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SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

**APPLYING PERSUASIVE SYSTEM DESIGN MODEL TO THE
TRANSTHEORETICAL MODEL OF BEHAVIOUR CHANGE**

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AUTHORSHIP STATEMENT

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LIST OF ABBREVIATIONS

HCI – Human-Computer Interaction
PSD – Persuasion System Design
TTM – Transtheoretical Model
UI – User Interface
UX – User Experience

INTRODUCTION

In today's era of rapid technological development, smartphones have become an omnipresent attribute of our daily lives. They have become a tool that offers new ways of creating, accessing, and sharing information. As a result, numerous applications are being developed that influence our daily lives. Oinas-Kukkonen and Harjumaa (2009) refer to this phenomenon as technology that is "always on" and influences people's attitudes and behaviour in one way or another.

People are constantly being exposed to technology in their day-to-day life. Furthermore, technology creators have taken advantage of this and keep developing information technology systems to change users' attitudes and behaviour. Fogg (2002) refers to this with the term persuasive technology and defines persuasion "as an attempt to change attitudes or behaviours or both" by implying voluntary change. As such, persuasion is a key element in attitude change.

Persuasive technology is a trend that has been well-established in the domain of human-computer interaction design which denotes use of computer technology, focused on the interfaces between people and computers. Persuasive systems are defined as "computerized software or information systems designed to reinforce, change or shape attitude or behaviours without using coercion or deception" (Fogg, 2002). To that end, comprehensive framework for the purposes of designing and evaluating systems was developed, termed persuasive system design (hereafter: PSD) model, laid out by Oinas-Kukkonen, Kukkonen and Harjumaa (2009) as an extension of Fogg's model. PSD model identifies three potential successful outcomes: 1) voluntary reinforcement, 2) change or shaping attitudes and 3) change or shaping of behaviours. Every goal may imply the use of differing persuasion strategies and techniques. When developing persuasive systems there are three steps to keep in mind. Firstly, it is crucial to understand key issues behind persuasive system, secondly, the context of persuasive system needs to be analysed, meaning we understand the intent, event, and strategies, and lastly to design system qualities. There are four categories this latter step consists of; primary task support, dialogue support, credibility support and social support. Each category has its own strategies used in order to capture people's motivation and persuasion when interacting with technology. The purpose is to understand what strategies have the greatest influence on the user's behaviour change.

Persuasive technology revolves around observing humans' interaction with computers and studying how to design technology that allows people to communicate in a new way. This highlights the need to incorporate the psychology of human behaviour in building persuasive technology in a way that intervention strategies are designed around psychological and social theories. Many works in psychology focus on how human behaviour can be shaped and influenced, however there is still a gap between designing persuasive technology and considering behaviour change theories. Although, there has been some consideration given to applying some of the most promising behavioural change theories to the study of

persuasive technologies, many scholars have pointed out the need to employ behaviour change theories to inform their persuasive design as well as to illustrate how the theories are linked to design features. Based on the systematic review (Orji & Moffatt, 2018) it was identified that approximately 74 percent of research did not put in use any behaviour theories when designing persuasive systems. However, among employed theories the transtheoretical model (hereafter: TTM) was the most frequently model used, eleven times out of 170 papers reviewed.

The TTM describes five stages of change through which the individuals progress when exhibiting new behaviour: precontemplation, contemplation, preparation, action, and maintenance. Each stage is characterized by different intervention strategies that are most effective for the individual to progress and reach the ideal stage of behaviour - maintenance phase (Ferron & Massa, 2013). The TTM addresses behavioural change as a dynamic and sequential process as well as nonlinear progression, meaning that the user can also regress from later stages to earlier ones, or remain in the same stage for a long period of time. Thus, the purpose behind the TTM is to tailor to specific stages by using activities that support progression through the stages and techniques to build self-efficacy and avoid temptation. Enabling behaviour change to be consistent and longstanding is an open challenge, consequently, combining it with persuasive design opens a whole new field of opportunities.

The purpose of this thesis is to combine two theoretical models – the persuasive system design and the transtheoretical model in order to identify which persuasive interventions work best for the user to progress through different stages of the TTM. As previous research shows, the persuasive technology field lacks integration of behaviour theory, thus examining how to incorporate persuasive components into behavioural change model will positively contribute to this field. This will enable designers and developers to understand what strategies make digital products appealing for the users. In addition, this thesis can be used as a reference for those who intend to develop further or improve applications which aim at behavioural change of users.

The thesis aims at filling the gap between persuasion system design and behavioural theory. The goal of the theoretical section is to provide a background overview of the transtheoretical model and persuasive system design. As a result of the literature review, I will first identify factors that influence individual progression through the stages of the TTM. Secondly, I will develop a framework of design intervention strategies, based on the PSD, that might work best at a particular stage of the TTM and which could support user progress through the different TTM stages.

To that end the following research question and two sub-questions are formulated:

How to use the PSD to support individual stages of the TTM?

1. Which stages of the TTM could benefit the most from the PSD?

2. Which elements of the PSD can be applied in a particular (identified from the previous question) stage of the TTM and how can we use them designing persuasive technology?

By answering the research question the thesis aims to provide insights and recommendations for future design persuasive interventions that consider the transtheoretical model of change by addressing individual stages of changes with specific design interventions.

This master's thesis consists of two major parts, the theoretical (first three chapters) and the empirical part (last two chapters). In the first chapter I review the work related to persuasive technology and explain the term digital persuasion, its evolvement through history and provide detailed PSD model overview. Chapter two discusses theoretical constructs around psychology of behaviour and outlines the TTM model of change. Chapter three combines the main findings of both previous chapters. Based on the literature review in the first two chapters I have mapped concrete system feature PSD elements onto specific stages of change. This resulted in proposing a framework which outlines how the PSD model could support individual progression through the stages of change. Then, I continue with the empirical part, where the main goal was to verify if the proposed framework is suitable for designing persuasive systems. The empirical part includes the description of research methods, results, main findings, and updated framework that considers insights from conducted interviews. Finally, the thesis concludes with the theoretical contributions, practical implications, limitations, and suggestions for further research.

1 PERSUASIVE TECHNOLOGY

1.1 Digital persuasion

Fogg (2002, p. 15) defines persuasion “as an attempt to change attitudes or behaviours or both (without using coercion or deception).” Gass & Seiter (2010, p. 33) add that persuasion “can attempt to influence a person’s beliefs, attitudes, intentions, motivations, or behaviours.” In general, persuasion denotes influencing one’s beliefs towards an idea by using different tools or communication approach to convey feelings or messages. In his definition of persuasion Fogg emphasizes that persuasion does not include coercion nor deception. Furthermore, he made a clear distinction between all three terms. Unlike coercion and deception, persuasion implies voluntary change. On the other hand, coercion implies force and deception refers to misinformation and reporting false emergencies.

Persuasion can take place on two levels, macro and micro. Macrosuasion is sometimes the sole reason that products exist. Microsuasion on the other hand, does not have the overall intent to persuade, but the interaction might result in achieving smaller overall goals, for instance, dialogue boxes, reminders, icons or offering a reward for completing small tasks.

To understand the nature of persuasive technology it is critical to point out that persuasion

does not include unintended outcomes, but designers focus solely on creating intended behaviour changes. Ideally, persuasion should bring the user to abandon some habits and adopt another. However, there are three possible outcomes: reinforcement, change and shape. The first one is about making the existing attitudes more resistant to change, the second response replaces attitudes with others and the last one refers to formulating a pattern when a situation does not exist beforehand (Oinas-kukkonen & Harjumaa, 2008a). Some examples of planned effects might be persuading people to buy things online, reminding people to drink more water and motivating people to take stretch breaks after extended periods of desk work. Planned effects could be achieved either by a direct or an indirect strategy. A direct route occurs when a person is evaluating the content of the persuader, whereas an indirect strategy takes place when a person is less thoughtful and uses heuristics, a mental shortcut, to enable decision-making.

Persuasion occurs only when a person reaches one of the outcomes and behaviour change takes place. In order for this to happen, we need to understand how the information process evolves. The basic elements of persuasion are the persuadee, who is an information receiver, the message and the persuader, the source where the message comes from. Other important elements are also dependent variables which can be manipulated; those are presentation, attention, comprehension, yielding, retention, behaviour. Firstly, the persuadee must pay attention to the idea presented, followed by comprehension, yielding, retention and lastly, the deciding element of behaviour. If the persuader reaches the last phase, then the persuasion process can be marked as successful (Oinas-kukkonen & Harjumaa, 2008b).

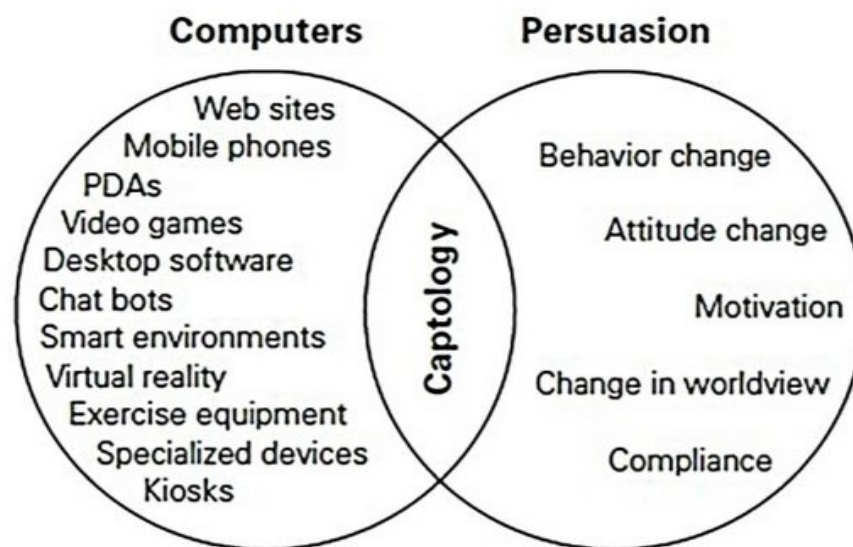
The term persuasive technology was coined by B. J. Fogg and it incorporates the same idea as persuasion as a standalone term. Fogg (2002, p. 1) defines persuasive technology “as an interactive computing system designed to change people’s attitudes or behaviour.” In a broader sense, persuasive technology incorporates insights from psychology into the design of digital products, such as mobile apps, websites, or wearables. The purpose behind it is to modify or change the individual’s behaviour. With that in mind, behavioural science has evolved into a crucial aspect to consider when designing products, especially as computers became part of our daily routine. In short, persuasive technology refers to interactive information technology developed for changing the user’s behaviour.

Persuasive technology firstly appeared in the 1970s and 1980s when a few software systems were developed to promote health and increase workplace productivity (Fogg, 2002). However, the real interest for digital persuasion can be traced back to 1992 when Fogg identified the opportunities in the future of information design, specifically in creating artefacts and interactive computing products to persuade people. Fogg (2002, p. 1) explains the phenomenon of digital persuasion with the following definition: “as computers have migrated from research labs onto desktops and into everyday life, they have become more persuasive by design. Today computers are taking on a variety of roles as persuaders, including roles of influence that traditionally were filled by teachers, coaches, clergy, therapists, doctors, and salespeople, among others.” At its core, persuasion is human

communication designed to influence someone's actions. Then, with new technological advances, Fogg has developed an additional idea that not only human communication, but also the interaction between human and computer can be persuasive.

Fogg started with examining how computer system can be created to change people's attitude and denoted them Charismatic Computers. His vision was to outline a new domain termed captology which explores the overlapping space between persuasion in general and computing technology, as shown in Figure 1 below. To elaborate, Fogg (2002, p. 5) described the term captology as one that focuses on “design, research, and analysis of interactive computing products created for the purpose of changing people's attitudes or behaviours.”

Figure 1: Captology illustrated



Source: Fogg (2002).

The traditional concept of persuasion was already incorporated before the 1970s with traditional media. Billboards, printed ads, or other static content are just a few examples of traditional persuasion. The reason why digital persuasion draws more attention than the traditional one, is the characteristic that makes digital persuasive technology unique – interactivity, which in digital world can be accomplished between the persuader and the target of persuasion. Software systems can interact dynamically with the target, in contrast with the traditional persuasive system where the content is static. Interactivity is the characteristic that gives digital technology a strong advantage over the traditional media. Furthermore, persuasion techniques are most effective when they are interactive, when persuaders adjust their influence tactics as the situation evolves. The biggest advantage of persuasive technologies is the capacity for content adjustment and tailoring its approaches based on user inputs, needs and situations. Traditional media cannot consider users' input and consequently provide dynamic content and tailored approach according to users' needs.

With the rapid technology development computers have become part of our daily routine and have consequently automatically become persuasive due to their nature of design. Different software systems from websites to productivity applications are enhanced with incorporating motivating and influencing elements while designing computer systems. Moreover, today's computers are replacing a variety of roles that were traditionally accomplished by teachers, salespeople, therapists, and doctors, to name a few. With this in mind, the field persuasive technology concentrates on creating beneficial experiences from the user's perspective, meaning that systems are developed to help people change their behaviour in the ways they want to. Although the potential of persuasive technology for using it for social good is huge, we still need to acknowledge that it can also be used in unethical ways in an attempt to change individual's behaviour. There is no doubt that potential for abusing such technology is vast, but by educating people and understanding the core concepts of persuasive technology we might get a more knowledgeable and more thoughtful society that is less prone to negative persuasion techniques. However, this thesis will focus only on the positive and ethical applications of persuasive technology.

1.2 Persuasive system design model

Designing persuasive technology is not an easy process to follow, thus it requires numerous techniques and strategies to ensure its success. In his book Fogg (2002) introduced the functional triad as a framework that highlights the roles of computing products and makes it easier to design persuasive systems. The functional triad shows that computers can operate in three ways: as tools, as media and as social actors. These functions describe how people use or respond to different types of products and are usually mixed to achieve the best possible outcome. Firstly, computers can take a role of social actors by creating relationships, rewarding users with positive feedback, and providing social support. Secondly, computers as a medium provide experience that motivates and helps people practice a behaviour. Lastly, computers can serve as tools by increasing capability, hence making activities easier to do, leading people through the process and perform calculations that motivate the user towards achieving a target behaviour. Fogg describes a persuasive technology tool as an interactive product designed to change behaviour by making desired outcomes easier to achieve. Furthermore, he identifies the following seven types of tools: reduction, tunnelling, tailoring, suggestion, self-monitoring, surveillance, and conditioning. Persuasive systems usually incorporate two or more strategies to achieve a target behaviour.

Functional triad framework captured praise as well as critique points that later lead to improvements. As argued by Oinas-Kukkonen, the key framework disadvantage is the limited possibility of strategies to be directly applied when designing persuasive systems. To address that Oinas-Kukkonen and Harjumaa (2009) built upon Fogg's model and proposed a new framework named the model of Persuasive System Design (PSD). It is comprised out of three core elements: 7 postulates behind persuasive systems, 3 ways to analyse the context and 28 design principles, whose foundations have been adopted and

modified from Fogg's model. Nevertheless, they reject conditioning and surveillance as acceptable strategies, from ethical reasons, but add three additional strategies; personalization, simulation, and rehearsal. Design principles are categorized by the type of support that they aim to provide to users: primary task support, dialogue support, system credibility support and social support.

As already mentioned above, PSD consists of three key steps; firstly, to understand the assumptions behind persuasive systems, secondly to analyse the context and lastly to draw out design principles. In the following paragraphs, I will focus on describing each step in more detail.

1.2.1 Persuasive system postulates

In the first phase of persuasive system development, it is crucial to understand the fundamental basis behind it. The PSD's postulates are standards used to meet non-functional software requirements. Oinas-kukkonen, Harjumaa and Oinas-kukkonen (2009) list seven assumptions that need to be addressed:

1. Information technology is never neutral.
2. People like their views about the world to be organized and consistent.
3. Direct and indirect routes are key persuasion strategies.
4. Persuasion is often incremental.
5. Persuasion through persuasive system should always be open.
6. Persuasive system should aim at unobtrusiveness.
7. Persuasive system should aim at being both useful and easy to use.

The first postulate means that technology is "always on", thus it is constantly influencing people's attitudes. Technology became incorporated in our daily routines, which results in influencing our behaviour in one way or another, as well as shrinks our capacity to be aware of the effects that technology has on us. Hence, the never-ending connection has persuaded us intentionally or unintentionally.

The second postulate is based on the idea that people like to be consistent with the things done in the past. Commitment and consistency originate from Cialdini's persuasion principles and describe people's desire to appear consistent in their behaviour (Cialdini, 2009). Hence, if the system supports making commitment a target behaviour the user is more likely to be motivated to use it. Cognitive consistency is an important psychological principle guiding behaviour formation and human judgement. Human beings strive for internal consistency to function mentally in the real world. Besides, coping with nuances of contradictory ideas is mentally stressful and requires energy. If a person has a contradictory belief and participates in an action that goes against them then psychological stress will follow. Therefore, the aim of the persuasive system should be to reduce such inconsistencies. For example, if the user has an interest in doing exercise and the systems helps him commit

by sending a reminder of the scheduled exercise time, the user is more likely to stick to his goals.

The third postulate describes the approach to addressing people. There are two ways of doing that - the direct and the indirect route. The former expresses the idea of approaching people who have knowledge, while the latter can be used with less thoughtful people by using cues or stereotypes. When cues appear, heuristics, also termed as cognitive shortcuts, are triggered, which leads to an important idea of how a user's background and experiences have an influence on their information processing. For example, if a person is lacking the knowledge about content being pursued, they are less likely to commit to it. On the other hand, if a person is knowledgeable, they will have high motivation and the ability to commit.

The fourth postulate states that persuasion is often incremental. To that end, the system should enable the making of gradual steps toward the target behaviour and encourage users to start with small steps and later progress to bigger steps (Mathew, 2005). If a user wants to start exercising, the system should allow them to move slowly but steadily, thus making them more confident and more likely to progress toward their goal, rather than forcing them to do everything at once.

