to avoid problems in real life.
Chapter 4

Addictive components in mobile games

No scientific papers about addicting components in smartphone games were found. This lack of studies can probably be attributed to the recent emergence of the mobile game genre. The missing scientific information also means that the information available about specific addictive components in games for smartphones had to be gathered from newspaper articles and blog posts.

This chapter summarizes the information gathered about addictive components in smartphone games. The established theoretical framework is used to relate the components found to scientific works. This means that the articles and blog posts were chosen based on the components’ inclusion in the theoretical framework. The articles and blog posts were either analysing a specific game (Angry Birds [24, 20, 25, 26] or Candy Crush [27, 28, 29]) or discussing multiple games at once [30, 31].

Different types of players are affected by different components, and different types of games use varying types of addictive components. The information gathered was analysed and divided into eight different areas of addictive components.

4.1 Simplicity

It is mentioned in most articles and blog posts that the game has to be easy to play in order to create an addiction. This is expressed in several different ways. In an analysis of Angry Birds, Chorost writes that the game is simple and has you playing in seconds which is a major factor in making the game addictive. [20] In other sources this is written as having a simple interaction
concept [25], simplicity of both basic concept and interaction [26] or just the game being simple [28].

The simplicity of the game is related to the interaction with the game and not the difficulty of the game itself. An analysis of Candy Crush mentions that the addictivity comes from the game starting out simple and getting harder as the player progresses. [28] An article discussing Angry Birds comes to a similar conclusion. Here, the author states that it is important to add more details to the player’s mental model at the right time. This should be done when the game complexity increases in order to make the game engaging. [25] This can be seen as the game trying to engage the player’s cognitive curiosity (Chapter 3.4.3) according to the description by Malone [21].

Making the game easy in the beginning also lowers the required ability (Chapter 3.3.2), which BJ. Fogg says to be one of the three components in persuasive design. [19] The amount of motivation (Chapter 3.3.1) required becomes less when the player’s ability is heightened. This can contribute to making the player want to play the game again.

4.2 Challenge

By starting out simple and increasing the difficulty as the game progresses, many users can play and advance to their appropriate level of difficulty. This can be related to the challenge component (Chapter 3.2) that is central in the theory of flow [18] and included in Malone’s factors of intrinsic motivation (Chapter 3.4.1). Finding the optimal level of challenge for the player is important to keep the player interested. [28] The simple start to the game also lets players create a mental model of the game and establish the goals of the game.

Addictive games often use the methods described by Malone to make achieving the goal uncertain (Chapter 3.4.1). [21] There are often different levels of goals [24] and the different difficulty levels are frequently represented by game levels, and sometimes different game worlds. Hidden information is also used by introducing things such as new levels, obstacles or enemies. One example of hidden information in Angry Birds is the structure to destroy being out of view for the player. It is also important that the hidden information is not negatively perceived.

An article discussing why Angry Birds is so addictive mentions that players like honing, or improving, their skills. [30] To become better, the difficulty level must match the level of the player. This is a key component of achieving flow (Chapter 3.2) as described by Csikszentmihalyi. [18] Honing skills can also be tied to the achievement component outlined by Yee (Chapter 3.5.1) as a factor in player motivation. Players improving their skills increases their chances of completing in-game achievements, improved skills can also be seen as an achievement in and of itself.
4.3 Reward

A further advantage of making the initial parts of the game easy is the possibility to quickly reward the player. Feedback is said to be an important part of the challenge component (Chapter 3.2) in the theory of flow. Positive feedback can be a motivating factor by itself. It can also be used together with the possibility for the player to advance in order to create a compulsion loop. A compulsion loop consists of the player performing an action, receiving a reward and a new possible action opening up. This leads to the player continuing to play the game compulsively, as the name suggests.

By using short or small levels the game can quickly establish a clear line of progression for the player. Short or small levels means a shorter time in order to receive a reward. The addiction comes from the rewards raising the dopamine levels of the player. Here, the dopamine becomes a type of reward too. The established line of progression also insures that the player gets used to receiving a reward after finishing a goal, for instance a level. Tension is created in the player by anticipating a reward but not knowing how good the reward will be. The dopamine released when achieving a goal makes the player want to repeat the action that creates the release. In this case, this is to play the game again.

In B.J. Fogg’s theory, feedback can potentially increase the motivation (Chapter 3.3.1) to play. This can be done by using both graphics, audio and text in order to create the largest effect. The encouragement of behaviour by using positive reinforcement can be related to the research on behaviour by Skinner. Creating a compulsion loop can be seen as behaviour created by a stimulant, which Skinner calls respondent behaviour. Increasing dopamine levels to make the player return to game at a later time without a certain stimulus is called operant behaviour. Candy Crush has even been said to be a version of the methods used in Skinner’s research on variable reward systems and their effects.

An unexpected reward schedule should be used in order to create the largest effect. As earlier established, the raised dopamine levels are also a type of reward. This is an example of randomness used to make the outcome uncertain (Chapter 3.4.1) as described by Malone. Random elements in the game are used to keep the player uncertain of success which keeps the player playing. The effect is further increased by using disproportionate feedback - rewarding the player more than they may have earned. This could give the player a sense of achievement (Chapter 3.5.1) included in player motivation types by Yee.
4.4 Achievement

According to Csikszentmihalyi, increasing one’s skill is part of what motivates a person. Having clear goals and feedback (Chapter 3.2) to be able to know if the goals have been achieved are essential in reaching the state of flow. [18] Achievement (Chapter 3.5.1) is also a main factor in Yee’s factors of play motivation [22], and can be seen a motivational component (Chapter 3.3.1) in Fogg’s model of behaviour [19].

One important factor in order to make a smartphone game addictive is to give the player a sense of progression. For the player to be able to progress, it is beneficial to include a clear line of progression in the game. It is also important to show the player how to progress. [26] In addition to the reward benefits, this also shows the user how to advance in the game. This benefits the players driven by advancement and achievement.

Achievement can also drive people who are motivated by competition. Competition can be part of making a game addictive [26] by making players challenge others. The achievement (Chapter 3.5.1) is then seen as winning over the opponent. [22]

4.5 Control

It is possible to also use the rewards as a means of making the player believe they are in control. [31, 28] The paradox of control is a part of the theory of flow (Chapter 3.2). This paradox means that a part of achieving flow is to feel like you are in control, even though you may not be. [18] Rewards can create the feeling of control. This can be done by complementing the player even if the effects in the game were random. [31]

The feeling of control increases the player’s perceived ability (Chapter 3.3.2) which is a factor in BJ. Fogg’s behaviour model. [19] The game can use different types of elements in order to increase the player’s sense of control. One example are boosters used in Candy Crush to make the player believe that they can influence the outcome of the game. [28]

Another component that can increase addiction to a game is related to the loss of control. By limiting the playing time, the player will never be completely satisfied. [28] This can be done by using lives which are lost for instance by losing a level. Making the player wait means that they want what they can’t have. This is said to make the game more fun over time. [29]
4.6 Social

Competition is mentioned as a factor of achievement (Chapter 3.5.1) by Yee. [22] It can also be seen as part of a social component (Chapter 3.5.2) in the game. Another addictive part of the competitive aspect of a game is that no one wants to be beaten. [26] Competition implies an opponent, which allows it to be included in a social factor. The social connections made possible by some games are pointed out as an addictive component. [29] It can also be argued that the social aspect extends to the real world if people discuss for instance their level of achievement in the game.

4.7 Escape

A few of the sources mention a game being an escape as part of what makes it addictive. This is stated as the game relieving stress [29] and clearing the mind in a relatively angst-free way [24]. The game takes up the user’s focus, distracting the players from other things in their lives. [29] Escapism is part of the immersion type of motivation (Chapter 3.5.3) found by Yee. [22]

One blog post mentions that it is possible to play for hours without feeling guilt. [24] Part of this can be attributed to the game being designed for playing while doing something else. Candy Crush is designed so players would be able to multitask. This means that the game is always available to play. [29] Because of this, there are advantages to making the game so it at least is possible to play with one hand. [27] Being able to only use one hand makes it easier to play the game and provides an easier path to escape.

4.8 Explore

The possibility of exploring a digital world can also be part of what makes a game addictive. [30] Exploration, or discovery, is included in the immersion type (Chapter 3.5.3) of Yee’s types of player motivation. [22] Being driven by exploration has ties to cognitive curiosity (Chapter 3.4.3) in Malone’s factors of motivation as well. [21] Game designers can use the fact that at least some players are motivated by exploring the game. The Candy Crush team releases new levels every two weeks. [29] By constantly expanding the game, this makes sure that there are always more levels to play.
4.9 Competitive analysis

The literature study was followed by a competitive analysis. This analysis aimed to look at some of the most popular smartphone games in order to review and be inspired by successive examples of addictive games. Evaluating competitors can give an example of what works [33], in this case the games are evaluated based on their addictive components. The main benefits of competitive evaluations are learning what the competitors are doing and how they are doing it. This can help in making decisions based on things that work well for the users. [33]

The games included in the competitive analysis were mainly chosen based on the number of players, often determined by how many people who have downloaded or installed the game. Angry Birds, Candy Crush and Temple Run are the biggest smartphone games identified with different versions of the games having been installed or downloaded from 0.5 to 2 billion times. Clash of Clans is included since it is one of the currently most popular games together with Clash Royale. The latter is also included since it is a current example of what players are interested in and seems to be a game on the rise.

4.9.1 Angry Birds

Rovio claims Angry Birds\(^1\) is the best selling game in history [34], showing the games’ popularity. Different versions of the game had been downloaded over 2 billion times in January 2014. That equals more than a quarter of the world’s population at the time. [35] Angry Birds was originally released in 2009 [35] and half of the two billion downloads is attributed to the original game. [34] The game is analysed since it is one of the most popular and successful smartphone games in history.

The game is based on using a slingshot to propel birds at buildings. An example of a level can be seen in Figure 4.1. The buildings are inhabited by pigs and

\(^1\)https://www.angrybirds.com/

![Angry Birds slingshot](a) Angry Birds slingshot

![Angry Birds enemy structure](b) Angry Birds enemy structure

Figure 4.1: Screenshots from Angry Birds showing the first level with (a) the slingshot and (b) the enemy structure to destroy.
the goal is to destroy the pigs and as much of the buildings as possible. The buildings in the game are made up of building blocks symbolising different materials. Some materials are made more fragile to simplify their destruction and often the buildings are mainly made up of blocks symbolising wood and glass. The player receives points by destroying pigs and the building blocks that make up the buildings. The number of birds is limited and to reach the next level, all pigs must be destroyed. When all pigs are destroyed, the points are added up and the player gets one to three stars on the level based on the number of points gathered. Unused birds also give bonus points.

Both the birds and the pigs can have different appearances and attributes. Birds differ in size and colour, with each different bird having a different ability. The birds’ abilities are performed by tapping once on the screen when playing on a smartphone. For example a blue bird splits into three smaller birds and a black bird explodes when triggered. The pigs have larger size differences, where bigger pigs can withstand more damage. Some pigs also wear hats or armour which make them harder to beat.