The fifth postulate implies that the system's mission should be clear to the user. Revealing designer bias is important, so that the user is not misled by the information. More importantly, false or untruthful content does not go in line with ethical principles and users' voluntarily changing attitude.

The sixth postulate follows the principle of unobtrusiveness. In other words, the persuasive system should avoid disturbing the user while performing their primary task. It is also equally important to consider the state or situation that the user is currently in, for instance, if the system suggests a user to exercise while being sick, this might lead to an undesirable outcome.

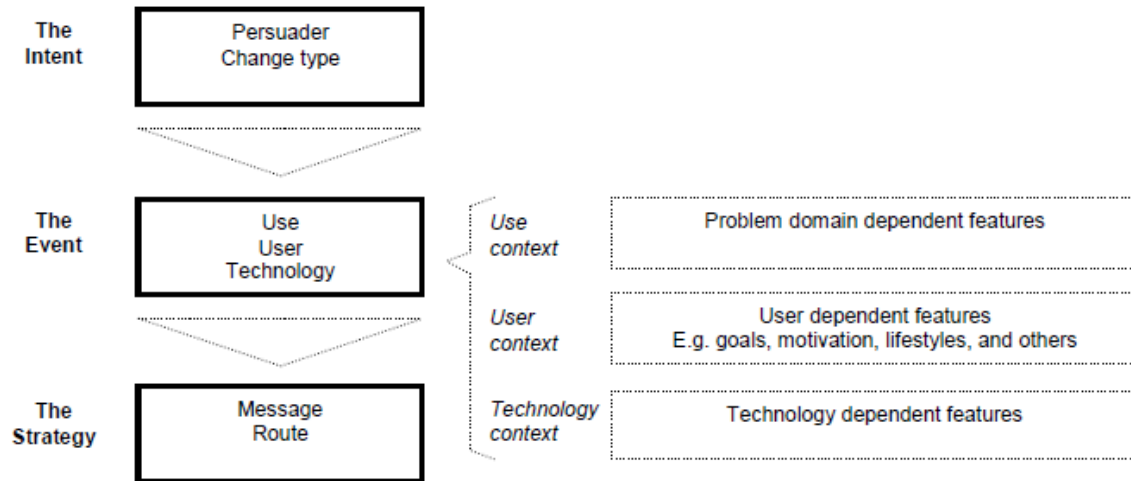
The last postulate encourages system designers to follow the principles of usability and easibility. It goes without saying that complicated and difficult systems will not capture the user's attention. The components that make a system useful and easy to use are responsiveness, lack of errors, high information quality, ease of access, convenience, good user experience and attractiveness. The mentioned components are not only persuasive systems requirements, but also other software systems that aim to provide easy and useful user experience.

1.2.2 Persuasion context

The second phase highlights the need to analyse the context that can either be an intent, an event, or a strategy. The context itself describes the situation within which something happens, and it is crucial for the issue to be situated in the context before we can understand

it. Hence, the persuasion context is used to consider conditions where persuasion takes place, and it is a crucial step to firstly understand and later to promote behaviour change. The persuasion context of the PSD model is presented in Figure 2.

Figure 2: Analysing the persuasion context



Source: Oinas-Kukkonen & Harjumaa (2009).

It starts with identifying the intent which includes the persuader and the change type. Persuaders decide on system components and can either be endogenous – creators of interactive technology who should always focus on users’ voluntariness toward behaviour change, exogenous – those who give access to others and whose main goal is to provide methods for personalization, and autogenous – individuals that use the interactive technology and where the emphasis should be on rewarding user experience (Fogg, 1998). The change type denotes that there are two main types of changes, behaviour change and attitude change, thus we need to clarify whether the persuasion aims at one, another or both. Attitude change usually involves changes in the mind’s predisposition to certain ideas, while behaviour change relates to the changes in actual expression of feelings and action. Attitude is usually directed by behaviour and may be the most difficult to achieve. However, persuasive systems can affect users’ attitude first if they are not inclined to a certain behaviour.

The next step is to understand the event which analyses the context of use, the user context and the technology context. Use context refers to problem domain factors that are addressed by the system. It concentrates on the question of what information is relevant to a user in a given situation. User context on the other hand, refers to individual factors, such as motivations, goals, needs, interests, and other different types of personality elements. People differ from each other, some have high need for cognition, others low, which results in different information processing. In addition, those differences should be taken into consideration when designing persuasion strategies. For example, people in need for higher cognition will more likely follow the direct route to persuasion. Another essential point to

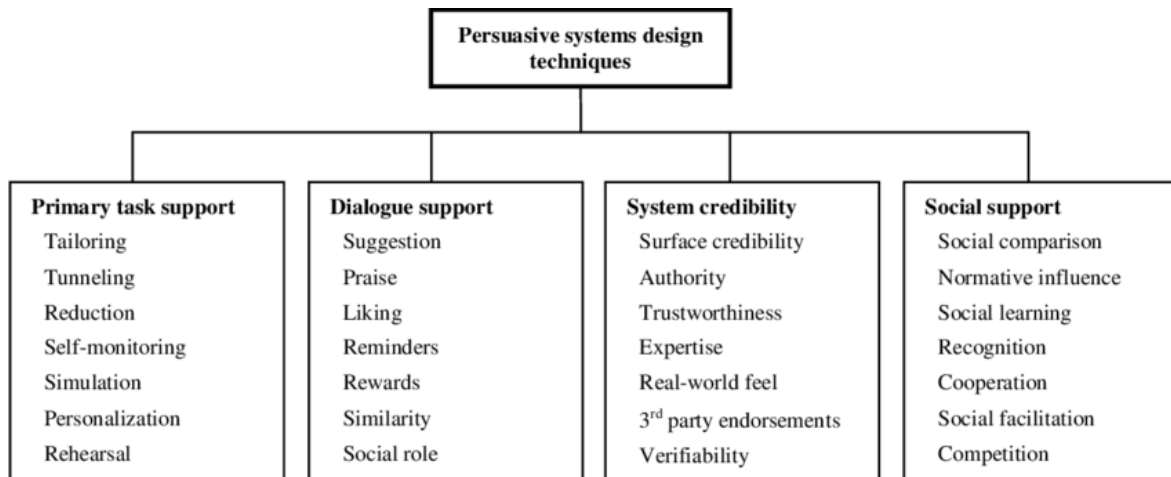
consider is the understanding of the theory behind user's goal. Setting goals leads to higher commitment and performance level, hence the persuasive system should encourage users to set goals and help them achieve it. The technology context specifies the use of technology. Due to the unique characteristics of a specific platform type, available device or application software holds, it is important to consider the technological context within which persuasion will take place (Halttu, Oduor, Tikka & Oinas-Kukkonen, 2015).

The last step of analysing persuasion context is to examine the strategy which includes the need to identify the route and message. It asks two main questions: what message the persuader wants to convey and what is the proper route of persuasion to reach the target. The route can either be direct or indirect. The former is less argumentative, usually used for users with better knowledge, while the latter involves facts and numbers to be applied for those with less interest or knowledge. Both processes might act simultaneously. However, the system designer needs to keep in mind that living in the era of information results in the user being more inclined to using indirect cues or stereotypes to evaluate the information.

1.2.3 Design of system features

The final stage of the PSD framework is divided into four categories: primary task support, which is built upon Fogg's seven persuasive tools, dialogue support, system credibility and social support. In each category various techniques for designing actual features, content and functionality are defined, so the artefact ends up being more persuasive. Firstly, primary task support is based on design elements that supports the primary goal of intervention for the end user. It includes the following principles: reduction, tunnelling, personalization, self-monitoring, tailoring, simulation and rehearsal. Secondly, dialogue support focuses on design elements that allow interactivity with users in the form of feedback through rewards, reminders, suggestions, praise, liking, similarity, or social role. Thirdly, system credibility describes elements focused on making the system trustworthy and credible for the users. Those elements are trustworthiness, expertise, surface credibility, authority, real-world feel, third-party endorsements, and verifiability. Lastly, social support represents principles that leverage social influences, such as social facilitation, social comparison, cooperation, normative influence, social learning, competition, and recognition. In the following paragraphs I will describe each category in more detail. The whole third step of the PSD model, design of system features is shown in Figure 3.

Figure 3: Design of system features



Source: Oinas-Kukkonen & Harjuma (2009).

Primary task support

As already mentioned above, the principles under the primary task support are reduction, tunnelling, personalization, self-monitoring, tailoring, simulation, and rehearsal.

The principle of reduction suggests the need of persuading through simplifying by reducing complex behaviour and translating it into simple tasks to achieve that users perform the target behaviour. The main goal is to reduce effort and friction that might discourage the user from performing the end goal (Fogg, 2002). Users do not like barriers, therefore, if they struggle with getting something done, they will not finish it. In the field of user experience (UX) there is a term that holds the same idea as reduction principle, named as learnability and it refers to how easy it is for the user to learn the product and its features. Each task should be designed in a way that it takes the complexity out, so that the user is able to perform the task with ease. According to Muhammad Ahsan Pervaiz (2020), there are four ways to improve learnability and reduce complex activity:

1. Making controls discoverable (e.g., big buttons)
2. Incorporating notifications in order to help the user if they encounter difficulties (e.g., are unable to send e-mail, so the system might offer them tutorial video)
3. Applying user on-boarding strategy (e.g., welcome screens)
4. Using familiar patterns for logins (e.g., social logins such as Facebook or Google)

An example of reduction strategy is one-click shopping experience. With one click of a mouse, the items you purchase are billed automatically, packed up and shipped off. Another example is a mobile application for calorie counting – MyFitnessPal, that lists food items coupled with the sum of calories, which allows users to keep the daily record of calorie intake with just few clicks. In addition, making the behaviour easier to perform increases a person’s motivation to engage in the behaviour more frequently, increase one’s self-efficacy

or an individual's belief in their ability to perform a specific behaviour. Consequently, the user feels more confident and has a more positive attitude towards a specific behaviour.

The Tunnelling technique refers to step by step guided persuasion. In other words, guiding users through a process provides opportunities to persuade along the way. When the user enters the tunnel, they are exposed to activities and information that otherwise would not come to their attention.

An example of tunnelling is registration to a website, where, for instance, a site could lead individuals through a set of questions to identify specific characteristics that later enable offering other related services or products.

Tailoring represents persuasion through customization. In other words, it is based on the idea that information provided by the system will be more persuasive if it is tailored to the potential needs, interest, personality, usage context or other factors relevant to a user group. In its core, the principle is about providing relevant information in order for the user to change their behaviour.

Web shops offer a wide range of tailoring, for example, suggesting additional items for customers to buy, based on previous shopping carts, history of viewed products or other gathered information. These recommendations are usually named "You might also like", "Customers who bought this item, also bought", "Frequently bought together" and so on.

One step further would be to provide contextual tailoring, which means taking information from other databases and provide it to people in different situations. However, adding contextualized information would require providing additional data, such as user location, identifying the task they are currently performing, determining whether they are in a company or alone, whether they are in a rush or at leisure and how they are feeling in the moment.

Personalization is a type of a strategy that offers personalized content or services that provide greater effectiveness for persuasion. In broader terms it means the same as customization and it refers to tailoring specific products or features in order to accommodate specific users. The user should always be in control and personalization is addressing this requirement by giving the option to change and configure, which gives them the feeling of satisfaction and being in charge. There is personalization all around us, but to name just a few examples, iPhone settings are personalized, the user can change a setting to meet their need. Basically, everything we interact with is customizable, for instance, screen brightness, audio levels of Youtube player, light and dark themes of applications, and so on.

Self-monitoring depicts the strategy of keeping track of one's own performance or status that supports the user in achieving goals. The key benefit is that self-monitoring allows users to monitor themselves and consequently to modify their behaviour to reach a desired goal. Letting people know how they perform in certain actions impacts their intrinsic motivation

by fuelling natural human drive for self-understanding. Besides, getting feedback increases the likelihood of maintaining a certain behaviour. A well-known example of a self-monitoring system is a heart rate monitor that allows the user to adapt their exercise according to the target heart rate. Another one is the step counter that can nowadays be found in almost every mobile phone.

Simulation refers to providing ways for immediate observation of the relationship between the cause and its effect regarding user behaviour. The strategy basically imitates the operation of a certain process that shows its operation over time. Suppose a user wants to lose weight. They might be a lot more motivated if they see the before and after pictures of a transformation and that is one simple example of simulation.

Rehearsal is focused on providing methods with which users can practice a behaviour that can enable them to change their attitudes or behaviour in specific situations. In simple terms, it represents a session of exercise in preparation for rehearsing the target behaviour. An example of this strategy is the flying simulator that enables a pilot to practice for different weather conditions.

Dialogue support

The second category of design of system features is dialogue support, which describes feedback that encourages people to move towards a behaviour. In every interaction the user should know what has just happened, what is the system doing, whether something was a success. For instance, mobile phones always inform us of a low battery. Generally speaking, different forms of feedback exist, such as movement, sharp colours, and (error) sounds, that can be combined in order to really capture the user's attention. The principles generally relate to the implementation of the human- computer interaction in a way that helps the user reach end goals. Dialogue support consists of seven principles: praise, rewards, reminders, liking, suggestion, similarity, and social role.

Praise should be offered by a system in order to make a person more open to persuasion. It can be provided via words, images, symbols, or sounds. For example, a mobile application that aims at motivating a person to exercise might praise the user by sending congratulations notes for reaching individual goals.

The Rewards technique focuses on rewarding target behaviour. That way, a person is more likely to achieve their end goal. Giving credit to a user for performing the target behaviour might result in the user being more motivated and determined to perform the behaviour more often. A concept worth mentioning regarding the rewards technique is gamification, which, in short, refers to the integration of game elements and game design techniques into a non-game context or a (business) process. When it comes to the psychology of rewards, gamification might be a great way to keep users motivated for performing a certain behaviour. Today, many systems include gamification elements, for example Strava, a sport mobile application, gives users a virtual trophy when they achieve a certain amount of

kilometres cycled. Games also use rewards to keep users in the playing loop by, for example, changing the characteristic of their main character.

Reminders aim at pointing something out in order for the user not to forget to engage in the system. If the system reminds the user of his target behaviour, they will be more likely to achieve their goal. Almost every application sends daily reminder to users for using the app and thus, engage in the target behaviour. A calorie tracker app reminder might be sending texts to its users saying not to forget to log in their daily calorie intake (Lee, Tsai, Griswold, Raab & Patrick, 2006).

Suggestion focuses on offering the right suggestion at the right time. Moreover, it is argued that the system will have a greater persuasive power if it offers behaviour suggestions at opportune moments. However, finding the right moment to present your message is not as easy as it sounds. The field of psychology recognizes some characteristics that define the right moment for persuasion. People are more open to persuasion when they are in a good mood, when they can immediately act or when they change their outlook on the world. Additionally, it is important to consider other elements as well, such as physical setting, social context, and transient disposition (mood, feelings of self-worth) of the user being persuaded. The suggestion strategy might appear in macrosuasion or microsuation. The suggestion strategy can be found in the real world with a computer suggesting you to update your software system, a mobile application suggesting you to exercise today, or even in the physical world, with speed monitoring radars displaying the car speed reminding the driver of the speed limit and giving them a chance to reevaluate their driving behaviour if they drive too fast.

Similarity refers to the idea that a system should imitate its users in a specific way. If the system in some way or another shares the same characteristics or features as the user, consequently the system reminds them of it which results in greater persuasive power. For instance, a system that aims at encouraging teenagers to exercise is more effective when using slang names (Toscos, Faber, An & Gandhi, 2006).

Liking suggests that a system should be visually attractive to its users. People are visual and emotional beings. Not only we are wired to use good-looking product, but also, we perceive them as better functioning, which is a result of people being irrational and responding with emotions. Our first impression is formed without any rational thinking. In other words, we judge on physical appearance. Furthermore, attractive things are more likely to cause positive reactions because of how our brain works, thus designers should ensure the creation of appealing systems. For example, a website that is trying to promote the idea of children taking care of their pets will be more effective if it includes cute animal pictures.

The last principle of dialogue support is the social role which describes the importance of a system adopting a social role. Systems can provide this functionality via a virtual assistant that is already present today as chat bots. The point is that the user needs to they are not

alone and that they can always reach out for help. For instance, an e-health application can support its customers by offering them a virtual specialist to support communication between customers and health specialists (Silva, Zamarripa, Moran, Tentori & Galicia, 2006).

System credibility

The third category of system design features, named system credibility, aims at designing credible, trustworthy, and thus more persuasive systems. The principles that fall under this category are trustworthiness, expertise, surface credibility, authority, real-world feel, third-party endorsements and verifiability.

Trustworthiness is achieved by providing unbiased, truthful, and fair information. Following this principle increases the power of persuasion. For example, mobile apps offer insight to users on who they are, what their purpose is, what they provide, their business model, management team, etc. In brief, by reading this information the user quickly understands the brand. Such information is usually located in the “About” section, which introduces the business to the public.

Expertise is recognized by the user by incorporating information that shows knowledge, experience, and competence. An example of this principle is a mobile app that is developed based on a scientific literature review. Also, a system should keep its core knowledge base, avoid out-of-date information, and update regularly.

Surface credibility covers the importance of a system having a competent look and feel. People judge things by initial assessment; hence designers should not underestimate the power of the first impression and should therefore aim at providing attractiveness at the first encounter. For example, a system should not be overloaded with ads, especially ones taken out of context. There should always be a logical reason behind displaying certain ads.

Real-world feel highlights the need for a system to provide behind the scenes information, meaning that the system might enjoy more credibility if actual information about the people and organization behind the content is shown. This principle can be achieved by providing possibility to directly contact specific people through sending feedback or asking questions.