4.9.2 Candy Crush Saga

Another popular mobile game is Candy Crush Saga\(^2\), which has been installed over 500 million times across mobile platforms and Facebook in November of 2013. \[^{36}\] In addition, Candy Crush Saga was the first game to ever be top of iOS, Android and Facebook at the same time. \[^{29}\] Candy Crush was released to smartphones in November of 2012 and is also one of the most popular smartphone games ever. An analysis of Candy Crush gives relevant examples of addictive components and how to use them for best effect.

Candy Crush Saga is a match-three puzzle game where you play on a board filled with candy. A view of the levels and the first level of the game are shown in Figure 4.2. You make a move by trading places of two candies at the time such that three or more candies of the same kind appear in a row. When the candies of the same kind are in a row, they disappear and points are given. This also means that above candy falls down to replace the disappeared candy. If this makes three or more candies of the same kind align again, they also disappear and further points are given. By combining four or more candies in a row, you get special candy that has special properties when combined with others. These special candies clear more candy than ordinary candies. The number of moves is limited and the goal is to get a certain number of points to complete the level within the allowed number of moves. This objective can also be combined with others, like clearing jelly or getting ingredients to the bottom of the screen. In these examples, you remove jelly by combining rows of candy on top of the jelly or get ingredients to the bottom by clearing the candies underneath. If you lose

\(^2\)http://www.candycrushsaga.com
4.9. Competitive analysis

(a) Candy Crush levels
(b) Candy Crush first level

Figure 4.2: Screenshots from Candy Crush showing (a) a view of the levels and (b) the first level.

In a level, you lose one of a total of five lives. The lives regenerate every thirty minutes.

4.9.3 Temple Run

Temple Run\(^3\) is also one of the most popular games of all time. \cite{37} The game was originally released in 2011 \cite{38} and had, together with the sequel Temple Run 2, been downloaded over a billion times in 2014 \cite{38, 39}. The game is said to have pioneered the game type “endless runner”, where a running character runs forever and there is no end. The goal of the game instead becomes to beat previous high scores. Together with its popularity, the game is included to analyse a game with a different type of structure and gameplay.

As stated earlier, Temple Run is an endless runner. The player controls the character “Guy Dangerous” who is in an ancient temple and has stolen an artifact. \cite{40} Guy is chased by demonic monkeys \cite{37} and tries to outrun them on narrow temple paths. The player sees Guy from above but slightly behind at an angle showing the path in front. The paths that the character runs on has sharp turns and various obstacles but also rewards in coins and powerups. The game is included in Figure 4.3 where both coins and a powerup can be seen.

The character is controlled by either swiping or tilting the phone, where swiping to the sides turns the character in the direction of the swipe. Turning the character is used to follow the turns of the path in the temple. Swiping up

\(^3\)http://www.imangistudios.com/
or down makes the character jump or slide respectively, which can be used to avoid obstacles or gathering powerups. Tilting the phone to the side makes the character run on the corresponding side of the path which is used to avoid obstacles, avoid missing parts of the path or to collect coins.

Coins are laid out on the path of the temple and can be collected. They can be used to upgrade powerups and make them better, purchase utilities like resurrection or initial boosts, purchase new characters and to buy wallpapers. In the game, there are gold, red and blue coins. Gold coins are worth one coin, with red and blue being worth two and three coins respectively. Coins can also be bought using real money.

Finally, powerups are also laid out along the paths of the temple. These powerups can give the player different powers like a coin magnet that automatically collects all coins nearby or making the player invisible and not be affected by obstacles. Others include a mega coin worth many coins, boosting the player at the start of the game and doubling the value of the coins after the character has run 1500 meters.

### 4.9.4 Clash of Clans

In 2015, it was reported that Clash of Clans\(^4\) had a daily revenue of 1.56 million USD which was the highest of all smartphone games. [41] Supercell, the company behind Clash of Clans, does not announce number of players for specific games. They did however report that that the total number of players of all

\(^4\)http://www.clashofclans.com/
their four games (Hay Day, Clash of Clans, Boom Beach and Clash Royale) reached more than 100 million per day on March 6 2016. At the same time, their games were played in all countries in the world (except for one - Tuvalu) and Clash of Clans is probably the most popular game of the four. [42] The game was released in 2012 on both iOS and Android and is included because of the large number of players and big revenue. These indicate a successful game that should include good examples of addictive components.

Clash of Clans is a Massively Multiplayer Online (MMO) game where the player starts with a small village. In the village, which is viewed from the top, the player can build different types of buildings. These different buildings can be used to mine for gold, collect elixir or train troops. The goals of the game are to build and upgrade the buildings in your village, train troops and attack other players. There also exists a single player mode in which the player can attack computer generated goblin villages. An example of a village and the attack view can be seen in Figure 4.4. The name of the game comes from players being able to join groups called clans to support each other with either troops or advice. Clans facing each other makes for a clash of clans.

![Clash of Clans village](image1)

(a) Clash of Clans village

![Clash of Clans attack view](image2)

(b) Clash of Clans attack view

Figure 4.4: Screenshots from Clash of Clans showing (a) a village and (b) the attack view.

Gold, elixir and gems are the currencies of the game. Gold must be generated in mines and stored in a gold storage. Elixir is produced by elixir collectors and stored in elixir storage. The buildings used to generate and store both gold and elixir can be upgraded in order to generate more of these currencies quicker and to increase the amount possible to store. Players also receive gold and elixir from attacking other players. Gems cannot be created but are given as a reward for completing achievements. They can also be given for clearing auto generated obstacles, like trees and stones, or a gem box. Both the obstacles and the gem box are spawned at certain times in the village. Gold and elixir are used to pay for buildings, upgrades and training troops. Building or upgrading buildings and training troops takes time, which increases with the level of the buildings and troops. The process can be speeded up by using gems, which boosts the buildings to shorten the time needed to complete the task. Since Clash of Clans is a freemium game the gems also can be bought by using real money.

Troops are trained in barracks and live in army camps. Both barracks and army
4.9. Competitive analysis

camps are buildings and can as such be built and upgraded. Upgrading barracks gives access to new kinds of troops, where upgraded army camps increase the number of troops possible to keep in the camp. Troops can also be upgraded by researching upgrades in a laboratory building, which of course also can be upgraded. More troops are made available when upgrading the town hall, which is an important building in the village. The level of the town hall determines much of what buildings can be built and what upgrades to these buildings are available.

Attacks are a central component of the game between both players and clans. Players who attack other players are sent to their opponent’s village. There, troops can be deployed in order to try to destroy the village. The defending player does not defend the village actively. Instead, players can build defensive buildings in order to try to defend the village. Stars are given to the attacking player based on the amount of destruction they caused.

Wars between clans play out by members of the clans attacking a member of the opposing clan. Clan leaders, or co-leaders, can start wars with other clans. The war starts with a day of preparation before the day of war. In a clan war, a player is limited to two attacks. The clan with the most stars, who as mentioned are given based on amount of destruction, at the end of the war wins.

4.9.5 Clash Royale

Supercell’s latest popular game Clash Royale was released on the 2nd of March 2016 and topped Apple’s App Store download chart after 12 hours. [43] The game became the top grossing app in the US on the iOS App Store after only a few days [44]. Clash Royale is included in the analysis since it is to date one of the newest of the games identified as popular. Including a new game provides insights in what is currently popular since the other included games were originally released in 2009, 2011 and two in 2012.

Clash Royale is a digital card based strategy game which shares elements with Clash of Clans. As a player, you have a card collection that can total 48 cards. The cards have different properties and are used to battle other players. The menu and an example of a battle are shown in Figure 4.5. From the card collection, the player chooses 8 cards to include in a so called battle deck. Cards have a type and can be of different rarity. The different types describes what kind of card it is and can be troop, building or spell. The rarity indicates how rare it is to receive the card and its upgrades.

When the player has chosen 8 cards to include into a battle deck, there is an option to start a battle. A battle is played in an arena between two players from top to bottom, where you as a player play from the bottom of the screen. The two players have three towers each. The goal of the battle is to destroy the
opponent’s towers. This is done by playing cards, which take elixir to play. The strategic aspect of the game is based on playing the correct cards with limited resources to defend your own towers while simultaneously attacking the towers of your opponent.

The three towers consist of a king’s tower and two arena towers. A battle is three minutes long and whoever has destroyed more towers when the time ends wins. By destroying the opponent’s king’s tower, you automatically win the game. If the game is tied at full time, an extra minute is given to destroy another tower. Destroying a tower in this minute wins the game. If no tower is destroyed the game ends in a tie.

When the battle starts, each player starts generating elixir. Elixir is used to play cards, with cards needing different amounts of elixir to be played. The elixir starts at six and is generated one unit at the time. A player can have a maximum of 10 elixir. When a card is played, the corresponding number of elixir is depleted.

Different types of cards have different effects and properties. For example, troops are mobile units that attack other troops or buildings. Buildings can be used to generate troops or attack opponent’s troops, and spells are used to attack either troops or buildings.

By winning battles you win trophies, crowns and chests. Trophies are won from the other player. The number of trophies decides the arena you play on, meaning that more trophies equal higher arenas and more difficult opponents. Climbing in level and playing at higher arenas also unlocks more possible cards to find.
4.9. Competitive analysis

Crowns represent the number of the opponent’s towers you were able to destroy. Destroying a tower always gives you a crown but trophies are only won by winning a battle, and you consequently lose trophies by losing battles.

Chests are as mentioned given for winning battles. They can also be given as reward for free, by winning 10 crowns or bought using gems. The chests contain money, gems and playing cards.

4.9.6 Addictive components of competitors

In this section, the games previously described will be analysed regarding their addictive components. The games will be analysed according to the different identified areas of addictive components outlined earlier in the chapter (in Chapters 4.1-4.8).

Simplicity

Regarding simplicity, all games included in this analysis have some things in common. All games start with a tutorial in order to teach the player the controls of the game. Angry Birds, Candy Crush and Temple Run have very short tutorials that show the basic interactions with the game. Both Supercell games, Clash of Clans and Clash Royale, use longer tutorials. The reason for the longer tutorials in these games might be the more complex game models where both games require a better understanding of the game and its structure before playing.

Both Angry Birds and Candy Crush uses different levels who are clearly divided. Temple Run instead uses a high score as an indication of the player’s current level. Clash of Clans and Clash Royale use a different way of showing how far the player has progressed, with rank of either the player or of certain resources. Despite the different systems, all games start out easy and lets the player progress quickly in the beginning to establish the goals of the game and how to achieve them.

The controls of all games are simple and are easily learned, especially since all games use tutorials as mentioned earlier. The interactions are done via either simple taps or swipes and does not include difficult patterns or areas that are hard to hit. Clash of Clans and Clash Royale both includes placement of characters or buildings which can be very precise and hard to do exactly but both offer some possibility of adjustment either before or after placement. Clash of Clans includes many different types of elements, like buildings and troops, which may take a longer time to learn and understand. This might mean a longer initial learning curve, with the player requiring more time to learn the game and its controls.
4.9. Competitive analysis

Challenge

By starting out easy, the games can raise the difficulty level to quickly find the appropriate level for the player regardless of the player’s skill. All analysed games use similar techniques to increase the difficulty and find the optimal level for the player. The levels in Angry Birds and Candy Crush get harder as the game progresses, the speed is increased in Temple Run as the character runs longer and a higher level in Clash of Clans or Clash Royale means facing better opponents. Upgrades to buildings (Clash of Clans), characters (Clash Royale) or powerups (Temple Run) also requires more resources at higher levels which makes it harder to advance.