Authority states that a system should contain reference to people in the role of authority. By showcasing praise from roles of authority the system’s power of persuasion will increase and the system will gain the users’ trust with more ease. An example of implementing this principle is gathering quotes of important market players, government people, industry leaders or well-known and respected CEOs, which are later published on the website.

The Third-party endorsements principle aims at providing endorsements from well-known and respected sources in order to boost perceptions of system credibility. For example, an ecommerce shows a logo of certification, issued by a respectful organization that deals with assuring secure connections. Also, a system could refer to its specific rewards that it received

for outstanding characteristic and features.

Verifiability should provide methods to verify the accuracy of the site content via outside sources. The system will gain more credibility if users are able to test or check the accuracy of the system's correctness. For example, if a website claims or features certain facts and content, it should offer referral links that confirm and support the claims, as well.

Social support

The last category named social support describes how a system should motivate users by leveraging social influence. The principles in this category are the following: social facilitation, social comparison, cooperation, normative influence, social learning, competition, recognition.

Social learning states that a system should provide ways to observe other users who are performing their target behaviours and view the outcome of their behaviour. If a person can observe others performing the behaviour, they will be more motivated for reaching their goal. For example, fitness mobile applications could encourage physical activity and healthy lifestyle by providing a shared fitness journal (Consolvo, Everitt, Smith & Landay, 2006).

Social comparison holds the idea of users having more motivation to achieve their goals if given a chance to compare their performance with the performance of other users. For example, nowadays, almost all fitness applications allow their users to share their success via social media or messaging applications. Hence, users can compare themselves to other members of the fitness crowd. This can result in the user being more driven to achieve goals and improve their abilities.

The Normative influence aims at providing ways to bring together the people who have the same goal and get them to feel the norms. By exploiting peer pressure, a system increases the likelihood of making a person adopt a target behaviour. For example, if the system's purpose is to encourage people to stop smoking, the feature to challenge friends either via email or text messages should be implemented.

Social facilitation states that users are more likely to perform the target behaviour if they have the possibility to identify other users who are performing the behaviour along with them. For example, for the users in a gym community it may be encouraging to see how many people are exercising at the same time as them.

Cooperation should provide methods for co-operation. Users could have greater motivation for adopting target behaviour if the system allows them to work and act together for a common benefit. For example, in order to better understand behavioural patterns of overweight people, a mobile application might collect data and send it to a central server, where it can be analysed at the group level in more detail (Lee, Tsai, Griswold, Raab & Patrick, 2006).

The Competition principle should aim at providing ways for users to compete with each other. Humans could be motivated to adopt a target behaviour by their natural drive to compete. For example, when a group of people is trying to quit smoking, organizing an online competition might be an appropriate strategy to encourage users to stop smoking and win a prize.

Recognition states that by users offering public recognition, a system can increase the likelihood of users adopting the target behaviour. Acknowledging users or public appreciation is a great motivating factor for achieving the desired outcome. For example, the winner of the month can be featured, or personal stories of people succeeding in their behaviour change can be published on website.

1.3 Application areas of persuasive technology

PSD framework has been applied in many areas of human interaction design (HCI), especially in domains such as public health, energy saving, green mobility, sales, diplomacy, politics, religion, and management. In general, designers of persuasive technology are aiming to address specific challenges within certain areas, for example obesity, alcoholism, internet addiction, environmental issues and learning disabilities. To illustrate that, healthcare software applications might be developed either to encourage people towards healthy behaviour (Consolvo, Landay & McDonald, 2009; Jafarinami, Forlizzi, Hurst & Zimmerman, 2005; Lin, Mamykina, Lindtner Delajoux & Strub, no date; Maitland et al., 2006; Dantzig, Geleijnse & Halteren, 2013) or to manage and prevent diseases and health conditions (Intille, 2003; (Kraft, Drozd & Olsen, 2009). Furthermore, persuasive systems within environmental conservation have the potential to provide effective solutions aiming to support sustainable energy and water consumption behaviour (Kappel & Grechenig, 2009; Kuznetsov & Paulos, 2010; Elsmore, Wilson, Jones & Eslambolchilar, 2010). In the same way, the PSD model can be applied in green mobility initiatives and smart city solutions (Jylhä, Nurmi, Sirén, Hemminki & Jacucci, 2013; Meloni & di Teulada, 2015). Persuasive systems can also be used in education in assisting the learning process as a support for pedagogical activities or as a tool to persuade users in general education activities (Dewi, Widyasari, Nugroho & Permanasari 2019).

The shared common goal of all systems, regardless the area of application, is either to motivate people to acquire new knowledge, to encourage individuals to engage in more knowledge sharing, or to continue with a particular activity (Fogg, 2002). In general, persuasive systems have the potential in every field, facing different kinds of challenges and aiming for behavioural change to achieve the common good in society. Hence, persuasive systems that could help resolve even small parts of today's challenges and help in long-term sustainable change would bring considerable added value.

Despite many applications where the PSD has been implemented, it has received some critiques (Wiafe, Alhammad, Nakata & Gulliver, 2012; Corbett, 2013) for being too general

and not providing precise guidelines for engineers and designer on how to actually implement the described principles. As an interesting response to bridge the gap between the PSD and design practice has been introduced by Ren, Lu, Oinas-kukkonen and Brombacher (2017), Perswedo, a card-based tool that supports creative design flows by expanding the concept development and more precise design and feature requirement coupled with concrete examples. Since the PSD evolves around observing humans and their interaction with computers, integrating behavioural theories and PSD might be another attempt to provide easier understanding and thus, concrete guidelines for designing such systems. An example of Perswedo card is shown in Figure 4.

Figure 4: A Perswedo Card from Social support category



Source: Ren, Lu, Oinas-kukkonen & Brombacher (2017).

2 PSYCHOLOGY OF BEHAVIOUR

2.1 Behaviour

There is no common agreement among psychologist on how to precisely define behaviour. Some define behaviour as “anything that an organism does”, (Davis, 1966, p. 2; Lehner, 1996, p. 8; Pierce & Cheney, 2004, p. 1), others, in terms of any activity in which an organism engages (Donahoe & Palmer, 1994, p. 3; Watson & Brown, 2011, p. 221; Jessor, 1958, p. 172–173; Maturana, 1995, p. 151–152), then again others “as a process of an inner entity bringing about a bodily movement or environmental outcome” (Dretske, 1988, p. 1). Building on these definitions, a broad and simple interpretation is that behaviour is the response of an individual to its environment, it is every action that person does in response to external or internal stimuli. Essentially, behaviour is any observable movement that includes physical or verbal activity made by individual or group (Lazzeri, 2014).

Human behaviour is a complex phenomenon. It is driven by factors, such as thoughts, feelings, beliefs, values, and other psychological traits that are unique to each individual and on the other hand by many other factors such as environment, social norms, religion, attitude, weather, and others. The number of factors influencing human behaviour is enormous, thus studying human behaviour does not only include the science of psychology but also social science, economics, and anthropology.

A crucial aspect of human behaviour is a habit, which denotes the routine of regularly repeated behaviour that usually occurs subconsciously. According to the American Journal of Psychology, a habit is defined as a “more or less fixed way of thinking, willing or feeling acquired through previous repetition of a mental experience.” Thus, habitual behaviour tends to occur unnoticed, because performing routine tasks usually does not require a person’s engagement in self-analysis. Duhigg (2014) defines habit as a formula our brain automatically follows. It consists of a three-step loop: cue, routine and rewards. First, we need to see a cue, which refers to a trigger suggesting your brain to switch on the automatic mode that tells you which habit to use. This is followed by a routine, that can either be psychical, mental, or emotional. Finally, there is a reward, which can range from causing physical sensations or emotional payoffs. Habits influence how people work, eat, play, live, spend, and communicate, hence, forming good habits is crucial for living our lives to the fullest. However, bad habits such as smoking or binge eating indeed exist and even though people are aware of them, and know exactly what strategies they should use to change the habitual behaviour, they still struggle.

People often face a gap between their intentions and their actions. Findings that have been made in the field of behavioural science importantly contribute to explaining why humans behave the way we do. According to Wendel (2020) the following lessons include core fundamentals of behavioural science:

- As human beings we are limited in attention, time, energy, willpower etc.
- Our behaviour is shaped by two minds: conscious and nonconscious.
- Due to limitations, human beings economize, meaning we use shortcuts to make quick decisions.
- Context is everything, thus, our decisions are deeply affected by the situation we are in.
- To improve people’s decision making a designer can intelligently and thoughtfully design a context.

When it comes to behavioural design, the above mentioned behavioural lessons should be considered similarly as postulates behind the PSD. They highlight the basic requirements that should be taken into consideration when designing systems for behaviour change. Even though people have good and ambitious intentions, they struggle to turn them into actions. So, the first step towards designing persuasive system is not only to understand the PSD, but to figure out how human minds work and how decisions are made. Only then are we equipped with knowledge that helps us intervene in the decision-making process with the

right technique and right interventions for a particular target group and situation. To get better insights into behavioural science, the next chapter will discuss behavioural theories and at the end focus on one of them – the transtheoretical model of behavioural change – which is the model I have used for my research purposes.

2.2 Behavioural theories

To study human behaviour and more so, to understand the complexity of it and thus, to help people change destructive behavioural patterns, many theories have emerged. Each theory illustrates behaviour and behaviour change from particular perspectives and includes different constructs to influence a desired behaviour. Hence, they are categorized by different determinants affecting and influencing behaviour, different evaluation strategies for measuring effectiveness, and different design interventions.

The term behavioural theories refers to the social-psychological theory of behaviour change, which emerged even before the age internet and technology. Behavioural theories are used for understanding and predicting certain behaviour. Moreover, they play a crucial role in increasing the effectiveness of designing different types of interventions and have been used as a guide for targeting behaviour such as lifestyle habits, chronic disease self-management, coping with mental health symptoms, and health service utilization.

The main purpose behind behavioural change is to change the actions of people. To achieve that, first step is to translate behavioural theory framework into a specific context or population, followed by the application of specific behavioural change techniques (Wang, Fadhil, Lange & Reiterer, no date). The most frequently used behavioural theories are the social cognitive theory (SCT), the transtheoretical model of change (TTM), the health belief model (HBM), the theory of planned behaviour (TPB) and the goal-setting theory (GST). Since I will use the TTM as a foundation to build a framework that combines stages of change and the PSD stage-matched interventions, I will commit the next chapter to describing it in detail, but for now, I will briefly describe other mentioned theories.

The Social cognitive theory states that behaviour is determined by an individuals' social context and is influenced by personal, behavioural, and environmental factors. The key element of this theory is self-efficacy, which illustrates the individual's confidence in their own ability to perform a behaviour and is influenced by the person's intellectual and physical capabilities, experience, perceptions of their environment and social context. Self-efficacy also represents key application of social cognitive theory and it represents an important construct in the TTM as well. Digital interventions that could support behaviour change should focus on growing self-efficacy by doing social modelling, applying mastery experience, improving physical and emotional states and verbal or social persuasion (Bandura, 1986).

The Health belief model focuses on individuals' beliefs and attitudes. A key predictor of

adopting new behaviour is confidence in one's ability to act. In other words, the key idea of the framework is based on perceived benefits of taking action, perceived susceptibility, perceived severity, perceived barriers to taking action, and ability to take action. Some examples of digital interventions might focus on promoting awareness about risk and benefits of unhealthy behaviour or sending reminders for engaging in target behaviour and provide coaching to grow confidence (Strecher & Rosenstock, 1997).

The Theory of planned behaviour states that key determinants of performing a behaviour are intentions, as well as attitude towards the behaviour, beliefs about how others view the behaviour and perceived behavioural control. Digital interventions should aim at using motivation strategies to support intentions as well as at skill building to grow self-efficacy (Ajzen, 1991).

The Goal setting theory explains how people respond to different types of goals and what characteristic would be the most appropriate to be more effective and motivating. It is linked to task performance, that should go along with appropriate feedback which contributes to higher task performance. Two core elements are again self-efficiency and goal commitment, which assumes individual commitment to the goal and thus, less chance to drop out of achieving the goal. A system should enable an easy way of tracking the individual's progress and providing feedback and incentives as progress is made (Locke & Latham, 2002).

Employing behaviour theories on persuasive technology is not a common practice. Research has shown that too little persuasive technology is developed and designed without any support of behaviour theories. Nevertheless, when behaviour theories are employed, the TTM appeared to be the most effective of all (Orji & Moffatt, 2018). Therefore, choosing the TTM for thesis research appeared the most effective solution.

2.3 The transtheoretical model of behavioural change

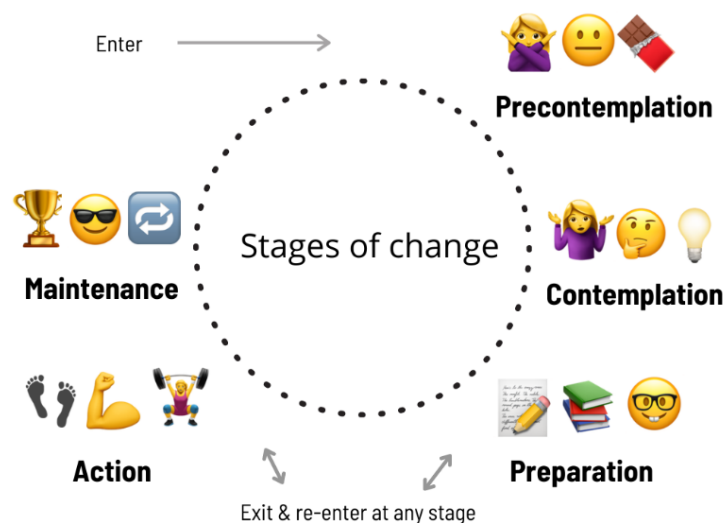
According to Prochaska & Velicer (1997), the transtheoretical model "posits that health behaviour change involves progress through six stages of change: precontemplation, contemplation, preparation, action, maintenance and termination." It describes one's readiness to act on a new desired behaviour (Norcross & Goldfried, 2005). Defined as a model of intentional change it functions on the premise that people do not change behaviour decisively and quickly, but slowly and continuously through a cyclical process. Behavioural change was often defined as an event, such as starting exercising, though change occurs over time as a progress through specific stages as individuals struggle to remove problematic behaviour. Hence, it is conceptualized as a longitudinal and dynamic process across different stages (Prochaska & Velicer, 1997).

It consists of the following constructs: stages of change, processes of change, decisional balance, self-efficacy, and temptation. The six stages of change throughout which an individual progresses over time are:

- 1) Precontemplation – no intention to change the behaviour within the next 6 months.
- 2) Contemplation – recognizing problematic behaviour and intending to change it within next 6 months.
- 3) Preparation – planning to change, already taking small actions.
- 4) Action – performing consistent behavioural change for less than 6 months.
- 5) Maintenance – successfully maintaining behavioural change for 6 months.
- 6) Termination – no temptation to relapse, high level of confidence.

The stages represent individual readiness or propensity to engage in certain a activity which might lead towards desired behaviour. The concept of stage is important as it reflects a temporal dimension in which change unfolds coupled with a set of tasks required for progressing to the next stage. Notwithstanding the different time individuals spend in each stage, the tasks to be done to progress to the next stages are equal, therefore, the stages serve as an important step for understanding certain behavioural patterns. Targeted behaviour is achieved by moving through each stage of behaviour change, hence, skipping stages is not an option as it might result in high risk for relapse (Brinthaup & Lipka, 1994). In Figure 4 stages of changes are shown.

Figure 5: Transtheoretical model of behavioural change



Source: Prochaska & Velicer (1997).

Ten processes of change have been identified for producing progress through stages of change. such as, consciousness raising, dramatic relief, self-reevaluation, environmental reevaluation, self-liberation, social liberation, counterconditioning, stimulus control, contingency management, helping relationships. The process of change includes the activities that individuals use to modify their thoughts, feelings, and behaviour and to progress through the stages. In addition, they represent important guides for designing intervention strategies (Prochaska & Velicer, 1997). Table 1 defines the processes of

changes that received most empirical support to date, adding a brief description of how to apply each process.

Table 1: Processes of change

Processes of change	Description and intervention examples
Consciousness raising	Refers to increasing awareness about the causes, consequences, and cures for problematic behaviour (e.g., education, feedback, confrontation, bibliotherapy, and media campaigns).
Dramatic relief	Focuses on increasing negative or positive emotions to encourage taking appropriate action (e.g., personal testimonies, role playing).
Self-reevaluation	Combines affective and cognitive assessment of one's self-image, with or without unhealthy behaviour (e.g., value clarification, role models). It answers the question of how a person thinks and feels about themselves. One can see themselves as a couch potato or as an active person.
Environmental reevaluation,	Combines affective and cognitive assessment of the behaviour impact on one's social environment. Identifies how the presence or absence of a specific behaviour impacts others. In other words, examines how a person thinks and feels about the effects of certain behaviour on their environment (e.g., empathy training, documentaries, family interventions).
Self-liberation	Describes the belief of one's ability to change and to (re)commit to act on that belief (e.g., New Year's resolutions).
Social liberation	Refers to the increase of healthy social opportunities, especially for deprived and oppressed people. For example, advocacy, empowerment procedures, easy access to walking paths, smoke-free zones.
Counterconditioning	Describes learning healthier behaviours that can replace unhealthy behaviour. For example, relaxation replacing alcohol or fat-free food substituting unhealthy food.
Stimulus control	Focuses on removing cues to problematic habits and adding prompts for healthier alternatives (e.g., avoidance, environmental reengineering, self-help group,
Contingency management	Implies providing consequences for taking steps in a particular direction. Relying on rewards is much more effective than relying on punishment (e.g, group recognition, contingency contracts).
Helping relationships	Illustrates open, caring and trusting support from others trying to achieve behaviour change. For example, positive social network, counsellor calls, buddy systems.

Source: Prochaska & Velicer (1997).