The games also make achieving the goal uncertain by using different game elements and designs. Angry Birds and Candy Crush for instance use goals on different levels by giving 1-3 stars on the levels completed. In this way, achieving three stars on a level becomes another goal. Similarly, attacks can be won with 1-3 stars in Clash of Clans and battles with 1-3 crowns in Clash Royale.

On the iPhone, all games included in the analysis are connected to Apple’s online multiplayer social network called Game Center. One feature of Game Center is the possibility of using achievements, which all included games do. Temple Run and Clash of Clans also use these achievements in the games themselves, where Clash of Clans gives rewards for finishing an achievement and Temple Run treats the achievements as goals in themselves. One way used in all games to increase the difficulty is to introduce new game elements, like new things to clear in Candy Crush or harder materials to destroy in Angry Birds. This is a way of using hidden information to increase the difficulty. The increased difficulty also lets the players improve their skills.

Reward

By making the start of the games easy, the players are quickly rewarded and given positive feedback. All games except Clash of Clans, which makes the player wait for training troops or upgrading buildings, provide an easy opportunity for the player to continue playing by advancing to the next level or playing again. The levels of Angry Birds and Candy Crush are short which means that the rewards are given often. Battles in Clash Royale lasts a maximum of four minutes and Clash of Clans attacks are also relatively short, especially in the beginning. As an endless runner, playing Temple Run takes longer and longer time to play with an increasing high score.

The games all use both graphics and sounds to provide feedback and reward the player. Angry Birds mainly uses sounds from the characters and bright colors to give feedback, in addition to the satisfaction that comes from destroying buildings and pigs. Candy Crush similarly uses graphics and colors but also gives compliments in text and sound. Temple Run mainly gives coins and powerups
as rewards, where Clash of Clans and Clash Royale gives rewards in the form of gold, elixir, gems, trophies, crowns and chests.

Rewards are given often, in multiple forms and perhaps disproportionately to the achievement of the player. One example of this is Clash Royale where the player is given crowns, chests and gold for winning a battle. Candy Crush is also an example of using randomness to determine the success of the player, meaning that the reward schedule becomes unexpected. This is an effect of the player not knowing if the goal will be achieved.

Achievement

Like mentioned before, the increasing difficulty leads to the player improving their skill. Part of this is done by establishing clear goals and using feedback to show the players if they have reached their goals. Angry Birds and Candy Crush have a clear path of progressing in the game which is shown by finished levels being clearly distinguished from levels not yet completed. Clash of Clans and Clash Royale both use some version of rank to show the player they are progressing, together with the current level of buildings or playing cards. Temple Run instead uses the high score and different achievements to give the player a sense of progression.

There is also a competition component that is explained in the Social component below.

Control

The rewards mentioned in a previous chapter can give the player a sense of control. Angry Birds use the physics of a slingshot to let the player improve their aim. Candy Crush gives compliments for combos that the player is not responsible for, and improving the high score in Temple Run can mean that the player feels improved and more in control. The important part is the sense of control and not the control itself. Both Clash of Clans and Clash Royale are more strategy based games where the player is responsible for a village or a deck of cards. Clash of Clans includes a village that must be maintained, expanded and upgraded. Clash Royale instead uses a virtual deck of cards which also must be upgraded and updated for the player to use the best combination of cards. This can give the player a sense of controlling their resources and affecting the outcome of the game.

All games also use elements in order to increase the player’s sense of control. Angry Birds introduces new types of birds with different properties that are useful in different situations. Candy Crush makes boosters available to try to affect the outcome, and in Temple Run the player can buy upgraded powerups and utilities in order to run longer or get more rewards. Clash of Clans uses many possible buildings and upgrades to make the player feel in control, where
Clash Royale instead uses playing cards where the player can actively choose which cards to upgrade when upgrades are available.

In Angry Birds, Temple Run and Clash Royale there is no limit to how much the player can play. Candy Crush and Clash of Clans do however use different methods in order to make the player take a break from playing. Candy Crush uses a system with lives, where the player has five lives. After these lives are up the player cannot continue playing. Clash of Clans instead uses a limited amount of builders and time delays on training troops and building or upgrading buildings. These delays increase with the levels of the troops and buildings and create natural pauses in playing.

Social

Of the games analysed here, all games use some social components. The competition element is included in all games but in slightly different forms. The Game Center connection in all games means that there is a platform for comparison with other friends that have an iPhone. Candy Crush can also be connected with Facebook in order to follow and compete with the player’s friends. Angry Birds and Temple Run does not include this competitive component but players can use their current level or high score to compare with other players. Clash of Clans includes an competitive element of attacking the villages that other players have set up, and all battles in Clash Royale are matches between two players.

Escape

The games included in this analysis can except for Clash of Clans be played with one hand. Angry Birds and Clash of Clans are landscape oriented, where Candy Crush, Temple Run and Clash Royale are played in portrait orientation. Most interactions with Angry Birds is however done on the left side of the screen, mostly leaving the right hand free. The short levels (Angry Birds and Candy Crush), runs (Temple Run), attacks (Clash of Clans) or battles (Clash Royale) also contribute to letting the player adjust the playing time to how much time is available. This means that the games can be played both when the player only has minute to spare and for longer periods of time. Providing an experience with simple controls that can be adapted depending on time available means that all games can be an easy escape for the players. Since most games can be played with one hand, they can also be played while doing something else.

Explore

The many different game elements mean that most games have much to explore. Temple Run is the possible exception, where parts of the temple path differs in
appearance and obstacles but there are only a few repeating types. Angry Birds and Candy Crush both have many levels for the players to explore, and Clash of Clans uses both the single player mode, attacking different players and the many upgrades to buildings and troops as possible explorations. Clash Royale has the different battle arenas to explore, which also unlocks new playing cards and better opponents.

In fact, most games unlock certain characteristics on certain levels of play. Examples from the games are new types of birds in Angry Birds, new boosters in Candy Crush, the powerups and utilities that are possible to buy in Temple Run, new buildings and higher levels of upgrades in Clash of Clans together with the different arenas and playing cards in Clash Royale. Both different areas of play and new game components can be used as things for the players to explore.
Chapter 5

Design guidelines

This chapter gives the resulting guidelines based on the addictive factors in smartphone games in Chapter 4. The 16 guidelines that have been identified as addictive components in smartphone games are presented below.

1. **Simple controls**
   Simple and intuitive controls contribute to making a smartphone game addictive. Making the controls easy to learn and understand lets the user start playing quickly. This is related to the simplicity component in Chapter 4.1. Making the game playable with one hand can also contribute to making the game addictive. A game designed for multitasking makes it easier to play the game when also doing something else (Chapter 4.7).

2. **Easily understandable goals**
   By making the goals of the game easy to understand, you can establish a clear line of progression. Goals are an important part of creating a challenge (Chapter 4.2) and by making the goals clear you let the user know what they are striving for. Striving towards achieving a goal is an important part in creating an addiction.

3. **Easy in the beginning**
   A game that is easy in the beginning lowers the required ability to start playing. The simple start is related to simplicity in Chapter 4.1. It also allows for progressing the game to find an appropriate level to make the game challenging from Chapter 4.2. Starting simple allows for quick rewards too, which is mentioned in Chapter 4.3. All these factors contribute to making the game addictive.

4. **Become more difficult as the game goes on**
   An addictive game should increase the level of difficulty in order to keep the player optimally challenged. This is a very important part of challenge in Chapter 4.2. Advancement and achievement are motivating parts of
a game (from Chapter sec:addictive-achievement), but the achievement comes from completing challenges and a game that is too simple is not challenging.

5. **Become more difficult at an appropriate level**
In order to keep the player at an optimal level of challenge, the game needs to keep an appropriate level at the rate of which the difficulty increases. Here too the advancement and achievement components from Chapter sec:addictive-achievement play a part. A challenging game, as in Chapter 4.2, needs to be neither too simple or too hard. This is true throughout the game and means that the increasing difficulty must be adjusted to keep a good pace. An appropriate level of increasing difficulty is an addictive component.

6. **Uncertainty of achieving the goal**
The challenge component in Chapter 4.2 brings up that the player achieving the goal should be uncertain. An established line of progression means that the player knows the goal of the game (Chapter 4.2) and can be taught to expect a reward (Chapter 4.3). The uncertainty of achieving the goal contributes to making the game addictive by keeping the player guessing and making them play again to achieve the goal.

7. **Short levels**
Making the levels of the game short contributes to establishing a clear line of progression and shortens the time for the player to receive a reward (Chapter 4.3). Short levels can mean both separate levels in the game and a larger level with rapid progression and smaller steps of advancement. Small levels increase the amount of rewards (Chapter 4.3) which can contribute to creating an addiction. The small levels can also be associated with exploration in Chapter 4.8. Wanting to know what the future levels hold can make the player continue playing.

8. **Let the player improve**
Players like improving their skills according to Chapter 4.2. The game can also use rewards to compliment the player. The player does not really need to get better, only get the illusion that they are improving (Chapter 4.5). By increasing the level of difficulty in the game, the player should improve but the rewards can be used to increase the feeling of improvement. This can contribute to an addictive part of the game.

9. **Reward the player for achieving a goal**
Positive feedback is a motivating factor, and players should be rewarded in order to expect a reward when achieving a goal (Chapter 4.3). This makes the player continue playing to achieve the goal and get the reward. Rewards can give a player a feeling of being in control (Chapter 4.5) which gives a sense of improvement. Some rewards should also be unexpected and disproportionate in order to achieve the greatest effect (Chapter 4.3).

10. **Easy to continue playing**
The game should be easy to continue playing in order to help create an addiction. This is related to simplicity (Chapter 4.1) but can also help create a compulsion loop if used together with a reward (Chapter 4.3).

11. **Multiple types of rewards**  
   In order to increase the effect of the rewards of the game, they should be of different types. Some examples given are using graphics, text or sound with each other to reward the player in multiple ways. Giving rewards, especially when using multiple types, can both make the player continue playing and return to the game at a later time (Chapter 4.3).

12. **Continual progress**  
   It is important to make the player feel like they are progressing continually in order to create an addiction. Advancing in the game and achieving goals can motivate some players. They also need to progress in the game in order not get bored by being stuck at the same level for too long (Chapter sec:addictive-achievement).

13. **Make players believe they can affect the outcome**  
   Even if the player cannot affect the outcome in the game, they should feel like they can in order to increase the possibility of them becoming addicted. This can be achieved by complementing the player for random things in the game, or adding elements to make the player believe they can improve their chances of succeeding (Chapter 4.5).

14. **Concentrated on playing the game**  
   In order to let the player escape their everyday life, the game should require an element of concentration. The concentration could come from making the game appropriately difficult in order to match the skills of the player. The game should despite this not be made too complex or difficult so it requires total attention for a long time. Instead, the game should be able to play for short periods of time in order to be accessible and provide an easy way of escape (Chapter 4.7).

15. **Make the game social**  
   Adding a social element to the game could contribute to making the game addictive (Chapter 4.6). This can be done by connecting the game to social media, adding a scoreboard or using competitive elements where players play against each other.

16. **Make the player wait**  
   After having established a reward schedule and a clear line of progression, the game could use elements of making the player wait. This can be done by taking time to complete things in the game, or using lives as a means of limiting playing time. Making the player wait increases their motivation to play by making them want what they can’t have (Chapter 4.5).
Chapter 6

Method

This thesis had two goals. The first was to investigate what components in smartphone games make them addictive. The second was to incorporate these components in a Proof of Concept smartphone game prototype. In order to reach these goals, the project was structured using a design process outlined in Chapter 6.1.

The design process consisted of a literature study, workshop, competitive analysis, establishing guidelines, prototyping and user testing. The literature study is described in Chapter 6.2. This was the basis of the theoretical framework (Chapter 3) and identifying areas of addictive smartphone game components (Chapter 4). The workshop is presented in Chapter 6.3 and the results are described in the prototyping process (Chapter 6.4). After the workshop, design guidelines were established using the identified addictive components, and these guidelines are presented in Chapter 5. The established guidelines were then used when creating the prototypes and the results of the prototyping process can be seen in Chapter 8. In the final part of the project, the prototype was evaluated using the methods described in Chapter 6.5. Results from this evaluation can be seen in Chapter 7.

6.1 Design process

A design process was chosen at the start of the project to better be able to structure the work according to a proven method. The two main design processes evaluated were Design Thinking [45] and Nielsen’s usability engineering cycle [46].

Design Thinking is a method for developing creative and practical solutions to problems with the goal of an improved result. This method consists of five steps: empathise, define, ideate, prototype and test. [45] Another way of describing
6.1. Design process

this process is for the designers to put themselves in the position of the users, define the problem, create ideas, develop ideas to prototypes and then test these prototypes. The process have developed into different versions and can also be described using seven steps - define, research, ideate, prototype, select, implement and learn. [47] After assessing this method, it was decided against using Design Thinking in this project. Design Thinking was deemed not detailed enough, it also lacked a guideline component and seemed to focus on solving a problem. Even though usability was not the main goal, the usability focus of Nielsen’s method was judged to improve the project.

The design process instead used in developing a game prototype was based on Nielsen’s usability engineering cycle. This model of designing for usability is constructed from Gould and Lewis’ “golden rules” and is focused on designing new systems. Nielsen’s design process covers usability activities before, during and after the design and implementation in software development.

The design process outlined by Nielsen consists of the following ten steps. [46]

1. **Know the User**
   Study the intended users of the product
   
   **Individual user characteristics**
   Create personas to take relevant information into account
   
   **The user’s current task**
   Study the user’s goal and current approach to the task
   
   **Functional analysis**
   Study the functionality needed to best solve the problem
   
   **Evolution of the user**
   Make educated guesses about future uses of the product

2. **Competitive analysis**
   Perform a heuristic analysis of existing products

3. **Setting usability goals**
   Prioritise usability goals based on the analysis of users and their tasks

4. **Participatory design**
   Involve representative users in the design

5. **Coordinated design of the total interface**
   Make the design consistent over the entire user interface
   
   **Standards**
   Follow interface standards (either widely followed standards or in-house standards)
   
   **Product identity**
   Create a high-level description of the product to specify the overall
6.1. Design process

goals of the project

6. Guidelines and heuristic analysis
   Use guidelines that list well-known principles for the design

7. Prototyping
   Use experimental prototyping to test ideas

8. Empirical testing
   User test the system to check if usability goals have been achieved and which parts of the system need work or cause problems

9. Iterative design
   Use the test results to create improved versions
   **Capture the design rationale**
   Record the reasons behind the various design decisions

10. Collect feedback from field use
    Gather data after release for future versions and new products

The Nielsen engineering cycle is focused on designing interfaces and assumes that existing guidelines and heuristics exist. In this project, the goals are to identify addictive components in smartphone games and incorporate them in a proof of concept prototype. No guidelines existed for creating an addictive game and because of this, new guidelines had to be developed. The project was also time constrained and did not aim to create a commercial product. Limited time combined with existing research on human behaviour led to using the theoretical framework to perform the first step - know the user. A competitive analysis was performed but usability was not the main goal of the product and because of this, usability goals were not set. The coordinated design of the entire interface was less prioritised, also since usability was not the main goal. The goals with the project, the scope and the limited time meant that the remaining steps were adapted. The adapted version consisted of the following steps.

1. **Know the user**
   This was done by performing a literature study to establish the components in smartphone games that make them addictive, thus affecting the users

2. **Competitive analysis**
   A competitive analysis was performed, analysing some of the most popular smartphone games

3. **Participatory design**
   The game design originated with a workshop where the employees of Compentus participated which gave ideas on how to use the identified components in order to create an addiction

4. **Guidelines**
   Guidelines were established using the results from the literature study
6.2. Literature study

5. **Prototyping**
   Prototypes were developed using the established guidelines

6. **Empirical testing**
   The prototypes were tested continuously during the process in order to improve

7. **Iterative design**
   The levels and the different parts of the game menu system were designed iteratively

8. **Collect feedback from field use**
   The final prototype was tested on users to get feedback on the game, investigate if the guidelines were followed and whether the game prototype was deemed addictive

6.2 Literature study

The project continued with a literature study to gather information about smartphone game addiction. The literature study was performed with the goal to create a broad knowledge base and find addictive factors in smartphone games. In order to achieve this, behavioural addictions and impulse disorders were studied. This was done to learn about addictions, their effects and how to diagnose them.

As mentioned in Chapter 1, few studies have been made specifically about what factors that make smartphone games addictive. Smartphone game addiction is also not recognised as an addiction in two large diagnostic tools. This combined with the fact that comparatively few studies have been made about this relatively new phenomenon led to studying games and their motivational factors in general. To broaden this study, motivational factors were first studied in general. The next step was to look at persuasive technology which later led to studies about motivational factors in games and different types of players. This information was mainly gathered through scientific papers and conference articles.

The final step of the literature study aimed to identify specific factors in smartphone games that make them addictive. Since no existing studies about this was found, this information was largely gathered from newspaper articles and blog posts. These findings were later analysed using the previous theory to ground them in scientific studies.

The results from the literature study was used as a basis for the workshop, gave the addictive factors included in the prototype and contributed to the design guidelines which were developed to create an addictive game.
6.3 Workshop

One of the goals of this project was to create a prototype of an addictive smartphone game. In order to generate ideas about this prototype, a workshop was performed after the competitive analysis. The workshop had two goals, the first of which was to discuss the existing game idea. This was done to decide whether to use the idea and in that case discuss which parts to implement in the prototype. Based on the game idea used the second goal was to generate ideas about the game and how to implement the addictive components. Ideas were generated specifically about game mechanics, levels, characters and design.

While planning the workshop, the method Creative Problem Solving (CPS) [48] was used. The CPS method is based on trying to understand the problem by breaking it down into smaller parts. Ideas are then generated to solve the problem, and finally the ideas are evaluated in order to choose the best one. Osborn, who invented brainstorming, formalised the CPS method together with Parnes. [48] Many different versions exist but this version was chosen since it focuses on innovation.

CPS is a method that consists of the following seven steps. [48]

1. Clarify and identify the problem
2. Research the problem
3. Formulate creative challenges
4. Generate ideas
5. Combine and evaluate the ideas
6. Draw up an action plan
7. Do it! (implement the ideas)

The first three steps of the CPS method was performed in preparation of the workshop. This was done to create a knowledge base, prepare a presentation and decide the goals of the workshop. The workshop consisted of steps 4 and 5 in CPS and took place at Compentus’ office in Stockholm, Sweden on the 8th of March 2016. The results from the workshop were later used as a basis for an action plan and used in creating the game prototype according to the last two steps of CPS.

The workshop schedule is included below.

**Presentation about the theoretical framework - 20 min**
- Presentation about persuasive design, motivations to play games, player types and the theory of Flow

**Presentation of game idea - 5 min**
- Caroline from Compentus, responsible for the game idea, held a short presentation about the game idea
Presentation about addictive components of games - 10 min
Short presentation about the components in smartphone games that make them addictive

Discussion about tools and limitations - 5 min
Short discussion about the tools to use and the limitations of the project

Discussion about and evaluation of the game idea - 5 min
Short discussion about the game idea and whether it should be used in the project

Brainstorm about game mechanics - 15 min
Idea generation about what you do as a player.

Brainstorm about game levels - 15 min
Idea generation about how the player reaches the next level.

Brainstorm about game characters - 15 min
Idea generation about what characters to include in the game.

Brainstorm about game design elements - 15 min
Idea generation about which graphical elements have to be designed.

6.4 Prototyping

After the guidelines in Chapter 5 had been established, the next part of the project consisted of prototype development. The prototyping part of the project included an initial paper prototype, a lo-fi prototype and a hi-fi prototype. Prototypes are used for many different things in software, both for internal visions and for creating products for consumers. Using prototypes tested by users can help test, expand and evolve ideas. In some cases, prototypes can even help create new ideas. [49]

In the start of the prototyping process, the target audience was decided. One goal of the project was to create a possibly addictive smartphone game prototype. For the game to have the highest chance of creating an addiction, the target audience was decided based on which age group spent the most time playing smartphone games. A study by a north american game community in 2011 analysed the smartphone game habits on their 22 million members. This study showed that people in the age group 25-35 spent nearly double the amount of time playing than the other age groups. [50] A different study in 2011 by market research company AYTM (Ask Your Target Market) was done on 500 american Angry Birds players. One question asked was how often the person felt addicted after playing. The age group 18-34 was three times more likely to answer “often” or “always” than the others. Based on these studies, people aged 18-35 were chosen as the main target audience.
Since the game idea provided by the company was inspired by real life events, it was decided together with the company to include the inspirational age group as a target audience. The game idea was inspired by seniors trying to kill snails and because of this, seniors were included as a secondary target audience.

The prototyping process used in this project is based on the spiral model of prototype development. This spiral model is an iterative model of the waterfall model, which consists of analysis, design, implementation and test. Using an iterative version of this model means that the process is repeated multiple times. The spiral model also introduces activities that run parallel to the different steps in the model, like documentation and evaluation. [51] This spiral model was used in order to have a structured work process and be able to continuously improve the prototypes based on feedback. A waterfall model without iteration requires extensive initial documentation and includes no way of incorporating feedback. These are two of the reasons that the waterfall model does not work well for interactive user applications. [52] Being able to test prototypes and iterate to find a better version is an important part in prototype development to understand users and their behaviour. The spiral model was chosen since it provides a platform of continual improvement of the prototype.

As stated earlier, the prototyping stage consisted of three kinds of prototypes. The first prototype was sketched using paper. Paper prototypes were used to quickly illustrate and test many different ideas. The second prototype was developed using a software prototyping tool. The main goal of this was to test the navigation of the game. Finally, a hi-fi prototype was implemented in order to test the guidelines, whether they had been followed and see if the prototype was addictive. The results of the different prototype stages can be seen in Chapter 8. The implementation of the hi-fi prototype included implementing the features of the game, where Compentus were responsible for providing the graphics.