The model also defines other contrasts that characterise its nature. Firstly, decisional balance, which refers to individual assessment on decision benefits compared to decision downsides. In other words, someone's ability to weigh the pros and cons of changing behaviour. Secondly, self-efficacy that indicates someone's confidence to perform a behaviour and

willpower to resist temptation, consequently, to avoid relapse. Lastly, temptation, that reflects the desire to engage in a specific urge that threatens long-term goals. Emotional distress, positive social situations and cravings are the most common types of temptations (Naslund, Aschbrenner, Kim, Mchugo, Bartels & Marsch, 2017).

Research and development of the TTM initiated from smoking studies, when researchers learned that behaviour change appears through a series of stages, using different processes at different time. Later, application in other fields followed, for example alcohol and substance abuse, HIV/AIDS prevention, eating disorders, cancer screening, and so on. The TTM emerged from a comparative analysis of leading theories of psychotherapy and behaviour change. For example, consciousness raising comes from the Freudian tradition, contingency management from the Skinnerian tradition, and helping relationships from the Rogerian tradition (Prochaska & Velicer, 1997). Due to its involvement in the psychotherapy field, its constructs are mostly relying on clinical resource which later generated a need to develop different intervention programs that replace a meeting with a therapist (Lin, Mamykina, Lindtner, Delajoux & Strub, 2006). Hence, it is even more important to prosper with stage-matched interventions that are more comprehensible and simpler for people who want to change but do not want to pay for a psychotherapist. This might be another reason why combining the PSD and the TTM appears to be an adequate step towards making behaviour change more accessible and straightforward. The next chapter will focus on describing each stage and its intervention requirements that are built upon the process of change.

Stage description and interventions requirements

The importance of integrating stages that people are in and the processes of change designers are applying were among the earliest discoveries. When it comes to designing interventions there is no one-size-fits-all approach, not all people would receive the same feedback regardless the current stage of change they are in. Quite the opposite, the underlying philosophy behind the model is that in order to obtain the desired behaviour we need to provide personalized feedback according to the stage of behaviour change an individual is in (Ferron & Massa, 2013). Different processes of change need to be emphasized at different stages of change. In the early stages of behavioural change the emphasis is on applying cognitive, affective and evaluative processes, whilst in the later stages people rely on conditioning, commitments and environmental processes to progress through the stages (Prochaska & Velicer, 1997). To support people achieving the termination stage and thus, to help avoid relapsing into previous behavioural patterns, interventions should be stage-matched, which means linking the right interventions with the right stage. That way, we help the user to move through stages more effectively and thus, decrease the likelihood of relapsing into previous stages. In short, the early stages should focus on cognitive, evaluative and affective process, while the later stages that are more action-oriented, should focus on contingencies, commitments, conditioning and environmental control (Glanz, Rimer & Viswanath, 2015). Furthermore, if we translate this requirements intervention from

psychotherapy concentrated into more comprehensible way, the early stages (precontemplation, contemplation, preparation) are understanding-related while the later are doing-related (action and maintenance). This explanation was proposed by Laurillau, Calvary, Foulonneau and Villain (2016) when they introduced SEPIA (Support for Engineering Persuasive Interactive Applications), a conceptual tool that draws out a set of properties and functions required for developing persuasive systems. The SEPIA framework proposes that in the understanding-related phase user interface properties are focused on observability, intelligibility, learnability whereas in the doing-related phase properties should address protectability, accountability and maintainability. It was developed as a complementary approach to the PSD and is linked to another framework as well, for example some of SEPIA's properties may be mapped directly onto the PSD model and explained by the TTM.

Despite the TTM being a sequential process, nonlinear progress across phases is also a possible scenario. For example, an individual can return from the later stages to an earlier stage or remain in the same stage without moving forward for a long period of time (Ferron & Massa, 2013). Behaviour change is a complex and dynamic process that is characterized by different motivational levels, thus adopting an adaptive, personalized approach might be the most effective way to start encouraging users towards healthier behaviour change.

Precontemplation

When an individual is a part of the first stage named precontemplation, they have no intention to change their behaviour in the foreseeable future, usually measured with the next six months. Two different groups of people can be identified here. The first group consists of people being at this stage, because they lack information about the consequences of their behavioural pattern and are not aware of the damage a certain behaviour might cause them. They simply do not want to think about the problem. In the second group, people may have tried to move towards the desired behaviour, but have become demoralized about their abilities to change due to unsuccessful attempts to change. People in both groups avoid talking, thinking, and reading about their behaviour. Moreover, they are defensive towards the social pressure to change. Additionally, they are characterized as unmotivated, resistant, and unknowledgeable (Glanz, Rimer & Viswanath, 2015). Precontemplators devote less time and energy to reevaluating themselves, process less information about their issues and experience few emotional reactions to the negative aspects of their problem. Moreover, they do not shift their attention or environment to the direction of overcoming the problem.

Individuals are moving their decisional balance by considering and strongly thinking about whether change has more advantages or disadvantages for them. Thus, design interventions should be focused mainly on motivation building. It is suggested (Ludden & Hekkert, 2014) that the strategy should have a general and publicly available form, instead of a personal one, since the individual in this stage lacks motivation to start using a personal intervention. Raising awareness of the importance and the advantages of behavioural change should be in

the spotlight when building design interventions. This could be achieved by presenting choices in a way that influences people's decision making process and encourages them to make self-beneficial choices. In other words, intervention aims at removing stimulus control, which means removing a cue for unhealthy behaviour, and adding a hint for the desired alternative. The application of this intervention can be seen in the research work done by Lee, Kiesler and Forlizzi (2011) where they used behavioural economics strategies to persuade people to make healthy snacking choices in their workplace. They designed a robot holding two types of snacks, that made it was easier for them to pick an apple instead of a cookie. Since they made picking a cookie slightly more difficult, a cue for an unhealthy habit was removed. Moreover, by making the healthy alternative easier to pick they encourage people to act towards the desired behaviour, in this case picking an apple.

According to the TTM the first step that is necessary for someone to change is revealing the behaviour. Thus, the functionality proposed in precontemplation is observability (Laurillau, Calvary, Foulonneau & Villain, 2006). We need to make behaviour observable to make people understand their behavioural patterns. Observability is then further categorized into three functionalities: reveal, reflect, and discover. Reveal allows users to access raw data which inform about the current behavioural pattern and thus, make behaviour observable. Reflect implies making cause observable by reflecting user activity. Discover makes the correlation between the user activity and observed fact, therefore, it is easier for the user to understand the dynamics of the behaviour. By offering exploration and giving insight, observability in a way reflects the PSD's self-monitoring principle. A great example of applied observability in practice is Show-Me (Kappel & Grechenig, 2009) that makes water consumption observable through visual coloured LED display and reflects one's activity by showing a shower calendar which includes visual elements representing the amount of water consumption.

Contemplation

Individuals that reach stage two – contemplation, do have the intention to change in the next six months, but have not yet committed to take action. At this stage, they are aware of the consequences of not changing the behaviour, understand the potential benefit of changing, yet can remain in this phase longer because they focus too much on calculating the pros and cons of changing the behaviour. This overthinking and weighing between the advantages and disadvantages of behavioural change might result in ambivalence, hence, people end up being stuck at this stage too long. This phenomenon is termed chronic contemplation or behavioural procrastination (Glanz, Rimer & Viswanath, 2015). To put that into perspective, a study has shown (Brinthaup & Lipka, 1994) that a group of 200 smokers remained in the contemplation stage for two years without making any steps. Even though people are aware of the benefits that change would bring them, they are not ready for traditional action-oriented programs, thus pushing or forcing contemplators into behavioural change is not a recommended strategy. To sum up, people at this stage know where they want to go but are not quite ready yet.

Contemplators are most open to the consciousness-raising technique, for instance, observations, interpretations, confrontations and to dramatic relief experience that raises emotions. As an individual is becoming more conscious of themselves and the problem, they are more likely to reevaluate their values as well as the effect their behaviour has on their environment. In order to progress through the contemplation phase, an individual should slowly become more conscious of their undesired behaviour. Their decisional balance must shift towards a mindset that portrays behaviour change as more desirable compared to staying in current behavioural patterns. An example of addressing contemplation stage by using tailor-made interventions is the mobile application FotoFit designed for students to raise awareness about their (un)healthy lifestyle, developed by Brown, Chetty, Grimes and Harmon (2006). To achieve that, they developed a system that allows the user to journal about their eating and exercising habits. The FotoFit dashboard shows the food and exercise pictures on a timeline that has been uploaded by users. Such an overview allows users to reflect on their eating habits and exercise activity. The process of change being addressed here is self-revaluation, which denotes the assessment of one's self-image with or without a specific undesired habit. By allowing the uploading pictures of food and journaling about exercise, the system enables users to objectively review themselves and consequently raise awareness of their unhealthy behavioural patterns (Ludden & Hekkert, 2014).

To be able to move from contemplation to action people need to understand why their behaviour may be problematic. In the words of Laurillau, Calvary, Foulonneau and Villain (2016), this stage requires intelligibility property which reflects the user's comprehension of the problem phenomenon. It is further classified into situate, recommend, and explain. Situating aims at better understanding of behaviour importance, by putting the effect or situation into context, for example indicating average metrics to make better sense of the information. Recommend functionality refers to suggesting alternative behaviours. Explain means illustrating the relationship between the cause and effect in a certain situation. Intelligibility mirrors the PSD's principles of suggestion and social comparison. The Shower-Calendar (Laschke, Hassenzahl, Diefenbach & Tippkämper, 2011) brought intelligibility into practice by monitoring, comparing and then displaying water consumption over time and through that, conveying social norm.

Preparation

Preparation depicts the stage in which individuals have the intention to change their behaviour, usually in the next month. Hence, people might have already developed a plan of action, started to take actions, or made small behaviour changes, for instance, joining a health program, buying a self-help book, talking to a doctor, or reducing the number of smoked cigarettes. Preparation is not as stable as the two previous stages, rather, it is defined as a transitional one, since people intend to progress within next 30 days (Brinthaupt & Lipka, 1994). People in this stage could be introduced to action-oriented programs, such as weight loss and smoking cessation programs.

Here, interventions should aim at making the behaviour as simple as possible to perform and reengineering the environment so that it is easier for the user to make changes. Social liberation and self-liberation are change processes worth addressing at this stage as well as counterconditioning and stimulus control. Social liberation includes creating opportunities for individuals to perform the target behaviour. In other words, reengineering environment makes it easier for people to change their habits. A smoke-free zone is a great example of this type of interventions. Another great example is a salad bar, where colour coded ladles inform people what type of ingredients they can eat a lot of (green colour), in small amounts (yellow), and moderately (red) in order to prepare themselves a healthy salad.

Laurillau, Calvary, Foulonneau and Villain (2016) adds that interventions in preparation should focus on learnability, which refers to learning by experimenting. The purpose behind learnability is to simulate behaviour with experimentation to give people the opportunity to learn about the desired behaviour. Learnability consists of three functionalities: induce, deduce, and experiment. Induce allows user to generate relevant behaviours coupled with his goal, while deduce allows users to generate possible consequences. Both can be implemented as a simulation environment. Experiment allows users to evaluate inductive-deductive cycles to choose appropriate behaviour. For example, the Hydrao system (Kuznetsov & Paulos, 2010) provides a colour-based scale representing water consumption and allows its user to set the scale to reduce water consumption.

Action

After taking the first actions, individuals reach the stage of action, which means they have already exhibited the target behaviour in the last 6 months. They feel motivated for moving forward and keep performing healthier behaviour. People at this stage are actively engaged in eliminating their undesired behaviour by using processes of change, more than during other phases. Consequently, this is the busiest stage and at the same time the least stable one, carrying the highest risk for relapse (Brinthaupt & Lipka, 1994). However, not all modification of behaviour counts as an action. In most cases, people have to obtain certain criteria that scholars agree are enough to identify something as a successful behavioural change. For example, with smoking, people do not reach the action stage if they reduce smoking just for 50%, thus total abstinence is required. For that reason, it is important to determine desired behavioural outcomes and for each one of them to use validated and accepted measures.

In order to progress through this stage, intervention needs to help users avoid problematic behaviour and at the same time help them discover desired alternatives. As an example, the food initiative Bilder & De Clercq located in Amsterdam can be mentioned. Their mission is to provide a wide range of fresh and healthy ingredients in the exact amount required for either one or two persons, coupled with the recipe that explains how to prepare a meal easily and quickly in the comfort of one's own home. That way, they offer people healthy and quick alternatives and help them to avoid consuming less healthy food. The strategy used is

termed counter-conditioning, which focuses on our responses to stimuli. In this example, Bilder & de Clerq is making healthier options more accessible to people, which might result in substituting this for undesired behaviour (picking unhealthy evening meals).

Laurillau, Calvary, Foulonneau and Villain (2016) argue that accountability might be applied in both the preparation and the action stage. Accountability refers to engaging people in the desired behaviour and setting the goals for reaching it. It is further categorized into target, engage and control. Target allows users to define their objectives to achieve the desired behaviour. Engage supports users to participate in the performance of the new behaviour, for instance, through reminders and notifications. Control provides the user with means to set and adjust intermediate goals. For example Hydrao (Kuznetsov & Paulos, 2010) supports this functionality by allowing the user to set a target goal of litres of water used per day.

Laurillau, Calvary, Foulonneau and Villain (2016) as well highlight the need for protectability to be included in the action stage. The term refers to protecting a person from risky conditions where they might be triggered. It is centred on managing and keeping appropriate behaviours as well as detecting and preventing inappropriate actions. Due to its nature, it might also be applicable in the maintenance stage. Functionalities illustrating protectability are alert, prevent and anticipate. Alert focuses on signalling the user in case of undesired consequences compared to target goal, for example displaying threshold metrics. Prevent tries to keep the user from undesired behaviour, by giving a warning, for example. Anticipate refers to predicting specific conditions where the user might perform undesired behaviour and provide support to avoid unwanted circumstances. For example, Shower-me has a functionality that alerts users when they are consuming too much water.

Maintenance

Following the performance of the targeted behaviour the individual moves into the maintenance stage where they make specific modification in their lifestyle and sustain desired behaviour for six or more months. They are less tempted to relapse and feel more confident in continuing with the changes. Furthermore, in order to prevent relapse, they rely on their experiential and behavioural skills (Glanz, Rimer & Viswanath, 2015). Individuals should focus on building confidence to continue performing target behaviour and need to be motivated to keep up the new behaviour. Despite maintainers being less tempted to relapse, designers need to assess conditions in which a person has more chance to relapse and thus, develop alternative responses for coping with specific conditions.

After people have decided to change their behaviour, they need motivation to continue. Applying counter conditioning and stimulus control appears to be most effective technique as this stage. Sense mother can be viewed as a design intervention matching this stage. This smart home product consists of the “Mother” (data tracker) and four “cookies” (remote sensors) which can be used for tracking activity and monitoring specific behaviours, for instance drinking enough water or turning off the lights. The user is getting feedback and

reports through a storyboard on a cell phone. Mother sense is making use of the process of contingency management by reinforcing desired behaviour. Furthermore, it encourages competitions between users and consequently enforcing group recognition and stimulation.

Maintainability (Laurillau, Calvary, Foulonneau & Villain, 2016) implies making the change sustainable by reinforcing positive behaviour and thus, keeping a high level of motivation. It is further categorized into benefit, sustain and reward. Benefit makes the user aware of the desirable effect in the present as well as in the future. Sustain strengthens the user's awareness of appropriate behaviours to become valuable in the future. Reward refers to gratifying users for either achieving desired behaviour or escaping a risky behaviour. For instance, displaying congratulation notes if a user succeeded to maintain water consumption. Another example is FigureEnergy (Elsmore, Wilson, Jones & Eslambolchilar, 2010) displaying the energy saving percentage in real time. The latter example echoes the PSD's principle of social facilitation.

Termination

The individual then reaches the final stage – termination, where they feel no temptation to relapse or return to the unhealthy behaviour. This stage is characterized by completely eradicating the problem behaviour. Two criteria define termination: 1) zero temptations to engage in problem behaviour and 2) 100 percent confidence in one's ability to not engage in the problem behaviour, in other words, 100 percent self-efficacy. Even when people feel bored, depressed, angry, or anxious they are confident in not returning to their old undesired behavioural patterns. New behaviour has become automatic and it is like they never acquired undesired behaviour in the first place. This stage appears to be the ideal goal for the majority of people, although the criteria to reach this phase might be too strict. To put that into perspective, a study of smokers and alcoholics, for example, reports that fewer than 20 percent had achieved the criterion of zero temptation and total self-efficacy. Whereby in other domains, like exercise and weight control, the realistic goal may be a lifetime of maintenance, since relapse temptations are so prevalent and powerful (Glanz, Rimer & Viswanath, 2015).

3 MAPPING THE PSD ONTO THE TTM

The purpose of the literature review in the first two chapters was to present and analyse both models in detail and to identify the specific areas where the models complement each other. Therefore, the following chapter will focus on mapping the PSD elements onto stages of the TTM. Specifically, I will use the system features part of the PSD model and link an individual feature requirement to a particular stage of the TTM. Based on the literature review I have first identified the characteristic of all the TTM stages of change. Secondly, I have built upon the already established TTM construct – process of change, to determine the need and intervention requirements of each stage. Lastly, I mapped the PSD system features

that best match the needs of individual stages and serve as a guideline for designing stage-matched interventions.

As it has been emphasized, designing stage-matched interventions is a crucial aspect to consider when designing with the goal of behavioural change. Despite process of change generally incorporating core ideas of how interventions should be designed, and to which stage they should be matched, they have some downsides, one of them being not putting enough emphasis on computer-based interactive interventions which emerged with new technology advancement. Processes of change have focused mainly on between-person interaction, but the advancement of technology brought new opportunities to explore behaviour change through collection of individual-level data, using mobile devices, wearable gadgets, mapping digital footprint of online activities and continuous monitoring (Naslund, Aschbrenner, Kim, Mchugo, Bartels & Marsch, 2017). On top of that, I have already emphasized the issue of processes of change being too psychotherapy-oriented and the need to be more comprehensible (Lin, Mamykina, Lindtner, Delajoux & Strub, 2006 2006).