The different prototype versions all started with an analysis phase. This phase determined what guidelines would be implemented in the current version. Designing the prototypes included outlining the different parts before implementing them in their various forms. The prototypes were then tested on employees at the Compentus office to collect feedback and suggestions. The testing on employees was separate from the user testing and aimed to identify and correct the biggest problems with the prototype before the final test. The employees who tested the prototypes in the different stages were not included in the final user tests because of their familiarity with the prototype.

6.4.1 Paper prototype

The prototype work started with sketching different ideas of gameplay and menu structure. By using paper sketches, many different ideas could be outlined quickly and discussed with the employees at the company. Substantial insights
can be gained from low fidelity prototypes [46], and paper prototypes were chosen to start the prototyping process. Sketching ideas help explain them to others and initial discussions were important to determine the specifics of the game prototype. Paper sketches also means that the ideas are documented and can easily be improved upon. The goal of the paper prototype phase was to include guideline 1 (simple controls) in the game.

The results from the workshop were analysed before the paper sketching started. The workshop resulted in many different ideas and some were deemed outside of the scope of the project. Certain ideas did however create the base of the game. One idea in the workshop was that the game should have a 2D or 2.5D perspective. Another was that the game should use different levels and worlds, where finishing a level should give a reward using some kind of points. It was suggested that snails should increase in difficulty to kill as the game progressed and that the worlds should end with a boss. Ideas for different worlds in the game with varying game related themes were given and one idea was to record voices for the characters in the game. All of these ideas were included in the game in some way.

The paper prototype phase started by limiting the game idea to the scope of the project in order to be able to implement a hi-fi prototype. These limitations were made based on the ideas from the workshop. The project was already limited to developing an iPhone game using Unity according to the limitations in Chapter 2.4. The idea was further restricted to only including the ability to play as a senior, killing snails. Another restriction was to only create one world in the game with a few short levels. In an effort to make the implementation

\[\text{1 simulating 3D in a 2D environment}\]

Figure 6.1: Initial sketches of different perspectives and ideas about the design and game play functionality of the game.
easier, the game was also restricted to using a 2D view.

After limiting the project, paper sketches was used in order to quickly be able to test different ideas and decide the general structure of the game. These sketches were based on the ideas generated in the workshop. The first sketches focused on making the game simple to play by trying to make the controls as intuitive as possible. The sketches made in this stage made no distinction between different phone orientations. Different sketches tried out varying perspectives and changed the sizes of the seniors and snails. An example of these sketches can be seen in Figure 6.1.

When initial sketches had been made they were evaluated and discussed together with Compentus employees. At this point it was decided to make the game possible to play with one hand in order to fully follow guideline 1 - simple controls. The perspective in the game was determined, is illustrated in Chapter 8.1 and can be seen in the implementation of the hi-fi prototype. At this stage it was also decided to include more menu pages inspired by other games. This was done to give the impression of a more complete game and give experienced smartphone game players a sense of familiarity. After these decisions had been made, the research on how to use the Unity program started. This research consisted of watching instructional videos and following tutorials. The research was done to learn the environment, the possibilities and limitations of the program and to get initial experience with using Unity.

Because of the time restrictions of the project, the development of the game mechanics started simultaneously with the paper sketches. A project was started

![Figure 6.2: Initial sketches of the menu system design in the game. Sketches include levels presented horizontally in a line, a choose game mode view, worlds in a horizontal line and levels presented as following a path (similar to the layout in Candy Crush).](image)
6.4. Prototyping

in Unity, which is a game engine for multiple platform used to create games. BitBucket\(^2\) was used in the project for version control. In the implementation of the final prototype, JIRA\(^3\) was used to register features to be implemented, graphical elements that were needed and improvements to be made.

In this stage, the first sketches of the menu system in the game were also outlined and sketched. Here, it was determined that the game should use different worlds and short levels in order to achieve guidelines 7, 8, 9 and 12. Short levels (7) lets the player improve (8) and the player can be rewarded for achieving the goal of finishing the level (9). Short levels with an appropriate difficulty level also lets the user progress continually (12). The initial menu system sketches can be seen in Figure 6.2.

The different ideas were tested and the best ideas formed the initial paper prototype, which is presented in Chapter 8.1.

6.4.2 Lo-fi prototype

The next step in the prototyping process was to mock-up the paper prototype using Balsamiq\(^4\). This was done in order to better test the navigation of the prototype. Using a prototyping tool to create a version with navigation resembled the final prototype more closely and gave new perspectives which improved the final prototype.

The lo-fi prototype did not incorporate any new guidelines since it only implements the menu part of the game. Instead, this version of the prototype was used for testing the layouts that had been decided. Implementing the game menu in a prototyping tool gave a more accurate version which in turn gave a better indication of how buttons and elements would look and behave in the final prototype.

Navigation in the lo-fi prototype was performed using a computer since touch interaction does not affect the navigation in this prototype. The goal is to test if the navigation is understandable which is not dependant on the user using a finger instead of a mouse to press a button. To make it obvious that the game would be on an iPhone, the different views were implemented using an iPhone frame and iOS versions of graphical elements where possible.

Based on the tests of the lo-fi prototype, certain game elements were changed and added. The top bar in the menu system was initially not included. This top bar with lives, money and points or experience was added after discussions following the first versions of the lo-fi prototype. The initial versions also tested including a settings view as a modal window. After discussions this was later

\(^2\)An online hosting service for revision control systems, https://bitbucket.org/
\(^3\)A project management tool with bug and issue tracking, https://www.atlassian.com/software/jira
\(^4\)A mockup prototyping tool, https://balsamiq.com/
changed to a separate view in order to make the interface more coordinated. Versions of the early lo-fi prototypes without top-bars are included in Figure 6.3. In the same figure, a settings view as a modal window is also included. After the tests of the final lo-fi prototype (presented in Chapter 8.2), multiple changes were made.

The money and lives changed places in the top bar to make it more symmetrical with rewards on both sides following suggestions. To make the interface more coordinated, the settings button was included in a bottom bar on the menu pages. At the start of implementing the menu system there only existed one senior character. Because of this, the change character-view was removed. The user page button was also included in the bar at the bottom of the menu pages.

### 6.4.3 Hi-fi prototype

After completing the lo-fi prototype followed five weeks with focus on implementing the hi-fi prototype. The work on implementing the hi-fi prototype started during the paper prototype phase and continued with implementing the game mechanics during the lo-fi prototype development. This laid the basis for the game mechanics but the implementation of the menu system both graphically and functionally mainly was performed during this phase. Here, the different levels were also implemented including the different types of snails and the boss.
The process of implementing the hi-fi prototype improved the prototype by trying to include most of the guidelines in Chapter 5. Only guideline 15 (make the game social) was totally omitted due to the complexity of an eventual implementation. Guideline 16 (make the player wait) was not implemented fully, partly because of time constraints. The short tests also contributed to not implementing this guideline. The tests were determined to have no room for making the player wait and the focus was instead on maximising the test users’ exposure to the game.

Tests on early versions of the hi-fi prototype showed that some users had difficulty understanding how to move the character in the game. This meant that an instructional modal window was included when starting the first level, and is included in Figure 6.4. Including these instructions was done towards achieving guidelines 1 and 2 in making the controls simple and the goals easily understandable. Making the first level a training level is also a step in the direction of making the game easy in the beginning as per guideline 3.

The snails and flowers in the levels are placed randomly in the level which contributes to making achieving the goal uncertain in guideline 6. The levels are intentionally short in accordance to guideline 7, and the number of snails and flowers are adjusted to make the game harder in higher levels. The rate of which the difficulty increases was tested during the creation of the prototype and was adjusted in order to try and find an appropriate level. These actions were taken to try to fulfil guidelines 4 and 5. If an appropriate level is found, the player should have to concentrate which would mean that guideline 14 is included.

By making the levels short but increasingly more difficult, the player has a chance to improve to conform with guideline 8. One way of making the levels harder are introducing new snails with more hitpoints in higher levels. Money

Figure 6.4: Screenshot from the hi-fi prototype the instructions modal window of the first level.
and experience are given for finishing levels and killing snails respectively. They are both part in implementing guidelines 9 and 11, by rewarding the player for achieving goals and giving multiple rewards. This can also work towards guideline 12, making the player experience continual progress. The random placement of game elements affect the player’s chances of completing the level. This is especially true in the higher levels. Despite this, the player is always complimented on completing the level. The compliment despite the element of luck is done towards including guideline 13, making the player believe they can affect the outcome. Lives are lost by losing a level. This was done to try to implement guideline 16, make the player wait. This functionality was not implemented fully since the short user tests meant that there was no time for them to wait for more lives.

Modal windows are shown after the player has played a level, with different modals showing depending on whether the player completed the level or not. Both modals shown after a level is played serve the purpose of making it easy to continue playing, trying to follow guideline 10. Together with giving the player rewards, this tries to create a compulsion loop in the player. If the player completed the level, the rewards given are shown in the modal. Showing the rewards is a means of implementing guideline 11 with multiple rewards given. The player is also shown a compliment for completing the level to give positive feedback according to guideline 9. When the players lose they are instead shown that they lost a life and an encouraging text.

The continuous testing of the different versions of the hi-fi prototype led to many changes in the game, included game elements and the behaviour of various components. The placement of the different world and level buttons was changed following comments from the tests. Vibrations were also added, first when the player was attacking a snail but later also when snails took a bite from the flower. These changes were made since the tests showed that no feedback was given for these actions, meaning that the player did not understand what was happening. Later, bars representing the number of hit points the flowers and snails could take in an effort to make these actions even more clear.

Tests also led to comments about the missing music and sound effects in early versions of the hi-fi prototype. Based on this, background music was added to the menu system. Different sounds were also recorded to further stress various happenings in the game. Together with the Compentus employees, sounds were recorded, edited and included in the game. Audio was recorded for the senior moving, the senior hitting the snail and the snail dying. Inspired by the sounds in Angry Birds, laughter was recorded to play after winning or losing a level. When the player finishes a level, a laugh supposedly coming from the senior is played. If the level is lost a different laughter is played which instead is meant to come from the snails.

Creating an optimal difficulty level throughout the game was seen as an important part in the prototype and meant that many different versions of levels with varying amounts of flowers and snails were tested. The difficulty levels of
the alternative snail with more hit points and the boss were adjusted according
to tests, together with the number of snails and flowers. Finally, many fine
adjustments were made regarding the perspective of the game and the size of
the game board.

6.5 User testing

After the final game prototype had been implemented, a user test of the proto-
type was performed. The goals of the user test was to evaluate the prototype,
how well its design lives up to the established guidelines and if it can poten-
tially create an addiction. The user test was designed to be qualitative but
also includes quantitative elements in a usability questionnaire and a short sur-
vey. Testing the prototype on potential end users represents the final step in
the design process used in this study, which is to collect feedback from field
use.

Qualitative studies use direct observation to collect information about behaviour
and attitudes. This is opposed to quantitative studies which gather information
indirectly via surveys or other analytical tools. [53] The study performed in
this project followed Nielsen’s guidelines for effective user testing [54] meaning
that five test participants were chosen. Choosing five participants also should
identify most usability problems. [46] The qualitative component of the test
consisted of observing the participants while playing the game and interviewing
them afterwards.

The participants in the study were chosen to include the main target audi-
ences and also get a different perspective. The target audiences are explained
in Chapter 6.4. Based on this, two users were included from the primary target
audience (between ages 18-35). Two other users were chosen from the secondary
target audience (aged 65+). Finally, a user not included in the two target au-
diences were chosen. This meant that the user test participants had varying
backgrounds and experiences. Even though the game has defined target audi-
ences, a broad user base is beneficial for the success of a game. Based on this,
the user test participants were chosen to identify the major usability problems
and to evaluate the addictive components for as many users as possible while
still focusing on the target audiences.

While the participants were playing, they were asked to think out loud as ex-
plained in the Instructions section (Chapter 6.5.1). While playing the game,
the users were also asked questions about game components, their meaning and
functionality. This is included in Chapter 6.5.2 and the results are combined
with the Interview answers in Chapter 7.1.3. When the participants had fin-
ished the game, they were then interviewed which is described in the Interview
section (Chapter 6.5.3). The final step of the user tests consisted of filling out
a survey about addiction and a usability questionnaire.
6.5. User testing

6.5.1 Instructions

The users were recorded using QuickTime\(^5\) and all tests took place in a separate room with only the test participant and test administrator present. All test participants were also asked for consent before the recording started. Before playing the game, the participants were given a short introduction to the project and told that the game they were about to play was only a prototype. As such, the participants were told that unexpected behaviour may occur and everything may not work as expected. The users were also told that they were about to play a game. They were instructed to use the Think Aloud method\([46]\) while playing. The Think Aloud method means that the user is asked to continuously think out loud by verbalising their thoughts. By doing this, the user’s misunderstandings are exposed and can be documented. While playing the game, the users were also asked questions to increase the amount of information given. The questions asked about components in the game were not asked immediately when a user experienced something new but rather after having been shown the component a few times without commenting on it. This was done to give the user a chance to notice the element before being asked about it.

6.5.2 Playing the game

The test participants were first instructed to walk through all menu views in the game to have seen the entire game. All participants were also asked about the different buttons in the game and what effect they would have. Similarly the users were asked about the various icons and their meanings. This was done to test the understandability of the different buttons and icons. On the settings page, the user was instructed to change the settings in order to test the simplicity of the controls. After having seen all pages in the game, the user was instructed to play the game. The game only has ten short levels and all test participants were asked to complete the game in order to maximise their exposure to the game. This was done to increase the probability of affecting the user. Like earlier, the users were asked about the meanings of the components in the modal windows before and after playing a level. When the user had finished the game, they were finally asked to navigate to the user page in order to see how many times they had died and how many snails they had killed. This concluded the game play part of the test.

6.5.3 Interview

After having played the game, the users were subjected to a short interview. Interviews can be structured, semi-structured and unstructured. Structured interviews are scripted with a determined set of questions. Semi-structured

interviews can be seen as a compromise between structured and unstructured interviews, containing both predetermined questions and a possibility to ask unscripted questions in exploration. Lastly, unstructured interviews are conversations with an agenda but without determined questions. Semi-structured interviews can lead to the detection of previously unknown issues and provide flexibility for the interviewer. [55] Because of this, a semi-structured interview was chosen.

The interview was structured around the following three questions. The questions were chosen to first get the initial reaction of the user, then make sure the user had the ability to both point out positive parts and give suggestions for improvement.

1. What did you think about the game?
2. What was good about the game?
3. What can be improved about the game?

For each answer, the user was asked to expand on their answer. This often led to short discussions and more answers given.

6.5.4 Usability questionnaire

After the interview part of the test was finished, the users were asked to fill out a usability questionnaire and a survey about the addictive factors. Here, the usability questionnaire will be presented. The survey evaluating the addictive components were included in the same form but is presented separately in Chapter 6.5.5.

This usability test was included to evaluate whether the game prototype was implemented in a simple and understandable way. A requirement for affecting the user is for the user to play the game. Testing the usability of the game, its navigation and interactions evaluates whether there is a chance for the user to experience the addictive components and perhaps become addicted.

The usability was tested using a System Usability Scale (SUS). When compared to other systems, the SUS was determined to give the most reliable result. The SUS also was the only system of those compared that asked questions about the user’s reaction to the entire system instead of just specific features. [56] The reliable results, questions about the total impression of the system and short test were the reasons behind using the SUS system to test the usability of the system.

Using the SUS system means that 10 questions are used to determine the usability of a system. All 10 questions can be seen in Appendix D and are written as statements. The questions in this system are graded on a Likert scale from 1-5, where 1 is described as strongly disagree and 5 equals strongly agree. The answers then recalculated and the usability is given on a scale from 1-100. This
6.5. User testing

is done by subtracting 1 from odd answers and subtracting the even answers from 5. All answers are then added together and multiplied by 2.5 (shifting the scale from 0-40 to 0-100) to get the final score. [57]

After investigating 500 SUS tests, Sauro [58] determined that 68 is the average score. This means that scores under 68 are below average and conversely that scores above 68 are over average. The investigation of the SUS tests also led to Sauro determining the following limits. [58]

0-51 is a failure
51-74 is acceptable
74-80.3 is good
80.3-100 is very good

These limits give an indication to where a system or product ranks in comparison to others and are used to evaluate the results of the questionnaire.

6.5.5 Survey

In the final part of the user test, the user was asked to fill out a survey. The first three questions were about age, gender and smartphone game experience. These questions aimed to determine whether the participant fit the target audience. After the initial questions, all other questions were written as statements. The survey was designed to use the same scale and layout as the SUS test since both forms were combined into one in the test in order to simplify the process for the participants. In the survey, the questions were adapted from the established guidelines. The last two questions were added to test if the game can be said to be addictive according to the definition in Chapter 1. The questions asked whether the game was fun to play and if the game made the player want to play again. These questions were added to clearly illustrate the result, however the results are based on the answers of the entire survey.
Chapter 7

Result

The results of this thesis are in three parts divided into separate chapters. The first part of the results are the design guidelines outlined in Chapter 5, developed from the addictive factors in mobile games in Chapter 4. The second part of the result is the hi-fi prototype, where results from the different prototype phases are described in Chapter 8. The prototype was both designed and implemented using the established guidelines. Finally, the hi-fi prototype was user tested including both users playing while thinking out loud, a short interview, a usability questionnaire and a survey. Only the results from the user tests are covered in this chapter since the two other parts are presented in other chapters.

7.1 User tests

This section presents the results from the user study performed using the hi-fi prototype. First, the results of the usability questionnaire are shown. Second, the survey with questions corresponding to design guidelines are given. Finally the results from playing the game using the Think aloud method and the results from the interview are presented.

7.1.1 SUS Questionnaire

The SUS questionnaire answers from the five participants resulted in a mean SUS score of 75.5, which according to the scale in Chapter 6.5.4 is classed as a good result. The results from the participants can be seen in Figure 7.1. In the figure, the senior participants are the two leftmost results. The two following results from the left are the main target audience participants, and the rightmost result is from the participants in neither target audience. The
7.1. User tests

Figure 7.1: The recalculated results from the SUS questionnaire on a scale to 100. The results first show the two participants from the secondary target audience, then two participants from the primary target audience and finally the participant from neither target audience. Included is a line at 68 indicating the average score of the SUS test.

average SUS score of 68 according to Sauro [58] is indicated by the vertical line in the chart.

7.1.2 Survey

This section presents the results from the user survey part of the user tests. Guidelines 15 and 16 were left out of the game and could as such not be tested. This means that guidelines 15 (make the game social) and 16 (make the player wait) were omitted from the survey. The survey consisted of 19 questions, where 14 corresponded to design guidelines.

The first three questions in the survey dealt with age, gender and experience with playing smartphone games. The participants were aged 27 (2), 40, 67 and 70 respectively. One participant was female and the remaining participants were male. The smartphone game experience was rated on a scale from 1 to 5, to follow the style of the SUS test and the questions corresponding to the design guidelines. Two participants answered 1, which indicated no to little experience. Two participants answered with 3, a medium amount. The final participant indicated much smartphone game experience by answering with a 5.

In the survey, the last two questions were regarding whether the game was fun
Table 7.1: The results from the questions corresponding to design guidelines in the survey.

<table>
<thead>
<tr>
<th>Design Guideline</th>
<th>Mean Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simple controls</td>
<td>2.6</td>
</tr>
<tr>
<td>“The controls of the game were simple”</td>
<td></td>
</tr>
<tr>
<td>2. Easily understandable goals</td>
<td>4.6</td>
</tr>
<tr>
<td>“It was easy to understand the goal of the game”</td>
<td></td>
</tr>
<tr>
<td>3. Easy in the beginning</td>
<td>4.8</td>
</tr>
<tr>
<td>“The first levels of the game were easy”</td>
<td></td>
</tr>
<tr>
<td>4. Become more difficult as the game goes on</td>
<td>4.8</td>
</tr>
<tr>
<td>“The levels became harder to complete as the game went on”</td>
<td></td>
</tr>
<tr>
<td>5. Become more difficult at an appropriate level</td>
<td>4.8</td>
</tr>
<tr>
<td>“The levels of the game became harder at an appropriate level”</td>
<td></td>
</tr>
<tr>
<td>6. Uncertainty of achieving the goal</td>
<td>2.8</td>
</tr>
<tr>
<td>“On each level, I knew I would be able to complete the level on the first try”</td>
<td></td>
</tr>
<tr>
<td>7. Short levels</td>
<td>4.8</td>
</tr>
<tr>
<td>“The levels were short”</td>
<td></td>
</tr>
<tr>
<td>8. Let the player improve</td>
<td>4.6</td>
</tr>
<tr>
<td>“I got better at the game the more I played”</td>
<td></td>
</tr>
<tr>
<td>9. Reward the player for achieving a goal</td>
<td>4.8</td>
</tr>
<tr>
<td>“I was rewarded for achieving a goal”</td>
<td></td>
</tr>
<tr>
<td>10. Easy to continue playing</td>
<td>5</td>
</tr>
<tr>
<td>“It was easy to continue playing”</td>
<td></td>
</tr>
<tr>
<td>11. Multiple types of rewards</td>
<td>4</td>
</tr>
<tr>
<td>“I was rewarded in multiple ways”</td>
<td></td>
</tr>
<tr>
<td>12. Continual progress</td>
<td>4.4</td>
</tr>
<tr>
<td>“I made continual progress in the game”</td>
<td></td>
</tr>
<tr>
<td>13. Make players believe they can affect the outcome</td>
<td>5</td>
</tr>
<tr>
<td>“I could affect whether I finished a level or not”</td>
<td></td>
</tr>
<tr>
<td>14. Concentrated on playing the game</td>
<td>4.8</td>
</tr>
<tr>
<td>“I was concentrated on playing the game”</td>
<td></td>
</tr>
</tbody>
</table>

to play and if the user wanted to play the game again. These questions used the same scale as the questions corresponding with the guidelines. The question on whether the game was fun to play received a mean score of 4.8. All participants answered the question on if they wanted to play the game again with 5.