On the other hand, a similar deficiency is present on the technological side. According to Naslund, Aschbrenner, Kim, Mchugo, Bartels and Marsch (2017) not many digital technology interventions have been informed by behaviour theories. To put that into perspective, based on the research evaluation made by Orji and Moffatt (2018) approximately 74 percent of research made did not put in use any behaviour theories when designing persuasive systems. However, among the employed theories, the TTM was the most frequently used model - eleven times out of 170 papers reviewed. Another issue that arises is that computer engineers and user interface designers are not very familiar with principles related to behavioural change, so this type of mapping would make great advancements on this field. The mentioned issues highlight the need to bridge the gap between the behaviour theories and persuasive systems. To elaborate, it would be beneficial for products aiming at behavioural change to adopt persuasive mechanism according to the stage of the TTM the user is currently at. Furthermore, incorporating the psychology of human behaviour on building persuasive technology in a way that intervention strategies are designed around psychological and social theories has a greater chance of success in helping sustain a consistent behavioural change. Intervention strategies might better correspond and target different stages of behavioural change the user is going through. Designing interventions means linking specific PSD elements to specific stages of the TTM, so that the strategy reflects optimal matching.

All things considered, it works both ways. Behavioural theories can be employed to inform persuasive technological intervention, as well as the behavioural principles from the theory can be translated into technology design elements in the persuasive systems.

Despite the growing body of research in both areas there is limited integration of behaviour theories and persuasive technology on behavioural change. In this respect, previous research

(Orji & Moffatt, 2018; Ludden & Hekkert, 2014; Fadhil & Wang, 2019; Aldenaini, Oyeboode, Orji & Sampalli, 2020) calls for researchers and developers to employ behaviour change theories to inform their persuasive designs. Moreover, it should be illustrated how the theories employed are linked to the design features. To that end, this chapter will focus on applying the PSD model on to the TTM. It is of interest of many to explore different intervention strategies which could be implemented in each of the TTM stages to sustain a consistent behavioural change. Enabling behaviour change to be consistent and longstanding is an open challenge, while consequently combining it with persuasive design systems offers a whole new field of opportunities.

3.1 Precontemplation and the PSD system features

In the precontemplation stage the user feels unmotivated, resistant to change and lacks knowledge about the consequences of not changing their behaviour. At this stage there is a need for interventions to focus on education, motivation and increasing awareness. In other words, interventions should focus on revealing the users' behaviours so they will have a clear understanding of their current behavioural patterns and will observe their behaviour. In the context of the processes of change the need is addressed by stimulus control, conscious raising, and dramatic relief. Building on that idea, I mapped the following PSD elements from primary task support: tunneling, self-monitoring, simulation and from social support, social learning.

- **Tunnelling** to raise education, by guiding the user through a process to identify specific characteristic and provide them with feedback. For example, a website registration questionnaire on one side provides opportunities to persuade and on the other side helps identify user specific characteristic.
- **Self-monitoring** to improve self-understanding and reveal behavioural patterns. For example, a system allows the user to journal about their current habits and evaluate their state of happiness or performance. Another illustrating example are heart rate monitors and step counters, although this type of self-monitoring is more applicable in action-oriented stages.
- **Simulation** to provide cause and effect observation. For example, the before and after pictures.
- **Social learning** to provide ways to observe other users' behaviour and learn that way. For example, a fitness mobile app that displays a shared fitness journal or informs users about others' current performance by sending a notification "Mark went on a 3 km run, join him."

Table 2: Precontemplation and the PSD focused interventions

Stage characteristics	Need	PSD element
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Unmotivated, resistant, unknowledgeable. No intention to change the behaviour.	To educate	Primary task support: Tunneling, Self-monitoring, Simulation
	To motivate	
	To understand and observe the current behaviour	Social support: Social learning

Source: Own work.

3.2 Contemplation and the PSD system features

Moving onto the next stage, the characteristics describing this stage are ambivalence, chronic contemplation, and behavioural procrastination. People at this stage are aware of the consequences, understand the benefits of changing and have the intention to change but did not commit yet. To that end, the need for interventions at this stage is to raise awareness and help people understand why their behaviour is problematic. Furthermore, interventions are more effective if they raise emotions. The PSD elements that I have suggested here are again self-monitoring and simulation, just like in the precontemplation stage, then I have added tailoring from primary task support, further I continue by adding suggestion and similarity from dialogue support and lastly social comparison from social support.

- **Tailoring** to provide information tailored to a potential need, interest, personality, and context. For example, tailoring information based on the location (using ZIP code) where we are currently located.
- **Suggestion** to recommend action or alternative behaviour at the right moment. For example, giving suggestions for healthy restaurants nearby.
- **Similarity** that aims at imitating the user by sharing the same characteristics to make the user feel more homely and encourage them to take action. For example, a mobile app for teenagers might include slang language.
- **Social comparison** to compare performance with others and through that conveying a social norm. For example, displaying a calendar that shows others' activity logging.

Table 3: Contemplation and PSD focused interventions

Stage characteristics	Need	PSD element
Ambivalence, chronic contemplation, behavioural procrastination	To increase awareness	Primary task support: Self-monitoring, Simulation, Tailoring
Aware of consequences and understand benefits of changing	To help people understand why a behaviour is problematic	
	To raise emotions	Dialogue support: Similarity, Suggestion

table continues

Table 3: Contemplation and PSD focused interventions (con.)

Stage characteristics	Need	PSD element
Has intention, but did not commit yet		Social support: Social comparison

Source: Own work.

3.3 Preparation and the PSD system features

This stage is characterized by people having intention to perform behaviour change, hence they have already developed a plan of action and started taking small actions such as buying a book or joining a program. The need for this stage's interventions is to reengineer the environment so that performing a behaviour is as simple as possible. The aim is to engage people in the change of behaviour, perhaps by recommending or suggesting different types of actions. Furthermore, to make people learn about the dynamics of the phenomenon. Based on stage characteristics and needs, the PSD elements I have suggested are rehearsal, reduction, and simulation from primary task support. And suggestion and reminders from dialogue support.

- **Rehearsal** to provide methods to practice behaviour. For example, a flying simulator enabling a pilot to practice a behaviour.
- **Reduction** to reduce effort and friction and simplify tasks to achieve behaviour. For example, using familiar patterns, discoverable buttons, sending notifications and have on-boarding strategy. A more concrete example might be automatic calorie counting or one-click shopping experience.
- **Reminder** to point something out so the user will not forget to engage. It can either be time-based or contextual based (using weather or location information). For example, sending users a notification to perform an action or allowing them to set a reminder for a specific activity.

Table 4: Preparation and PSD focused interventions

Stage characteristics	Need	PSD element
Developed action plan Has intention, did take small actions	To make behaviour simple to perform Environment reengineering To engage people in action performing To recommend and suggest	Primary task support: Rehearsal, Reduction, Simulation Dialogue support: Suggestion, Reminders

Source: Own work.

3.4 Action and the PSD system features

The nature of the action stage is behavioural change performance for less than 6 months. Individuals feel motivated, yet there is highest risk for relapse in this stage. This highlights the need for intervention to be protected and support oriented, meaning they should protect users from risky context and help to avoid problematic behaviour. Furthermore, there is also need to provide support for possible undesired behaviours. The PSD elements I have mapped to the action stage echo helping relationship from the TTM process of change, in terms of offering supportive and trusting environment of people who are going through a behavioural change. These PSD elements are from the category of social support: social comparison, normative influence, social facilitation, cooperation, competition. Also, I have again added reminders from dialogue support.

- **Social comparison** to comparing performance with others. For example, sharing fitness success via social media or seeing your performance on the scoreboard and comparing it to others.
- **Normative influence** to using peer pressure and bringing together people that share the same goal. For example, a system providing means to challenge friends. A more illustrative example might be a system having a feature that puts exercising in the context of calculating an average score among friends and then sends the user notification saying, “you're approaching the average score among friends” or simply displaying their performance in the calendar.
- **Social facilitation** to enable identifying other users that perform behavioural change along with them. For example, displaying real-time exercising budding or in energy-saving context, functionality that displays energy saving percentage in real time.
- **Cooperation** to enable users working towards a common benefit. For example, displaying team score of performing desired behaviour.
- **Competition** to enable users to compete with each other. For example, functionality that enables organizing an online competition.

Table 5: Action and PSD focused interventions

Stage characteristics	Need	PSD element
Performing change for less than 6 months	To protect users from risky contexts and help avoid problematic behaviour	Social support: Social comparison, Normative influence, Social facilitation, Cooperation, Competition,
Feels motivated	To provide support to anticipate inappropriate behaviours	
Highest risk for relapse		Dialogue support: Reminders

Source: Own work.

3.5 Maintenance and the PSD system features

A user in this stage has been sustaining a new lifestyle for more than 6 months, feels confident and is less tempted to relapse. The core need in this stage is to reinforce the desired behaviour and maintain change to make it sustainable. Additionally, it is beneficial to assess the conditions under which one can relapse and develop alternatives to help them not fall into the relapse phase. The PSD element that I have emphasized in the maintenance stage from primary task support is self-monitoring, from dialogue support, praise, rewards, social role and from social support, recognition.

- **Self-monitoring** to keep track of one’s performance and to improve self-understanding of behaviour performance. For example, a step counter or a hear rate monitor.
- **Praise** to reinforce the desired behaviour. For example, giving congratulation notes on exercising, either via word, sounds, images or symbols.
- **Rewards** to give credit to the user so they feel more confident. For example, giving virtual trophies for achieving the goal.
- **Recognition** to offer public acknowledgment for users when performing the desired behaviour. For example, featuring the winner of the month.
- **Social role** to provide information and guidelines via e-assistant. For example, a feature that offers tips from a coach.

Table 6: Maintenance and PSD focused interventions

Stage characteristics	Need	PSD element
Sustaining new lifestyle for more than 6 months	To assess risky conditions and develop alternatives	Primary task support: Self-monitoring
Feels confident	To reinforce the desired behaviour	Dialogue support: Praise, Rewards, Social role
Is less tempted to relapse		Social support: Recognition






Source: Own work.

Sometimes it is difficult to draw the line between the PSD elements that should be applied at specific stages, since the early-stages and the late-stages have similar needs and characteristics. For example, action and maintenance are both focused on social influence, hence, in the final stage, some elements from social support might also be a good fit for designing interventions. The ground rule when designing systems must follow the need of the early stages to be understanding-focused, while the later stages, action-focused.

There are some PSD system features I have marked as “universal”, which means they should be used throughout the entire system, regardless the stage the user is at. These principles are trustworthiness, expertise, surface credibility, authority, real-world feel, third-party

endorsements, verifiability (system credibility) and liking (dialogue support). The need for the system to be trustworthy and credible for the user is the basic criteria that designers should keep in mind. These are not nice-to-have features, but must-have features. The same goes with liking, which aims at a system being visually attractive. I have already mentioned in the first and second chapter that an attractive system not only produces positive feelings but is also perceived to work better. Subsequently, making appealing user interface is a must-have feature as well if we want a system to be persuasive and behaviour changing. Figure 5 provides a diagram, showing us a summary of key findings on mapping the PSD onto the TTM.

Figure 6: Mapping PSD onto TTM diagram

	 precontemplation	 contemplation	 preparation	 action	 maintenance
NEED	To motivate To educate To reveal behavior	To raise emotions To increase awareness To reevaluate	To recommend & suggest To make beh. simple To reengineer environment	To protect from risky context To provide support	To asses risky context & develop alternatives To reinforce beh.
PSD system features	Self-monitoring Simulation Tunneling Social learning	Self monitoring Simulation Tailoring Similarity Suggestion Social comparison	Rehersal Simulation Reduction Suggestion Reminder	Social comparison Normative influence Social facilitation Cooperation Competition Reminder	Self-monitoring Praise Rewards Social role Recognition

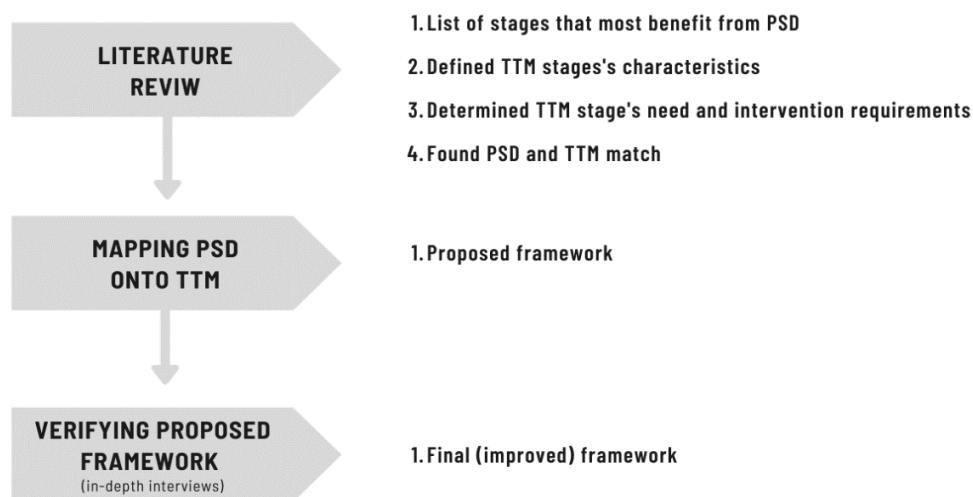
Source: Own work.

4 EMPIRICAL PART

4.1 Methodology

To meet the purpose of the thesis, qualitative research methods have been applied. Firstly, theoretical overview has provided a deep insight into the study setup. By studying the TTM, I have identified individual stage(s) that could benefit the most from applying the PSD elements. Based on the characteristics of each TTM stage I have identified the need that represents a guideline for designing intervention. Furthermore, I have used the PSD design of system feature part of the model to link individual feature requirements to a particular TTM stage. Secondly, based on the theoretical background I have continued by conducting in-depth interviews to validate if mapping of the PSD onto the TTM, made in the theoretical part, makes sense. The criteria for selecting respondents were 1) the maintenance stage of the TTM model and 2) behavioural change in the health domain. Respondents have had to practice the behaviour for more than half a year and the change had to relate to either physical activity, diet change or meditation. I have interviewed five people, out of these two male and three female. The men belong to the age group of 30-40, while the women were from the age group of 20-30. More interview details are provided in Appendix 1, where the whole interview matrix with key highlights is presented. Thirdly, I have translated the outcomes from interviews to intervention strategies, combined them with concepts derived from the theoretical overview and as a result, designed a framework that will provide insights and recommendations for future persuasive design strategies. Figure 6 provides us with research process overview.

Figure 7: Research process



Source: Own work.

The design of the questionnaires was based on findings from the theoretical overview. The questions were designed according to the qualitative research guidelines provided by Jacob

and Furgerson (2012) and Turner (2010). Specifically, this means that the main questions were coupled with probing questions and examples. If the respondent was more taciturn and did not widely discuss the main question, I asked them a probing question to give them more guidance. Furthermore, I prepared examples of concrete system features in order to validate all of them in case if the respondents did not mention them themselves.

The purpose was to validate if stage-matched interventions made on the basis of the PSD are useful in the TTM stages. The questions were aimed at validating all the stage interventions; however, the focus was on the maintenance stage. The interview contained the following 11 questions and started with a warm-up question to set up the context of behavioural change:

1. Tell me about your behavioural change.
2. How did your decision-making process of starting behaviour change look like?
3. What emotions and feelings did you experience at the beginning?
4. How did you prepare yourself for behavioural change?
5. How did your action stage look like?
6. Tell me about temptations.
7. How do you perform the desired behaviour change and how do you keep going?
8. What emotions and feelings do you experience now in maintenance stage?
9. What role does tracking have in maintaining your behaviour?
10. What role does social influence have on maintaining your behaviour?
11. What support can technology offer you to keep maintaining change.

4.2 Findings

To warm up, the first question aimed at the understanding the respondent's context of the behavioural change. Four behavioural changes come from changing eating habits and increasing the level of physical activity, while one change relates to incorporating a regular practice of meditation. All respondents went through the precontemplation and contemplation stage before taking any action. Most of them reported trigger for change coming from self-revaluation (looking at yourself in the mirror, asking reflection questions). Some said that the trigger were health issues, one was motivated to change because of an upcoming important event (wedding) and lastly, for one respondent behavioural change was the consequence of another changed habit.

The decision-making process

The second question aimed at understanding the decision-making process of starting the performance of behaviour change. In other words, I was interested to know what helped them progress from the (pre)contemplation stage to the preparation. Many of them said that their social circle (normative influence) has had a big influence of their decision, more precisely, a person they admire had to plant a seed in their mind as stated by one respondent: "The thing that helped me the most is the idea which I got from a person that I admire.

Someone has to plant a seed that later germinated into a change.”

Two of the respondents remarked how important it was to keep a diary of the current habits (self-monitoring), for instance, one that ceased eating sugar pointed out that: “At the beginning, you are not even aware of how much sugar you eat. That is why keeping a diary and having a weekly overview over your sugar consumption might be a good first step.”

Almost all participants had already tried performing the behaviour in the past, but failed, however, the moment that has encouraged the real change was either triggered by a narrow social circle (e.g., friend, role model), the anticipation of big event (e.g., wedding) or health issues. However, all the thinking and reflection served participants to set the basis for the change and make them inclined towards the change. In some cases, firstly being a part of X-day experiment (e.g., 40-day sugar fasting) or an intensive trial period (e.g., 9-day retreat) and then later taking a more serious approach towards the change, appeared to be a good step to initiating the move from (pre)contemplation to preparation. It seems people first have to take a glimpse into the desired behaviour and can later perform it more easily – just like rehearsal that the PSD element recommends.