The results of the questions in the survey corresponding to design guidelines are presented in Table 7.1. In the table, both the guideline and the corresponding question are included in the left column. The guideline is presented first and bolded to differentiate the guideline from the question. The question is also written as a citation to further differentiate it. In the right column, the mean value of the answers given are presented.

Most of the mean values of the answers are between 4.4 and 4.8. The only questions outside this interval are the two lowest and the two highest scores.
These scores are presented further below.

**Simple controls**

![Bar chart showing user test participants' answers on whether the controls were easy.](image1)

**Uncertainty of achieving the goal**

![Bar chart showing user test participants' answers on whether they knew they would finish the level on the first try.](image2)

**Easy to continue playing**

![Bar chart showing user test participants' answers on whether it was easy to continue.](image3)
Make players believe they can affect the outcome

![Histogram showing participant answers on whether they could affect if they finished the level.](image)

Figure 7.5: User test participants’ answers on whether they could affect if they finished the level.

### 7.1.3 Think aloud and interview

In this section, the results from the observed play test and following interview are presented. These results combine the comments during playing and thinking out loud with the following interview. The positive comments are presented initially. Then, the suggested improvements are depicted. Finally, nine major design issues with the game are presented in more detail.

The participants of the test all commented on some positive aspects of the game. All users found the game fun to play, and one user commented that the difficulty of the game was good. Two others said that the goal was easy to understand. The game was also called intuitive by one participant, which was interpreted to mean the goal of the game as the game progressed. The laughter by the senior character after finishing a level was said to be a positive reward by all but one participants. A participant also said that the game awakened a competitive instinct. Another participant felt that it was easy to understand what to do in the game and two mentioned it being fun to kill snails.

The user test participants also gave suggestions for improvements. All but one of the participants mentioned that the game could be improved by adding animations and making the movements of the characters more clear. One participant said that the game could be improved by adding more levels, and another that instructions were needed to understand the purpose of the flowers. The graphics were also mentioned by three participants as a possible area of improvement. One user gave the suggestion of removing the bugs of the game, having experienced a bug where the modal window after completing a level did not show. It was also suggested that the delay after attacking a snail should be removed, mainly because the user felt that there was no feedback given on the purpose of the delay.
Seniors - understanding the language

The senior participants did not understand English well enough to understand the language used in the game. Texts in the game then had to be translated for the participants to understand. This means that launching a game in Sweden with seniors as a target audience should be translated to Swedish before launch.

Modal windows

When navigating, some participants had difficulty understanding the boundaries of the modal windows. One senior tried to press the level 10-button since it was the largest, even though the area outside the modal was faded and the button was partially hidden. This shows that the modal windows used in the game had unclear boundaries and did not well enough hide elements that could not be interacted with.

World buttons on world view page

Users did not understand the world buttons on the world view page. It was unclear to the users that the game contained different worlds and that pressing a button would lead to one of them. All users instead believed that the button would lead directly to a level of the game.

Changing settings

When on the settings view and trying to change the settings, all users had difficulty interacting with the controls. The participants in the test had problems with both understanding how to change the values and actually changing them. It was also unclear what some settings did, mainly the sounds effects volume setting. A final version of the game should have improved interaction with the controls in the settings view. Better explanations of the settings should also be included.

User page

None of the users understood the purpose of the user page. This was to be expected since the user page only was a placeholder with preliminary information. The workshop outlined future plans for this page but the current implementation only shows information about number of deaths and number of snails killed. Improvement is needed on this page with relevant information and functionality to make the purpose more clear.

Controlling the character

Most users had problems controlling the character. The feedback was not clear on the delay when the character was either walking or attacking, meaning that the users tried to interact with the character when they could not. Senior participants in the test also had problems controlling the direction of the movements. Three participants also used two hands to control the character even though the game was designed to be possible to play with one hand. The poor results of controlling the character means that the interactions and character movement needs much improvement.
Rewards
Only two participants understood the meaning of money, lives and stars (representing points or experience). The seniors missed the rewards until they were asked about them, and then could not understand their function or purpose. These kinds of rewards seem to require experience playing games to understand. Improvement is needed in order to make the players understand the rewards they receive. Part of this may also be that the rewards served no purpose in the prototype since they cannot be used for anything in the game.

The flowers
All test users had problems understanding the flowers and their function in the game. One user believed the flowers could be collected and most tried to use the character to walk on them. Most only realised after being told that the flowers could not be walked on. The users did also not understand that the snails were meant to take bites of the flowers, perhaps because the animations for this were missing. Further improvements are needed to make the flowers, their function and their behaviour more understandable.

Different types of snails
Two users noticed the differently coloured snails on level 5, and only one of them guessed that they would be harder to kill than the first snails encountered. The difference in appearance between the two snails of the same size seems to be too small for the users to notice. The bar that indicates the life of the snails and flowers also seems to need improvement in order to make it clear how many hits they can take. All users did however understand the boss, which also was bigger in addition to differently coloured.
Chapter 8

Prototypes

This chapter presents the results from the different prototype stages. The prototype development consisted of three separate prototypes: a paper prototype, a lo-fi prototype and a hi-fi prototype.

8.1 Paper prototype

This final paper prototype contained six different views. Three of the views can be seen in Figure 8.1. The first view, to the left in the figure, shows a Compentus logo screen. The logo screen was identified as a common component in games in the competitive analysis. It was included to make the game seem more authentic. The middle view is an example of a loading screen which also

![Figure 8.1: First three views of the final paper prototype, which was the first prototype of the game. Included from the left are company logo, loading screen and choose character views.](image-url)
8.1. Paper prototype

Figure 8.2: The last three views of the final paper prototype. Here, a worlds view, an example of a world and an example of a level are included.

existed in most games tested. To the right is a view for selecting which senior to play as.

Figure 8.2 shows the remaining three views. The leftmost view shows an example of a page where the player chooses a world to play. The middle view in the bottom shows different levels, and the view to the right is a first example of what a level should look like.

(a) Company logo view  (b) Choose character view  (c) Worlds view

Figure 8.3: Screenshots from the lo-fi prototype showing three views: a company logo view, choose character view and worlds view.
8.2 Lo-fi prototype

The lo-fi prototype starts with a company logo screen in order to include a start point for the users. The loading screen was not included in the prototype to remove an unnecessary step in the navigation. Clicking the company logo screen led to the choose character-view. From here, the user could navigate to the user view, the settings view and the world view. The user view button was placed in the lower left corner of the screen wherever it was present. The settings button was placed on the lower right, and the Play-button in the top middle part of the screen led to the world view. The company logo view, choose character view and worlds view can be seen in Figure 8.3.

The user view, worlds view and settings view included a back button in the top left corner to navigate to the previous view. Earlier versions used different buttons in different views to tests whether to use a closable modal window for certain views. One example of this can be seen in Chapter 6.4.2. It was determined that it was preferable to use consistent navigation for all views which meant that all views in the menu system uses the back button in the final prototype. The user view and settings view are portrayed in Figure 8.4.

The worlds view, world 1 view and settings view contains a top bar to test the appearance and evaluate icon and text locations. From the worlds view, it is possible to navigate to the first world by clicking the image placeholder over the number 1. Similarly, the world 1 view contains a image placeholder over a number 1 that leads to the level view. The worlds view and level view can be seen in Figure 8.5.

![Figure 8.4: Screenshots from the lo-fi prototype showing two views: a user view and settings view.](image)
8.3 Hi-fi prototype

This section presents the final version of the hi-fi prototype implemented in Unity. This was also the version used in the user tests.

Figure 8.5: Screenshots from the lo-fi prototype showing two views: a world 1 view and level view.

Figure 8.6: Screenshots from the hi-fi prototype showing two views: the company logo view and the loading screen view.
8.3.1 Company logo and loading screen

The two first views of the final prototype are the company logo and loading screen placeholder views. Both views are included to try to give the player an increased impression of a finished game. These views are included in Figure 8.6. In the game, the company logo fades both in and out before showing the loading screen. The loading screen also fades in but does not fade out. Instead, it changes the view to the worlds view. The loading screen also starts the background music added in the game to increase the immersion.

8.3.2 Menu system

The worlds view is the first view where the user can interact with the game. This view can be regarded as the base view, since all navigation in the game starts from here. The worlds view and the world 1 view are included in Figure 8.7. All the views in the menu system (the worlds, world 1, user and settings views) have one bar at the top and one at the bottom. The top bar contains information about the player’s money, lives and points or experience.

![Figure 8.7: Screenshots from the hi-fi prototype showing two views: the worlds view and the world 1 view.](image)

The bottom bar contains two buttons - a user button and a settings button. The user button navigates the user to the user view, and the settings button to the settings view. Navigating to the user or settings view disables the respective button. Both the user and the settings view are shown in Figure 8.8. The numbers reflecting number of deaths and number of snails killed are updated when playing the game. In a similar manner, the settings in the settings page are also interactive and can be changed.

Only the top button of the world buttons in the worlds view can be pressed,
8.3. Hi-fi prototype

Figure 8.8: Screenshots from the hi-fi prototype showing two views: the user view and the settings view.

and this button leads to the world 1 view. In world 1 the buttons represent levels and only buttons before and at the current level can be pressed. When pressing a level button, a modal window appears. These modals are shown in Chapter 8.3.3.

8.3.3 Modal windows

In the game, modal windows are used when pressing a level button in order to start playing a level. Modals are also shown after a level, with different

Figure 8.9: Screenshots from the hi-fi prototype showing three modals: the level modal, the level cleared modal and the player died modal.
modal windows appearing depending on whether the player finished the level. All modals in the menu system are shown in Figure 8.9. The modal shown before playing a level contains information about how many snails and of which kind are in the level. They also show how many flowers there are and that the player will be rewarded with money if the level is completed. Money will only be rewarded the first time a player finishes a level. At the top right corner, there is a close modal button if the player does not want to play the level. A large, green play-button is placed in the bottom of the modal.

The play-button is changed and coloured blue regardless of whether the player completed the level or not. The button is changed to a continue-button if the level is finished and a retry-button if the player lost.

### 8.3.4 Gameplay

Pressing a level button in world 1 shows the play level modal window. After pressing the play-button in this modal the player is navigated to the corresponding level. A level of the game is shown in Figure 8.10. All levels have the same layout and perspective. The game takes place in a garden (outside a retirement home in world 1) which is seen from above at an angle. The player is represented by a senior character in the game which moves in the garden. The garden is walled on all sides and limits the movement of both the player and eventual snails.

The controls of the game were designed to be simple and possible to use with one hand, as mentioned in Chapter 7.1. To move, the player swipes in the direction to move in. The game board making up the garden consists of discrete squares which the player, a snail or a flower can occupy. Only one of these can occupy a square at the time. Levels are won by killing all snails before all flowers are

![Figure 8.10: Screenshot from the hi-fi prototype showing level 2 in the game.](image-url)
8.3. Hi-fi prototype

eaten. If all flowers are eaten before all snails are killed the player loses. The first level is a training level and only consists of one snail and no flowers. All other levels are made up of a different number of snails and flowers. On levels 5 and 10, new types of snails are introduces which can be seen in Figure 8.11.