All the respondents (except for one) had positive responses on simulation technique for motivating them to progress to the next stage. One remarked that: “Seeing what you are striving for would indeed be very encouraging. It would be useful having a functionality that offers different possible scenarios, for example if you exercise this much and eat this, you can achieve this. Or the other way around, having a feature that allows you to change body dimensions as you want to achieve them and offers you an action plan to achieve the results coupled with an image of your future self.”

As opposed to simulation, tunnelling did not appear as a technique that might help individuals to move faster from one stage to another. However, some did agree that tunnelling might motivate them, but were not sure if this would be enough to make the change. On the other hand, some said that “any form of encouragement in the beginning is welcome.”

It appears that the elements of social supports are very applicable already in the (pre)contemplation stages. All respondents pointed out that having someone that works with you and motivates you is the most helpful strategy for starting the change. Those who did not have this type of support emphasized missing having like-minded people around who would offer them additional support, mutual understanding, and help them to embrace the fact they are not alone in this. “You need proof that you as an individual are not problematic, because you want to change the behaviour,” said one respondent.

Emotions in (pre)contemplation stage

The third question aimed at understanding which emotions and feelings the individual felt at the beginning. Negative emotions prevailed, mostly of fear of failure, guilt, and self-blame

for not starting the change earlier, confusion, misunderstanding, shame and feeling that everyone is judging you. One respondent addressed the confusion and misunderstanding by saying: “Everyone says nuts are healthy and nutritious, but nobody points out how caloric they really are. I was confused at the beginning because my kilograms did not go down even though I ate so many nuts.” One participant believes that a daily reminder which offers a sense of calm and support in letting you know you are not alone here, might help her overcome the fear more easily.

Preparation stage

The fourth question was about the preparation stage. In general, the preparation stage was all about buying fitness equipment and gym memberships, making an action plan, adapting the environment (e.g., removing sweets and unhealthy food from the apartment), but mostly prioritizing your change: “performing behaviour change must initially become your priority” and incorporating it into the daily routine: “you need to find a way to incorporate change into a daily habit and to combine the pleasant with the useful.”

All the participants agree that suggestions might help them act more confidently. Such suggestions might come from a real person, again someone who you admire in a narrow social circle as pointed out by one: “you need someone that opens your eyes.” Another way of offering suggestions might be via a mobile app: “suggesting different approaches for behaviour change and guiding you throughout your daily activities.”

Most of the participants started with gradual steps and easy-to-perform exercises (reduction), and later escalated the difficulty, which shows that the reduction technique was already applied automatically among respondents.

Action stage

The fifth question aimed at examining the action stage. “It is about the conscious searching for a time slot, planning and making a routine out of it,” was basically the main message from the participants about how actions stage looked like for them.

The main motivation for them were the results that gradually showed and the satisfaction they felt after the performance. The key of keeping going is “to remind yourself of good feelings that follow after good training.”

Participants consider social facilitation as a strategy that would help them overcome temptations of skipping the training, for example: “It would be encouraging to see real-time if my buddy is at the gym. I believe it would motivate me even if I would not be in the mood for training.” One participant that was taking part in a fit challenge organized by a Slovenian fitness influencer said that having live trainings, a community of people that support each other, share their progress and struggles, but mainly having someone that shares knowledge and detailed training instructions is what makes you keep going. On the other hand, the

participant with sugar cessation addressed just that – the need of being surrounded by like-minded people: “It would be helpful to have a circle of people you can reach out and feel you are not the only fish swimming in the ocean.” In general, social comparison, competition and cooperation were positively perceived by most respondents, with the expectation of the participant performing meditation who said: “I do not use comparing functions. This is my world and I like to be alone in it.” Perhaps this is because meditation practice is something more personal and intimate than training.

Temptations

The next question was used to analyse the temptations. As reported by the respondents, temptations usually occur when feeling stressed, tired or being in a hurry. Other temptations arrive from the environment; when someone offers you unhealthy food, for example. However, most of the respondents pointed out the importance of having a routine for your change: “The closer I am to the ritual, the less temptations there is.”

Different strategies to fight against temptations were reported. One was to find alternatives, for example, for someone who likes sparkling beverages, sparkling water might be a good alternative for CocaCola. Then again, for someone who wants to keep away from sugar, replacing white sugar with stevia, fruit or other natural sugar sources is a reasonable alternative. The second strategy for overcoming temptations was quite straightforward and refers to environment reengaging - to avoid accumulating sweets at home. The third strategy was putting temptations into perspective, for example: “If I compare the number of calories with the amount of time I will need to train in order to burn them, it becomes easier for me to resist the temptations.”

Resisting temptation is a challenge, however a gently reminder sending the message that temptations are normal, that everyone is experiencing ups and downs, and that you can make it through, might be a good initiative for individuals to stop and re-think if it is worth it. Interestingly, receiving reminder from a friend appeared to be more positively perceived compared to a reminder from an expert.

Maintenance stage

The seventh question aimed at understanding the maintenance stage. The approach that keeps motivating respondents to maintain behavioural change is tracking their performance (self-monitoring) and striving for improvement. Almost all respondents track their behaviour by using wearable tech or mobile apps. In the case of meditation, tracking was not identified, although the participant did point out that having an app which could track meditation performance would be very useful. Not only that, for easier maintenance of meditation practice, having a guide on how to proceed would come in handy: “Now, that I feel calm and stress-free, I am wondering what the next destination is. A guide that would show me what more there is to see and where the next destination is would be very helpful.” As a

method for easier behaviour maintenance engaging in constant reflection was suggested as well.

Again, the importance of making a routine around behavioural change was emphasized. Moreover, one respondent noted that “It helps a lot having fun while performing. You need to combine the pleasant with the useful, for example, if you are running on a treadmill why not watch movie at the same time.” To maintain the behaviour, it is very important as well to remember what you gain with performing it and what feelings you do not want anymore. Once you manage to maintain the behaviour for a year or more “It becomes easy not to give up. You are not even trying to resist temptation anymore; this has become your lifestyle. You are aware of how clean your body is, you know how to say no and everyone around you is used to your change. To relapse is like going back to high school. You negate yourself.” said respondent who ceased to consume sugar.

Among social support features the most frequently mentioned was recognition: “If people around you notice the change and praise your appearance it is a big motivation.” Also, receiving rewards would motivate them to maintain the behaviour. It appears that praise, rewards, and social recognition are applicable in maintenance stage. People want to be seen and praised. However, there was one respondent that said reward should be private, so it can only be seen by the user. As an example, she mentioned the gamification approach that is used in Audible (audiobook app).

Emotions at maintenance stage

The eighth question was about emotions and feelings that appear in the maintenance stage. All the respondents shared positive emotions such as pride, content, a sense of control over the habit, a high level of motivation and happiness.

The role of tracking in maintenance

The ninth questions aimed at assessing the role of tracking in maintaining the behavioural change. As identified in the previous questions, it appears that tracking plays a big role in maintaining one’s behaviour. Respondents reported that especially in the beginning, tracking your behaviour is essential: “Tracking is very important, especially in the beginning. You have to have a story that encourages you.” Generally, tracking served respondents as a motivation boost. In the case of practising meditation, the respondent suggested that it would be convenient having a mobile app which tracks your well-being, in a way that you can record your current condition, though nothing descriptive and without text field, only by choosing predefined measures. The example of Apple Health was given, where you can mark your period condition by choosing predefined facts or measurements. Another example was pointed out, Apple Bad time: “It gives me concrete suggestions, for example, not scrolling the phone 45 min before sleep, and I truly believe and follow these tips.” Furthermore, she suggested that we need something similar for meditation tracking, an app telling its user when to meditate, how they were feeling throughout the day, whether they have encountered

any stressful situations and so on. For example, every time the user feels stressed, they need to tap the screen. That way tracking would be easier, and improvement could be done. For tracking physical activity and the following results one participant suggested that having a device that automatically measures body circumference would make measuring a lot easier, since it is really time consuming and exhausting to do this by hand.

The role of social influence in maintenance

the next questions aimed at understanding the respondents' perspective on the role of social influence in maintaining their behavioural change. All respondents agree that social influence plays a big role in the maintenance stage, however, one of them pointed out that it is more about a close circle of his friends than the whole society: "For me society is not so important, it means more if I am praised by my close friends." The influence the society has on individuals going through behavioural change can be either positive or negative. It is true that society as a whole can play many positive roles, for instance, it can be a source of knowledge, a promoter of change, a supportive environment or a source of motivation. On the other hand, society can set up high criteria and expectations, which, for some, might be too overwhelming. Such phenomena can be seen especially on social media, where so much misinformation and impossible-to-achieve beauty ideals are being distributed. In short, general trends plays a crucial role in generating and maintaining behavioural change. It is also very important for someone performing behaviour change that their closer circle of people is supportive, not judgemental and that it respects one's decisions.

Technology support on behavioural change

The last question was about identifying the services that technology can offer in order to support behaviour change. Based on the answers I identified three roles that technology can play in supporting behavioural change, which are:

- Technology as community enabler. Technology should offer means for individuals to be heard, connected, and accepted. "If you can see your buddy is in the gym at the moment and you are also just thinking of going, then this type of checking-in might help me increase my motivation."
- Technology as a "diagnose" maker. Technology should identify your patterns and create a path based on that. "Technology should examine each one's habits and patterns and then, create a way forwards based on that. It should offer you an opportunity and guide you through the process."
- Technology as a mentor guide. Technology should guide you through the process and offer a "therapeutic arm". "First it is on you to make the decision, but then technology can take you and guide you on a journey. So, it gives you daily reminders, rewards, feedback etc. From time to time it is nice to have someone that reminds you you are on a right path or calms you down when you are tempted to succumb to temptation."

Of course, it should be noted that many of the above mentioned roles are already being applied, for example, a smart watch that guides you through performing a physical activity or a smart bottle that winks at you if you do not drink enough. However, it is worth to point out that some opportunities still remain open and wait to be addressed to better support behavioural change. One opportunity might be complete personalization and continuous tracking and then pushing notifications based on the individual's context and situation.

Together these results provide an important insight into the stages of change and their characteristics, as well as evaluation of interventions that I have mapped based on the theoretical overview. Overall, I would sum up the empirical part into 8 main conclusions:

1. **The need to apply social support already in (pre)contemplation stage.** Most of the respondents were encouraged to change by their friends or mentors. Based on that, we can argue that social support system features, especially social learning, normative influence, social facilitation, and cooperation should be applied already in the early stages (precontemplation, contemplation and preparation). Firstly, this should be done to even encourage contemplation and to plant the idea of a change in one's mind and secondly, to motivate and support one's performance, especially in the beginning of the action.
2. **The social circle is not that social. It is a friend/mentor circle.** When thinking of applying social support system features, we need to keep in mind that people trust their people, meaning that in the early stage, too big a community might not be an appropriate option. Instead, the emphasis should be on small, friend and mentor oriented social circles.
3. **An experiment as a starter boost.** The easiest way to promote behavioural change is through performing an experiment first. It is fun and the user does not feel too overwhelmed at the beginning. Participating in an x-day experiment gives people a glimpse into the future of how their life would look like, if implementing the change.
4. **Simulation, rehearsal, and normative influence as the greatest potential.** Based on the interviews I can conclude that simulation, rehearsal, and normative influence are the features that were most often positively perceived by the respondents.
5. **Interventions for addressing negative emotions.** At the beginning, the most frequently reported emotions were fear of failure, confusion, or lack of understanding. That creates a need for designing interventions that aim at addressing such feelings by calming the user down and making them feel accepted and understood.
6. **Technology as a (psycho)therapist.** Behavioural change is very psychological. It requires a lot of mental effort, constant struggle with yourself and your inner voices which might lead you to relapse. Sometimes it just becomes exhausting and because we are all just human beings trying our best, many respondents said that just a gentle reminder saying it is normal to feel temptations and that it is normal not to perform at your best every day, would be a nice touch. Furthermore, change requires a constant reflection so guiding one through it appears to be a good approach for self-exploration.

7. **Making it fun.** Besides prioritizing new behavioural change and making it a routine, it is as well very important to have fun while performing it.
8. **The need for more early-stage interventions.** Moving from (pre)contemplation to preparation is the process that takes much more time compared to progressing in later stages. Therefore, further examination in how the PSD could support the early stages of the TTM is needed.

4.3 Updated framework of mapping the PSD onto the TTM

The results from the empirical part provide important insight into mapping the PSD onto the TTM. When analysing results, it appeared that many PSD elements which were initially mapped at specific stages are applicable to other stages as well. Moreover, some of the respondents remarked they did not exactly feel the specific changes of change. To put it simply, they contemplated for a long time, but after getting the right trigger and really deciding to change, they quickly progressed into the action stage. Even though the respondents subconsciously went through the stages of change, it appeared much more effective for the PSD elements not to be strictly linked one element to one stage, but rather expanding over more of them. Based on this finding I concluded that when mapping the PSD onto the TTM, the stages of change can be reduced into the early stages that focus on understanding, learning and motivation, and the later stages that focus on resisting temptations, performing the desired behaviour, and maintaining it. According to the terminology used by Laurillau, Calvary, Foulonneau and Villain (2016) the early stages are termed understanding-oriented while the later ones action-oriented. Their argumentation goes hand in hand with my findings, hence, I will propose a new framework which follows this view. Thus, the main criteria for mapping the PSD elements onto the TTM is that the early stages system feature should be focused on providing education, comprehension, and motivation, while the later stages include system features concentrated around reinforcing the desired behaviour. Figure 7 provides an overview of a new proposed framework. The biggest changes compared to the first version of the framework are marked with a red star (*).

In general, the early stages have more proposed features than the later stage as respondents initially spent more time and had more difficulties compared to the later stage. This brings me to a conclusion; since (pre)contemplation stages sometimes take years, it might be worth to consider how to shorten this phase by supporting it with the PSD.

There are two main differences compared to the initial framework. Firstly, results have shown that social support system features are already applicable in very early stages of change. Many of the respondents reported that their social circle has had big impact on their decisions to change as well as maintaining this decision. Therefore, I conclude that bringing in normative influence, social facilitation, social learning, and social comparison already in the early stages is an important requirement to consider when designing a persuasive system.

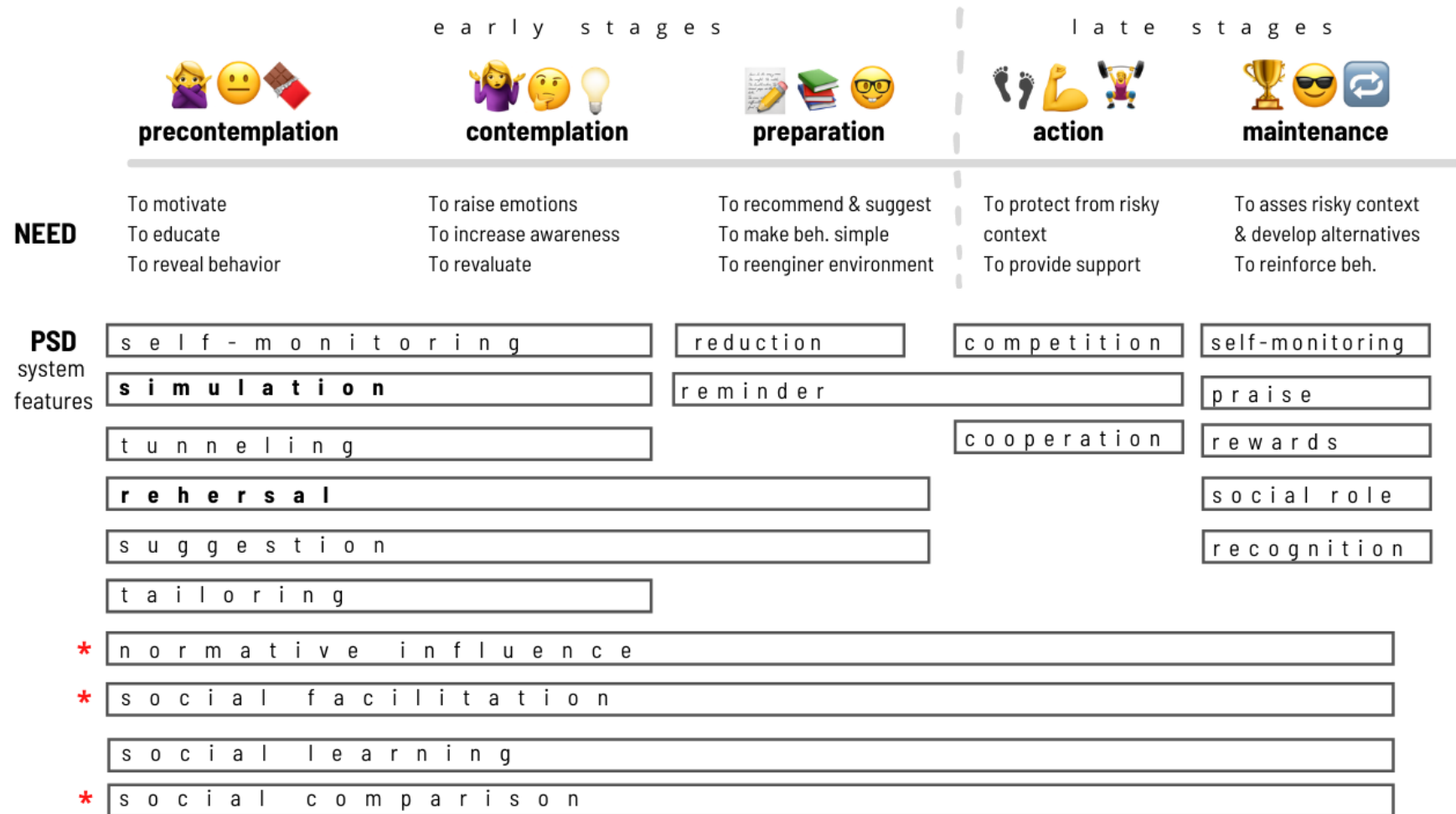
However, social support in the early stages has a different role, compared to social support in the later stages. In the early stages social support can serve as an enabler of increasing awareness, meaning that someone in your social circle might present you the idea of change and that way plant a seed in your mind. In the later stages, the role of social support is not so much increasing awareness, but more supporting each other and having access to a like-minded community. Additionally, the social support elements are much more trusted and applicable if provided by an individual's circle of friends or mentors, so taking a broad society approach might not be the best approach.

Secondly, another insight that has emerged during conducting the research is the potential of having the rehearsal feature already in precontemplation stage. Many respondents remarked that their change began by participating in some type of an experiment first. To enable participating in an experiment first to get a glimpse of a change might be a good start for (pre)contemplators to progress faster to the action stage. Based on this insight I moved the rehearsal system feature to the precontemplation stage and extended it to the preparation stage.

Otherwise, only minor changes were made. Since reducing the TTM model to two stages, when doing the PSD mapping, some stages share the same system features. For example, it turned out that the suggestion feature is applicable not only to the contemplation stage, rather it is more effective to place it in the precontemplation and the preparation stage as well. The same goes for tailoring.

Overall, the biggest changes were made in the early stages, while the late stages did not receive any special modifications. Many features were confirmed to be effective, for instance competition and cooperation in the action stages, or praise, rewards, social role, and recognition at the maintenance stage. Self-monitoring was also positively perceived by the respondents, however it was noted that similarly as with the social support system, self-monitoring has a different role in the early stages compared to self-regulation in the later stages. Self-monitoring in the early stages is aimed at understanding and revealing the current pattern behaviour (e.g., keeping a food journal) while at the later stages the focus is more on tracking the desired behaviour and striving to improve it. Based on the interviews I have concluded that the major opportunities lie in applying simulation, rehearsal, and normative influence in the early stages and self-monitoring and social recognition in the later stages.

Figure 8: Final framework of mapping PSD onto TTM



Source: Own work.

5 DISCUSSION

5.1 Theoretical contributions and practical implications

As emphasized several times throughout the thesis, previous research has shown that the persuasive technology field lacks the integration of the behavioural theory. Aiming to fill this gap, I have successfully identified the PSD system features and mapped them onto the TTM stages of change. Reviewing large-scale literature to determine the characteristics of each TTM stage and then identifying its needs and lastly to mapping appropriate PSD system features on specific stages was the first theoretical contribution made in this thesis. Based on the literature review I was able to design a framework that proposes stage-matched interventions. Then, I continued with conducting in-depth interviews to verify stage-matched interventions based on the theoretical overview. Based on the results of the interviews I have adjusted the first version framework and added insights from the practical part of the research. Some of the system features I have identified in the theoretical overview prove their effectiveness, some need to be moved to other stages and some have been merged. As a result, I have proposed a new framework, which is the second theoretical contribution made in this thesis.

These findings have practical implications for understanding which principles UI and UX and designers should follow when designing products for behavioural change. Moreover, the thesis provides insights and recommendations for future design of persuasive interventions that consider the transtheoretical model of change. The framework I have proposed could serve interface designers to firstly identify in which stage of change their potential users are at, and then, accordingly match the intervention in order to create software application in a persuasive way and make the user change the behaviour. There are 4 concrete suggestions I would give the designers and business analysts developing products for behavioural change:

1. **Pick a target group and conduct user research to find out in which stage of change the users are.** If the system aims at changing user behaviour, then the first step is to figure out in which stage they are currently in. Before prototyping, designing, and developing a system I would suggest beginning with conducting interviews or questionnaires to find out the current state of the users.
2. **Try to understand users' emotions.** Going through behavioural change is an emotional process. It requires a lot of mental effort and can be stressful, especially at the beginning. By understanding users' emotions, the design of interventions that are concentrated around addressing those emotions might be easier.
3. **Link the PSD features according to the TTM stage.** Which system features to use depends on the stage of change target customers are in. By conducting user research, a designer can identify which features might be effective in a specific TTM stage, according to the framework I have proposed.

4. **Give extra attention to simulation, rehearsal, and normative influence.** The chances for users to adopt behavioural change are higher if the simulation feature is applied. Also, providing means for rehearsal appeared to be a good trigger for someone to take the first step towards behaviour change. Lastly, social facilitation might create additional opportunities for those who doubt the change.

What can be learned from this thesis is that developing software applications does not only require technical knowledge, but a deep understanding of human psychology, behavioural theories or more specifically, how human minds work and how decisions are made. According to this thesis, it is clear that software feature requirements should be thoughtfully mapped on one's stage of change. However, there are still plenty of opportunities to be explored to bridge the gap between product development and behavioural science.

5.2 Limitations

There are many limitations to this research that should be considered. Firstly, the sample size is not representative, therefore it is difficult to make any general assumptions. The final conclusion on effectiveness of stage-matched intervention might differ in other sample groups.

Secondly, the context of behavioural change was not considered. The interviews were conducted among participants that performed any kind behavioural change in the health domain with no consideration given to the type of change. For example, designing interventions for changing eating habits might focus on different elements compared to interventions for meditation practice. The effectiveness of different interventions can be determined best when measured in the same context.

Thirdly, the measurement of interventions effectiveness might suffer due to subjectivity of the qualitative method. It is difficult to determine which system feature contributed the most to one's behavioural change. Especially, because behavioural change has started in the past, thus, people have limited memory and answers may deviate.

However, evaluating the effectiveness of persuasive strategies is difficult and this was one of the most emphasized critiques of the PSD model (Orji & Moffatt, 2018). Nevertheless, the findings can serve as a starting point to dig deeper into researching the effectiveness of stage-matched interventions.

5.3 Further research

There are many opportunities for proceeding with this research. Firstly, further research could be conducted with an increased sample size and use questionnaires with Likert scales to analyse users' attitudes toward specific features.

Secondly, these findings highlight the need to further investigate in what way we could better support the early stages of the TTM. Perhaps this could be done by conducting experiments and longitudinal studies to evaluate the effectiveness level of the stage-matched interventions at different time points during behavioural change.

Thirdly, it would be interesting to build an actual mobile application, a prototype, that would incorporate stage-matched intervention and give it to users to test it. That way, it would be possible to objectively measure the effectiveness of system features by data collection via Google Analytics, Hotjar or some other data analytics tool.

Fourthly, according to this research, social support brings many opportunities for behaviour change, thus, it would be useful to examine how to incorporate elements of social support to promote behavioural change. The same goes with simulation as it appeared to be effective for individuals to progress towards action stages.

Fifthly, since interventions vary from context to context (e.g., type of behavioural change, domain of behavioural change, target group) it would be interesting to further examine which strategies work best under particular context.

On the other hand, further studies could also assess whether stage-matched interventions are clear enough for UI/UX designers to translate them into actual design components.

CONCLUSION

Over the course of several decades there has been a massive growth in persuasive system development. However, too little attention has been given to incorporating human psychology and social theories to the development and design of digital products for behavioural change.

This thesis aims to address the need of limited integration of behaviour theories and persuasive technology on behavioural change. Many researchers have called for employing behavioural science to inform persuasive technology. Even more so, to illustrate how these theories are linked to design features, and how theoretical components are translated into actual design components, so that UX/UI designers would have a greater understanding of the principles related to behavioural change.

The aim of the research was to examine how to use PSD to support individual stages of the TTM, more specifically, which persuasive system features work best for users to progress through different stages of the TTM. To that end, the following two research sub-questions were formulated:

1. Which stages of the TTM could benefit the most from the PSD?
2. Which elements of the PSD can be applied to a particular (identified from the previous question) stage of the TTM and how can they be used to design persuasive technology?

To answer the first question, I have reviewed a large scope of literature on the PSD and the TTM. Based on the literature review I was able to identify the characteristics and needs of each TTM stage of change. I have concluded that all stages can benefit from applying the PSD model. However, the insights from the empirical part showed that specific attention should be given to the early stages of change. To answer the second question, I have again reviewed a large scope of literature on the PSD and tried to link individual elements with specific stages according to the needs and characteristics of each stage. I took the design of system feature part of the PSD and mapped individual features to different stages of change. In each stage I have identified interventions that could be implemented to sustain a consistent behavioural change. This resulted in proposing a framework that combines stages' needs and the PSD system features addressing that need. The last step of answering the second question was verifying the proposed stage-matched interventions with conducting in-depth interviews and upgrading the initially proposed model based on the empirical insights. I have successfully answered both questions. The main findings of the empirical part and upgraded framework can be found in the chapters 4.2, where main findings are presented, and 4.3., where the new framework is proposed.

This study has shown the importance of designing stage-matched interventions. It has given insight into how specific PSD system features can support one's progression through individual stages of the TTM. The results indicated that when mapping the PSD onto the TTM, stages of change can be reduced to two main ones; the early-stages and the late-stages. The former includes understanding-focused interventions, while the latter action-focused interventions. This study also lays the groundwork for future research on how the PSD system features of social support might offer better support to the early stages of the TTM.

Based on described findings I can conclude that bridging the gap between behaviour theories and persuasive systems is a prospective field filled with opportunities to be investigated more in depth.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

V današnjem svetu hitrega tehnološkega razvoja so pametni telefoni in računalniki postali del našega vsakdana. Posledično so se začele pojavljati aplikacije in sistemi, ki imajo veliko vpliv na naše vsakdanje življenje in spreminjanje življenjskega sloga. Oinas-Kukkonen in Harjumaa (2009) ta pojav imenujejo, kot, da je tehnologija »vedno vklopljena« in tako ali drugače vpliva na stališča in vedenje ljudi.

Trend nenehne izpostavljenosti tehnologijam, so razvijalci programske opreme izkoristili za začetek razvoja informacijske tehnologije, ki je usmerjena v spreminjanje obnašanje in vedenja uporabnikov. Kot rezultat tega, je Fogg (2002) uveljavil izraz prepričevalna tehnologija (ang. *persuasive technology*), ki opisuje vsako obliko informacijske ali komunikacijske tehnologije, katere namen je spreminjati, krepiti ali oblikovati vedenje in odnosa uporabnikov, s poudarkom na prostovoljni spremembi. Pri tem definira prepričevanje (ang. *persuasion*) kot poskus vplivanja na prepričanje, stališča, namere, motivacije ali vedenje posameznika ali skupine.

Trend prepričevalnih sistemov je dobro uveljavljen na področju oblikovanja interakcij med človekom in računalnikom. V ta namen je bil razvit model za oblikovanje prepričevalnih sistemov (angl. *Persuasive System Design – PSD*), ki služi načrtovanju in ocenjevanju informacijske tehnologije in cilja na vedenjsko spremembo uporabnikov. Model je sestavljen iz treh glavnih kategorij, ki ponazarjajo tudi glavne korake pri razvoju prepričevalnih sistemov. Prvi korak je razumevanje ključnih predpostavk, ki predstavljajo osnovno vodilo za razvoj prepričevalne tehnologije. V drugem koraku je potrebno analizirati kontekst, ki vključuje razumevanje namena, dogodka in strategije sistema. Zadnji korak predstavlja štiri kategorije funkcionalnosti: podpora primarni nalogi, podpora dialogu, verodostojnost sistema in družbena podpora. Vsaka izmed kategorij vsebuje orodja in strategije, katerih cilj je motivirati in prepričati ljudi k uporabi prepričevalnih sistemov.

Kot razvidno, je področje prepričevalne tehnologije tesno prekrivo s psihologijo človeka in razumevanjem človeškega vedenja. Iz tukaj izhaja potreba po vključitvi psihologije človeškega vedenja, ko se oblikuje in razvija prepričevalna tehnologija na način, da posamezne intervencijske strategije PSD modela temeljijo na psiholoških in socialnih teorijah. Številni znanstveniki še vedno opozarjajo na potrebo po vključevanju vedenjskih teorij pri oblikovanju prepričevalne tehnologije (Orji & Moffatt, 2018). Ugotovljeno je bilo, da kar 74 odstotkov raziskav o razvoju prepričevalnih tehnologij ni upoštevalo nobene vedenjske teorije. Med tistimi, pri katerih so bile vedenjski modeli upoštevani, pa je bil najpogosteje uporabljen transteoretični model spreminjanja vedenja (angl. *Transtheoretical model of behaviour change – TTM*).

Transteoretični model spreminjanja vedenja ocenjuje posameznikovo pripravljenost za novo vedenje in ponuja strategije, ki ga vodijo skozi stopnje spremembe. Sestavljen je iz petih faz: nezavedanje, namera, priprava, ukrepanje in vzdrževanje. Vsaka stopnja vsebuje različne

intervencijske strategije, ki so za posameznika v določeni fazi najbolj učinkovite in mu pomagajo doseči idealno stopnjo vedenja – vzdrževanje spremembe. Vedenjske spremembe posameznikov ali skupnosti predstavljajo velik izziv, zato združitev s področjem prepričevalnih tehnologije odpira nove priložnosti.

Namen magistrskega dela je združiti dva teoretična modela – PSD in TTM ter identificirati katere prepričevalne intervencije so najbolj učinkovite v določenih fazah transteoretičnega modela. Kot je razvidno iz prejšnjih raziskav, na področju oblikovanja prepričevalne tehnologije primanjkuje integracije vedenjskih teorij, zato bo preučevanje in vključitev PSD komponent v TTM pozitivno prispevalo k oblikovanju produktov za vedenjsko spremembo.

Prvi cilj magistrskega dela je podati teoretično ozadje TTM in PSD modela, ter na podlagi tega opredeliti dejavnike, ki vplivajo na posameznikovo napredovanje skozi faze sprememb TTM. Drugi cilj je razviti model, ki vsebuje intervencijske strategije PSD modela, ujemajoče se s karakteristikami in potrebami, ki jih ima posamezna TTM faza, da bi učinkovitejše podpirali vedenjsko spremembo. Za uspešno zasledovanje ciljev, sem zastavila raziskovalno vprašanje in dve podvprašanji.

Kako uporabiti PSD model za podporo posameznim stopnjam TTM?

1. Katere stopnje TTM modela so najbolj smiselne za apliciranje PSD modela?
2. Katere elemente PSD modela je mogoče uporabiti v določeni fazi TTM?

S pregledom literature sem identificirala značilnosti in potrebe TTM faz, ki jih mora intervencija naslavljalati, da podpre napredek uporabnika skozi stopnje spremembe. Sklenila sem, da apliciranje PSD modela koristi vsaki fazi TTM modela. Kljub temu, so rezultati empiričnega dela pokazali, da bi bilo potrebno posvetiti posebno pozornost zgodnjim fazam TTM modela.

Pri raziskovanju drugega vprašanja sem na podlagi pregleda literature, povezala PSD model (uporabila sem tretji korak modela – smernice za oblikovanje sistemskih funkcionalnosti) s TTM modelom, glede na potrebe in značilnosti posamezne faze. V vsaki stopnji sem identificirala intervencije, ki so smiselne pri oblikovanju prepričevalnih sistemov za vedenjske spremembe. Rezultat je bil predlog modela, ki združuje karakteristike in potrebe TTM faz ter funkcionalnosti PSD modela, ki naslavljalajo omenjene potrebe. Zadnji korak pri raziskovanju drugega vprašanja je bila empirična raziskava, kjer sem s poglobljenimi intervjuji preverila smiselnost predlaganega modela in nadgradila modela na podlagi empiričnih spoznanj.

Raziskava magistrskega dela je pokazala pomembnost usklajevanja PSD intervencij glede na stopnjo spremembe v kateri se posameznik nahaja. Prav tako, je dala vpogled v to, kako lahko posamezne PSD funkcionalnosti PSD sistema podprejo napredovanje skozi posamezne faze TTM. Pokazalo se je, da je pri mapiranju PSD na TTM smiselna redukcija

petih faz na dve ključni: zgodnje in pozne faze. V prvi fazi so intervencije usmerjene v razumevanje, v drugi fazi pa v ukrepanje.

Teoretični prispevek magistrske naloge je obsežen pregled literature, skupaj s predlaganim modelom, ki se lahko uporablja pri oblikovanju in razvijanju informacijske tehnologije, ki želi doseči vedenjsko spremembi pri uporabnikih. Prav tako naloga doprinese pomembne implikacije na področju oblikovanja uporabniških izkušenj in vmesnikov. Predlagan model lahko oblikovalcem pomaga identificirati fazo spremembe, v kateri se njihova ciljna skupina uporabnikov nahaja, nato pa uporabo ustrezne funkcionalnosti in intervencije.

Zaključim lahko, da za razvoj informacijske tehnologije ni potrebno le tehnično znanje, temveč tudi poglobljeno razumevanje človeške psihologije in vedenjskih teorij. Ugotovitve kažejo, da je zapolnjevanje vrzeli med vedenjskimi teorijami in prepričevalnimi sistemi perspektivno področje, z veliko možnostmi za dodatne in bolj poglobljene raziskave.