(a) New enemy with more hitpoints

(b) Boss on level 10

Figure 8.11: Screenshots from the hi-fi prototype showing an additional enemy and the final boss.
Chapter 9

Discussion

This thesis had two main goals. The first of which was to investigate and identify addictive components in smartphone games. The second was to use these components in order to create an addictive proof of concept smartphone game prototype. The subgoals determined in the project were:

- Investigate what components in smartphone games that creates an addiction
- Use the identified components to develop guidelines of how to make a smartphone game addictive
- Create a prototype of an addictive smartphone game using the established guidelines
- Evaluate how well the prototype uses the guidelines and if it creates an addiction

The first subgoal was investigating and identifying addictive smartphone game components. This was done by performing a literature study and reading a number of scientific articles, books, newspaper articles and blog posts. After performing the literature study, a theoretical framework was established. The addictive components were then summarised into eight different areas - simplicity, challenge, reward, achievement, control, social, escape and explore. Researching the area came with some challenges since specific addictive components in smartphone games had not been scientifically studied. The studies made in the area mainly focused on negative effects of smartphone game addiction or predictive psychological reasons for addiction. This meant that the theoretical framework had to be expanded to include studies about human behaviour, persuasive design, motivating factors in games and motivations for playing games. Specific components then had to be identified using newspaper articles and blog posts and motivated with the theoretical framework. The sources used in the theoretical framework were chosen since they were recurring
9.1 Limitations

in studies about addiction and seemed to have gotten some scientific consensus. However, defining the theoretical framework differently may have changed the results. It is still believed that results would be similar but perhaps changing some of the components. Central components like simple controls, challenge and reward are recurring in most of the material available and would most likely be included in other similar studies.

The second subgoal was to use the identified components to develop guidelines for making an addictive smartphone game. This meant that the areas of addictive components were further condensed by identifying specific components. The addictive component areas were outlined in Chapter 4. The sources other than the theoretical framework used in this chapter often identified specific components which made developing guidelines relatively easy. When summarising the addictive components, 16 guidelines were established for making a smartphone game addictive.

Third of the subgoals was to use the guidelines to create an addictive smartphone game prototype. The work was complicated by being restricted to using the game idea without a clear interaction model or definition of how the goals of the game would be achieved. Performing a similar project could be made simpler by using a very simple interaction model as a base for the game and expanding features as the project progressed, based on user tests and time available. Much time in the project was spent on developing an intuitive interaction model and making the goals of the game clear. Despite this, simple controls was still the guideline with the lowest result and all test participants had some problems with controlling the character. This result may have been improved with a simpler game idea and better defined interaction model.

The final subgoal of the project was to evaluate the prototype. An evaluation was made by observing test participants playing the game while thinking out loud. While playing, the participants were asked about specific game components, their meaning and their purpose. The test participants also filled out a usability questionnaire and a survey with questions corresponding to the 16 guidelines. The prototype had some problems, some bugs became apparent during the tests and the interactions were not optimal. Test scores of the prototype regarding both usability and the addictive components were however mainly good. Despite suggestions and some problems, the implementation is only a prototype and the evaluation is seen as positive overall.

9.1 Limitations

The limitation set in the beginning of developing a game for an iPhone using Unity proved to be a big part of the limitation of the project. Having never used Unity before, it was quickly learned that Unity is a powerful tool if you know how to use it. The many possibilities meant that tutorials were either
specific to a small project or very general. This made it hard to learn from the material available and meant that much had to be adapted or created without guidance.

Another complication of using Unity for the first time was knowing the limitations and possibilities of the program when implementing the game mechanics and user interaction components. The ideas from the workshop and the following discussions throughout the process were difficult to evaluate based on how hard they were to implement. The interaction model also required much tests to improve and still did not reach a positive result in the survey.

Time was also a big part of limiting the project. Creating a smartphone game can take years for experienced teams of game developers. In this project, a single person was tasked with trying to create as close to a functioning game as possible. This meant that large parts of the game were very rudimentary and there was little time to design the various aspects of the game such as menu elements or the sound components of the game. Much work is needed in all parts of the game for it to become a viable product. The amount of work needed to create a complete game meant that aspects like animations had to be excluded. These excluded elements could have a big effect on the user experience and contribute to different results.

9.2 Future work

There is much work that can be done in the area of smartphone addiction. Firstly, smartphone addiction has mainly not been recognised as a disease. The amount of research made in the area does however seem suggest that there can be some negative effects from playing smartphone games too much. This makes it a potentially ethical question of whether it is acceptable to identify addictive components in smartphone games as they in the future potentially could be used to create a diagnosable addiction with negative consequences. Further research is needed in the area in order to be able to correctly classify smartphone addiction and its effects.

In the area of identifying addictive components of smartphone games, no existing research was found meaning that much work can be done in the area. By using a different theoretical framework or a differently scoped project, new or different results could be found which could contribute to identifying more addictive components.

Finally, it would be interesting to use the established guidelines to evaluate existing and future games on the market. Using the survey which was used in this project to evaluate other games could give insights on how well the guidelines are implemented. Such tests could also give a further evaluation of the accuracy of the guidelines and if more components exist.
Chapter 10

Conclusions

The goals of this thesis were to identify addictive smartphone game components and use these to create a prototype of an addictive smartphone game. Addiction was defined in this project as “creating an experience that is fun and enjoyable enough to make the user want to return”. Based on the results of this project, it can be concluded that such an experience can be created.

One step in achieving the goals of the project was to establish 16 guidelines for creating an addictive smartphone game. These guidelines were developed by using the theoretical framework combined with newspaper articles and blog posts about smartphone addiction. Of these guidelines, only 14 were included in the game. From the included guidelines, only the first guideline (simple controls) received a bad score. Guideline 6 also received a score of under 3, meaning that the users disagreed with the statement. This guideline did however correspond to uncertainty of achieving the goal. The way the statement was written, the user should disagree with the statement to fulfil the guideline.

The scope of the project meant that the game was said to be addictive if it implemented the guidelines and managed to create an addiction as defined in this project. Based on the evaluation, 13 out of 14 guidelines were successfully implemented. In the survey performed in the user study, the statement "The game was fun to play” got an average score of 4.8 where 5 equalled strongly agree. On the same scale, the statement "I want to play the game again” received a mean of 5. The usability test of the prototype also received an average score of 75.5 which according to the included scale is a good result.

The guidelines were implemented successfully, the questions in the survey on whether the users thought the game was fun to play and wanted to play again received high scores and the usability scores were high. Based on these results, it can be concluded that addictive components were successfully identified and implemented in a smartphone game prototype. Thus, the goals of the project were achieved.
Chapter 11

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Bibliography


Appendix A

DSM-5 criteria for substance use disorder

1. Neglect of responsibilities
2. Use despite physical risks
3. Use despite psychosocial problems
4. Development of tolerance
5. Withdrawal symptoms
6. Reduced control
7. Compulsive use
8. Great deal of time spent in obtaining the substance or activity
9. Neglect of other activities
10. Use despite knowledge about negative consequences
11. Craving
Appendix B

DSM-5 criteria for pathological gambling

1. A preoccupation with gambling (e.g., preoccupation with reliving past gambling experiences, handicapping or thinking of ways to get money with which to gamble)

2. A need to gamble with increasing amounts of money in order to achieve the desired level of excitement

3. Repeated, unsuccessful efforts to control, cut back or stop gambling

4. Feels restless or irritable when attempting to cut down or stop gambling (withdrawal symptoms)

5. Uses gambling as a way of escaping from problems or of relieving a dysphoric mood (e.g., feelings of hopelessness, guilt, anxiety and depression)

6. After losing money gambling, often returns another day to get even (“chasing” one’s losses)

7. Lies to family members, therapist or others to conceal the extent of one’s involvement with gambling

8. Has committed illegal acts such as forgery, fraud, theft or embezzlement to finance gambling

9. Has jeopardized or lost a significant relationship, job or educational or career opportunity because of gambling

10. Relies on others to provide money to relieve a desperate financial situation caused by gambling
Appendix C

ICD-10 criteria for alcohol dependence

1. A strong desire or compulsion to drink
2. Tolerance
3. Withdrawal
4. Loss of control
5. Progressive neglect of alternative activities
6. Persistent drinking despite evidence of harm
Appendix D

SUS questionnaire questions

1. I think that I would like to use this system frequently
2. I found the system unnecessarily complex
3. I thought the system was easy to use
4. I think that I would need the support of a technical person to be able to use this system
5. I found the various functions in this system were well integrated
6. I thought there was too much inconsistency in this system
7. I would imagine that most people would learn to use this system very quickly
8. I found the system very cumbersome to use
9. I felt very confident using the system
10. I needed to learn a lot of things before I could get going with this system
Appendix E

User test survey responses

Age

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Figure E.1: User test participants’ age.

Gender

Gender (5 responses)

- Male
- Female
- Other/Prefer not to disclose

Figure E.2: User test participants’ gender.
Smartphone game experience

Figure E.3: User test participants' smartphone game experience.

Simple controls

Figure E.4: User test participants' answers on whether the controls were easy.

Easily understandable goals

Figure E.5: User test participants' answers on whether the goals were easy to understand.

Easy in the beginning
Figure E.6: User test participants’ answers on whether the levels were easy in the beginning.

Get harder as the game goes on

Figure E.7: User test participants’ answers on whether the levels got harder as the game progressed.

Get harder at an appropriate level

Figure E.8: User test participants’ answers on whether the levels got harder at an appropriate level.

Uncertainty of achieving the goal
On each level, I knew I would be able to complete the level on the first try

Figure E.9: User test participants’ answers on whether they knew they would finish the level on the first try.

Short levels

The levels were short

Figure E.10: User test participants’ answers on whether the levels were perceived to be short.

Let the player improve

I got better at the game the more I played

Figure E.11: User test participants’ answers on whether they got better at the game the more they played.
Reward the player for achieving a goal

Figure E.12: User test participants’ answers on whether they received a reward after achieving a goal.

Easy to continue playing

Figure E.13: User test participants’ answers on whether it was easy to continue.

Multiple types of rewards

Figure E.14: User test participants’ answers on whether they were rewarded in multiple ways.
Continual progress

![Bar chart showing user test participants' answers on whether they made continual progress.]

Figure E.15: User test participants’ answers on whether they made continual progress.

Make players believe they can affect the outcome

![Bar chart showing user test participants' answers on whether they could affect if they finished the level.]

Figure E.16: User test participants’ answers on whether they could affect if they finished the level.
Concentrated on playing the game

![Distribution of responses for being concentrated on playing the game]

Figure E.17: User test participants’ answers on whether they were concentrated on playing the game.

The game was fun to play

![Distribution of responses for the game being fun to play]

Figure E.18: User test participants’ answers on whether the game was fun to play.
I want to play the game again

Figure E.19: User test participants’ answers on whether they want to play the game again.