Appendix 2: Interview matrix

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
Q1 – Behavioural change	<p>Change: Regular physical activity (7x per week), 1,5 years</p>	<p>Change: 15.000 daily steps, 1,5 years</p> <p>As a consequence of behavioural change (selling the car and increasing active mobility)</p> <p>Why: 1) knowing that physical activity is important for leading a healthy life 2) combining pleasure with functionality – combining physical activity with something pleasurable. Intensive walking and meditation.</p> <p>Results: relaxation, less stress, feeling “fit”, »it is easier for me to cope with everyday stress«</p>	<p>Change: regular meditation + practising breathing exercises, 9 months</p> <p>Trigger: appendix inflammation, complicated recovery, and later encouragement from a person she admires (a role model), who practices meditation and self-exploration. Joining a 5-day online retreat.</p> <p><i>»It has developed from a need because I was feeling stressed. «</i></p> <p>Feeling of helplessness – not being in control of your own life.</p> <p>Results: improved focus, focus on the present moment</p>	<p>Change: giving up sugar, 2,5 years</p> <p>The desire to stop first appeared 5 years ago</p> <p>Trigger: feeling of dissatisfaction after consuming large quantities of sugar. You start wondering what can be done. You put it off.</p> <p>Beginning: a challenge – 40-day fast. You notice that you are feeling better, but you go back to your old ways.</p> <p>Trigger: it happens after lunch or when you are stressed. You eat to feel. When you eat sugar, your mind becomes clouded and you do not feel yourself.</p> <p>Results: feeling of success, being in control of your habits – not being controlled by a bad habit.</p>	<p>Change regular physical activity (4 times a week), healthy eating, 6 years</p> <p>First started contemplating in high school (10 years ago), when her mother encouraged her to join her food combining diet. She enjoyed the support. After 90 days she reverted to her previous habits.</p> <p>Trigger: looking at the mirror, reality check on the scale</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
Q2 – Decision-making process	<p>Beginning: the contemplating has lasted a couple of years before putting the plan into practice. He wanted to be in better shape when doing sports. He purchased a membership with a friend and started with him. Friend = trigger.</p> <p><i>With all behavioural changes it is important to have someone to supervise and motivates you.</i></p> <p>Trigger: photos of himself, upcoming wedding</p> <p>What I missed: a smart watch to keep track of the results. <i>I wished I was more motivated, got more help and encouragement from someone.</i></p> <p>Simulations: no</p> <p>Tunnelling: no</p> <p><i>»What helped most was working together with my friends, their motivation and comparing each other's progress. «</i></p>	<p>Two connected decisions:</p> <p>1) <i>What impressed me the most was when I had a meeting with a man (X) who told me that a one to two-hour walk is enough for a healthy body.</i></p> <p>2) A consequence of the change of the second habit (selling a personal vehicle). »From the point of view of a new mobility walking works perfectly with my change. You find out that while taking a walk you can think a lot, be creative. It helps me work through certain things. «</p> <p>Easier transition: /</p> <p>The current corona-related situation additionally triggered the process because I had more time.</p> <p>Conversation and situation (corona)</p> <p>Tunnelling: maybe. »Yet what helped mi most was getting this idea from a person I admired.</p>	<p>Feeling like there is no other option. Lack of meaning of life. Feeling of uselessness.</p> <p>Beginning: on sick leave, dedicated a lot of time to this</p> <p>Writing a diary and answering the question (what my attitude to money is, social status)</p> <p>The possibility of introducing the habit into the daily routine.</p> <p>Looking for info: experts, a community that consoles you, so that you do not feel like a looser for doing this</p> <p>Easier transition: proof, that you as an individual are not problematic because you want to change.</p> <p>»The community that I live in has a great influence. «</p> <p>Simulation: yes</p> <p>Tunnelling: Yes, but doubts that it would be enough to make the decision.</p>	<p>Presence of negative motivation, feelings of failure.</p> <p>On the other hand, positive motivation.</p> <p>Without planned information seeking. More exploring myself: <i>»Why do I resort to this. What motivates me to indulge in sugar. What stops me from doing this. «</i></p> <p>Trigger: post-partum problems. It was a gradual process.</p> <p>What I missed: the support of people around me. You look for understanding. Think-alikes.</p> <p>At the beginning you do not even realize how much of it you eat. You should have it written down and look at it weekly</p> <p>Simulation: yes</p> <p>Tunnelling: without looking for a tool, but if I come across one, maybe.</p>	<p>Beginning: started exercising alone, later discovered recorded classes online that gave her more encouragement and motivation.</p> <p>Results are motivation to continue.</p> <p>Joining an online course of a Slovene influencer. From there on it was easy. I got meal plans, exercise explanations. All the knowledge I needed. When everything is offered to you on a silver platter it is easier to absorb.</p> <p>Easier transition: »I could use additional support. At the beginning it is difficult to start because you are in bad shape and do not feel good in your own skin. It is difficult because you are not used to it from before, so a lot of discipline and persistence are needed. «</p> <p>Simulation: Yes, very encouraging. <i>So that you see what you work for.</i> An app that enables you to enter information</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
		<p>Someone has to plant the seed that later develops into a change. «</p> <p>Simulation: yes</p>			<p>(type of activity and food) and produces a simulation based on the two. Two additional functionalities: 1) The app offers various possible scenarios »if she exercises this much and eat this way, you can reach this goal. « 2) the option of changing body dimensions you don't like about yourself and the app offers you an action plane to reach results.</p> <p>Tunnelling: Yes. Personal trainers do this. Any help would be welcome at the beginning.</p> <p>Social learning: Yes. It is already offered by the app MyFitnessPal. Friends whose meal plans you want to follow are added. Negative aspect: obsessive comparisons, feelings of guilt, judgement.</p>
Q3 – Emotion in the beginning	<p>Positive: feeling content after working out</p> <p>Negative:</p> <p>Fear: /</p>	<p>»I am beginning to like it and I enjoy seeing results. «</p> <p>Fear: /</p>	<p>Change brings reflection.</p> <p>Negative: feeling of guilt, that you did not do this before, why do we allow it to get to this state</p> <p>Fear, that it would not help</p>	<p>Even with small changes you feel like a winner.</p> <p>Fear from failing, can I endure this</p> <p>Help with fear:</p>	<p>Confusion, incomprehension: for example, nuts, everyone says how healthy they are, nobody warns about how they are actually high in calories.</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
			Help with fear: daily check-in, daily reminder that offers a sense of calmness	»You need to get into the thing that hurts most and shorten the way. «	When you get the necessary knowledge about it, you start enjoying yourself. You get a desire to share the knowledge with others. Help with confusion: a person to guide you through the process and tells you ups, and downs are normal. Fear from failing, shame, feeling of being judged by everyone.
Q4 – Preparation stage	<p>Activities: purchasing gear, fitness membership, training plan</p> <p>Easier transition: some would perhaps benefit from the help of a personal trainer; I did not decide to get one as I believed I would succeed regardless.</p> <p>Environment adjustment: negotiating with my partner due to absence</p> <p>Reduction: maybe</p>	<p>Gradual exercise with no concrete goal.</p> <p>Introducing the change (walking) into the workday. Intentional prolongation of active mobility: going to the store, bakery on foot. Later longer routes.</p> <p>The current situation (corona) helped walking become a ritual (a walk every day).</p> <p>Easier change: Finding a ritual that you get settled in quickly.</p>	<p>Liberation of other activities.</p> <p>Facilitation of all activities.</p> <p>Environment adjustment: paper and pencil always with you, so that every time a thought comes you put it on paper. When I write it down on paper it does not worry me anymore and I do not think about it anymore.</p> <p>Suggestion: yes. Even if a person is aware of the need to change it is difficult to start. If someone suggested different approaches it would be very useful.</p>	<p>There were ups and downs. I tried for 3 days and then reverted again.</p> <p>I did not stock up on alternatives.</p> <p>Suggestion: Yes. On the right place at the right time.</p> <p>»What would help would be a group of people that I would communicate with. I should feel like a part of a community. So that you are not alone like a fish in the sea that swims against the stream. «</p>	<p>Activities: pre-prepared meal plan and trainings, adjusting the schedule,</p> <p>You have to organize your schedule in a way that you know what follows.</p> <p>»Realizing the change has to become your priority at the beginning. For me it is easiest to do this in the morning when I have the most time. When I come from work, I am tired. «</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
		<p>Suggestion: Yes. »I needed someone to open my eyes. «</p> <p><i>Reduction: Yes »Walking is by itself the simplest way of physical activity. The phone counts my steps which is a great motivation. I am competing with myself. «</i></p>	<p>An app that guides you through your daily activities. How to organise your day, what to make time for. I would make a schedule for the entire day. – Tunnelling?</p> <p>Reduction: maybe</p>		<p>When you have a plan and pre-made meal plan you do not reach for unhealthy food.</p> <p>Suggestions: maybe.</p> <p>Reduction. A lot. At the beginning everything was simplified. The exact calculation of calories I can eat/burn, exact training plan. If you have it written down somewhere it is easier than calculating it in your head.</p>
Q5 – Action stage	<p>Motivation: positive results, received praise</p> <p>Protection forms unwanted behaviour: strong will</p> <p>Social support: yes, some (max 3) a group of people who work out together</p> <p>Social facilitation: <i>»It would be a great encouragement for me to go to fitness to see that my friend is there. «</i></p>	<p>Conscious search for time slots for physical activity. In the morning, midday, and evening.</p> <p>Protection from unwanted: <i>» The phone notifies me of my results so I can compete with myself. If the average result is lowering, I feel bad. «</i></p> <p><i>Social facilitation: Yes, a great motivation.</i></p>	<p>Introducing meditation into the morning routine.</p> <p>During a busier schedule going back to breathing exercises.</p> <p>Avoidance: always carrying a notebook with to-dos. An overview of the worst scenarios + reflection</p> <p>Social support: »I never use comparing functions, what is more, if I come across one in an app, I turn it off. This is my</p>	<p>A lot of battles with myself.</p> <p><i>»You had to outdo yourself. it was necessary to ignore the want and go do something else. Sometimes you had to turn off your mind. «</i></p> <p>Facing yourself. Realisation: I did not dare to stick up for myself. Sugar helped me calm down.</p> <p>Social support: Yes.</p>	<p><i>»I started with very simple exercise. With no systematic choice of exercises, no warm-up, no stretching. If I was not doing well, I adjusted the difficulty of the series on my own. Now when I look back the trainings were ineffective and unsystematic, but they were a good basis to start from. «</i></p> <p>Social networks and joint fit challenges enable easier performance, additional knowledge, and precise instructions for all parts of the training.</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
			world and I like to be alone in it. «	Social facilitation: Yes. Sharing experiences would help a lot.	Help: outside encouragement Elimination of behaviour: <i>»If you stop you start feeling bad, which sets you back to the beginning. You need to remember you feel good after exercising and relive that. «</i> Social support: yes
Q6 – Temptations	<p>Temptations: testy food</p> <p>Controlling temptations: comparing kcal to workout time needed to burn the calories.</p> <p><i>»I am comparing, how much time I will need to burn the calories I ate. If I think this way, it is easier for me to resist the temptation. «</i></p> <p>Alternative: because he likes carbonated beverages, he substituted coca cola with sparkling water.</p>	<p>Controlling temptations: results on the phone.</p> <p>Situations in which the temptation occurs: tiredness</p> <p>Ideal environment: <i>»Closer that I am to the ritual, less temptations there are. «</i></p>	<p>Temptations: hurrying, belief that there is not enough time, location, travelling</p> <p>No matter where you go when you go you have to make this your priority.</p> <p>Controlling temptations: self-discipline, habit</p> <p>Situations in which the temptation occurs: stressful environment, unreasonable deadlines</p> <p>Help with temptations: <i>»That someone would remind me that the most important thing is that I eat, sleep and feel</i></p>	<p>There are two types of temptations.</p> <p>1) From outside: Saying no to a nice lady who offers you a tray.</p> <p>2) From yourself: And the other when you feel you want it</p> <p>The key is finding an alternative and have it in stock.</p> <p>Environment adjustment: No sweets at home. <i>»The environment has to encourage you to what you strive for. «</i></p> <p>Emergence: feeling bad, stressful period. You adjust the environment.</p>	<p>Temptations come from the environment (events). You succumb more easily and quickly. If you do not adjust the environment (sweets in the drawer).</p> <p>Temptation to leave out training: when you are having a bad day</p> <p>Controlling temptations: entering food intake into MyFitnessPal to see the calorie intake and you realize it is not ok.</p> <p>If everything is under control (regular training, healthy diet) it is easier to resist temptations.</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
			good. Then comes everything else. «	Help with temptations: A friend's encouragement would help.	Ideal temptation-free environment: a partner with the same goals, both striving to lead a healthy life, moving. So that no one can tempt you. Help: Not having time for the temptation. When you are constantly moving, you do not have time to think about food. Buddy support: No. It would be more helpful to get advice from a person close to me.
Q7 – Maintenance stage	<p>I have a goal that I want to reach.</p> <p>Help not to give up: Every time I want to increase my ability. Keeping track of progress and striving to keep improving.</p> <p>What helps: It helps a lot to have fun when you are doing this. You combine pleasure with functionality, you run when watching TV. Or you choose another sport.</p> <p>Reward: Yes. »If the people around you notice the change and praise your appearance, this</p>	<p>Maintaining a lifestyle because it is important for well-being.</p> <p>What helps: tracking success</p>	<p>The routine changed compared to the first half of the year. She no longer needs headphones; a walk or silence is enough to practice meditation.</p> <p>Adjustment: meditating on a walk, you try to feel every step, feel the sun.</p> <p>What helps: »<i>That I have people around me, who don't judge me.</i> «</p> <p>Easier to maintain striving to improve. Constant reflection. »<i>What would help would be a guide how to continue now I am calm and do not feel stressed a s</i></p>	<p>»<i>It is not about keeping up anymore, but that is how it is. It becomes your lifestyle.</i> You realise how to have a clean body, how to say no to this, everyone around you already knows, why would you go back. For me this is like going back to high school. Like negating myself. «</p> <p>Help not to give up: »<i>It is not difficult anymore. I am not struggling. It has become a life goal. You do not talk about it anymore. It is not a part of your environment. People do not offer it to you anymore.</i> «</p>	<p>Morning routine.</p> <p>Meal pan.</p> <p>Planned day.</p> <p>Help not to give up: Results. When I feel the results, I know I am on the right track and I will not give up.</p> <p>Easier to maintain temptation-free environment, combining pleasure with functionality – instead of going for a coffee with a friend, going hiking to Šmarna gora.</p> <p>Rewards, praise: yes</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
	is motivating. Also, if you join a competition and you do well. «		<p><i>much. When I get the desire to get somewhere someone would show me where that is and what else I can do. «</i></p> <p>Reward: yes, but one that I see, but not others. Gamification and collecting stamps – like in Audible.</p> <p>Something that would track your progress.</p>	<p>After a year resisting the temptation becomes easier.</p> <p>What helps: »You need to remember what you are gaining and which feelings you don't want. «</p> <p>Praise: Yes. But sometimes people around you do not understand.</p>	<p>»Sometimes we do not want to accept praise. Sometimes we do not reach the desired results, which shows. When someone praises us we are too critical towards ourselves, because we know we are not where we want to be. «</p>
Q8 – Emotions in maintenance stage	<p>Feeling better</p> <p>Visible results = feeling better</p>	Pleasant feelings.	Calm feelings.	Pride, contentment, feeling of being in control of your habits	<p>The same as at the beginning. But more of the good ones. Pride, Happiness. Joy. Motivations.</p>
Q9 – Tracking behaviour	»Tracking helped me a lot. I had a watch and was keeping track of my results. I was happy to be improve successfully. «	Tracking has a big role.	<p>Tracking was very easy. The app had a to-do list. Every day I had to meditate, and I was annoyed if I left one out. It was important to me to tick the to-dos every day and get stars.</p> <p>Easier tracking of improvement: I like Apple health for my period where you record your state. Nothing descriptive, you just mark. Or Bedtime that tells me to calm down 45 minutes before going to sleep. I stick to that very much.</p>	<p>»At the beginning, tracking is very important. You need a story to encourage you, such as today marks 50 days of not eating. When you reach the goal, you do not feel like tracking anymore. «</p> <p>Easier tracking: mobile app</p> <p>Taking notes of progress: physical charts and ticks, but not always.</p>	<p>A lot.</p> <p>I only track the positive things. When I break the rules I do not enter it into MyFitnessPal. Due to fear of being blamed and judged. I get a guilty conscience.</p> <p>Easier tracking: a device that measures dimensions on its own (smart scale). It is difficult to measure dimension every month.</p> <p>Tracking trainings with a smart watch. This is additional</p>

Category	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
			Better tracking. When to meditate or how I am feeling that day or if I have been in a stressful situation. For example, every time I feel stressed, I tap on my phone and then I can see my progress.		motivation. Because you can compare results for the past.
Q10 – Social influence in maintenance	<i>»I do not mind the broader society; I mind my friend group to notice changes on me and praise me. «</i>	Yes. Competitiveness, lasting mobility, promotion of walking, seminar about walking, collective consciousness, learning.	A lot. It is important for the environment not to judge you and your decision. The influence of the partner when introducing healthy eating. Even if I do not feel like eating meet, I do, because he does. The role of general trends.	What motivates you are successful and educated people and above all their lifestyle. Society as environment, in which I live, has no effect, except the already accepted.	Big influence. Negative: We look at pretty girls with no flaws, who are not real. On the other hand, we have girls who are real and show hard work and tell that hard work is necessary. Positive: support groups in academics, sharing progress, results. Seeing others work hard, too.
Q11 – Tech support on behavioural change	An app that enables you to see your friends in the fitness. This way you get additionally motivated even when you are having a bad day. Comparing results with friends.	The option of additional tracking throughout the day would serve as additional encouragement.	<i>»It's on you to make the decision. And the technology can take you through the process well. To keep reminding you daily, to reward you, to make you addicted, to feel good.«</i> It depends on the target group and their time, responsibilities. In her case the change worked best when she lived alone.	Feeling accepted. Sharing results, even if only with one person. Getting their feedback. Reminders. Like I am app to remind you once in while that you are on the right track. Once you have this desire you are bound to reach the goal, because I believe that we are	So that it studies your habits, patterns and create a way to move forward. To offer you opportunities. To guide you through that. Example: Smart bottles start winking when you have to drink.

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Gender	M	M	F	F	F
Age group	30-40	30-40	20-30	20-30	20-30
			An ideal app for behavioural change should be personalized and not that focussed on the type of notifications that, for example, pushes FB »a friend liked your pic « Notification should be mapped to our context, our situation.	inclined to progress. We always want more.	

Source: Own work.