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Mobile Interface Design for Evoking Motivation Design Implications from Self-Determination Theory and Motivational Interviewing

Master's Thesis

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<p>This study aims at finding ways to structure a mobile user interface in a way that it evokes user's inner motivation toward a behavioral change. More specifically, the user interface design of this thesis aims at eliciting change talk and making the user feel understood by the use of reflective listening while simultaneously supporting user's autonomy. The techniques being implemented are adapted from a face-to-face counseling method, motivational interviewing. Moreover, self-determination theory is applied as a theoretical framework.</p> <p>The differences of interaction in a face-to-face situation compared to the interaction between a user and a mobile UI form the foundation to design challenges in this study. Limited input and output possibilities, different use situations compared to interviewing sessions and the lack of real-time human interaction are the main differences and thus, reasons for the design challenges.</p> <p><i>A Research through Design</i> –model is applied as a research approach for this thesis. As a part of the model, different design alternatives were explored and design artifacts were created. Finally, the design created was evaluated by comparing it to other similar mobile applications on the market.</p> <p>Some of the most important results of this thesis include asking the user to think before revealing multiple-choice answer options in order to facilitate user's higher-order thinking process, providing both simple and deep reflections and a possibility to fine-tune previous answers in order to support the user's feeling of being understood, and letting the user be always in control to support user's autonomy. However, further research is needed to study if the research aims are met with real users in real use situations, as well as the effectiveness of the design for behavioral change.</p>		
Keywords	Persuasive design, self-determination theory, motivational interviewing, change talk, reflective listening, user's autonomy, mobile user interface	

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<p>Tämä diplomityö pyrkii löytämään keinoja järjestää puhelinkäyttöliittymä siten, että se herättää käyttäjän sisäisen motivaation elämäntapamuutosta kohti. Erityisesti suunniteltava käyttöliittymä pyrkii houkuttelemaan käyttäjästä muutospuhetta sekä saamaan hänet tuntemaan itsensä ymmärretyksi reflektiivisen kuuntelun avulla samalla käyttäjän autonomian tarvetta tukien. Käyttöliittymään toteutettavat tekniikat perustuvat motivoivan haastattelun metodiin. Lisäksi itseohjautuvuusteoriaa hyödynnetään tämän työn teoreettisena viitekehyksenä.</p> <p>Eroavaisuudet kasvokkain tapahtuvan haastattelumenetelmän vuoro-vaikutuksessa verrattuna käyttäjän ja puhelinkäyttöliittymän vuorovaikutukseen muodostavat perustan haasteille tämän tutkimuksen design-työssä. Rajoitetut tiedon syöttö- ja tulostusmahdollisuudet, puhelimen erilaiset käyttötilanteet haastattelutilanteeseen verrattuna sekä ihmisvuorovaikutuksen puute ovat tärkeimmät eroavaisuudet ja siten syyt suunnitteluhaasteille.</p> <p><i>Tutkimusta designin kautta</i> -lähestymistapaa sovellettiin tutkimusmetodina tässä työssä. Erilaisiin design-vaihtoehtoihin perehdyttiin sekä design-ratkaisuja luotiin tutkimuksen osana. Luotu design arvioitiin vertaamalla sitä muihin vastaaviin mobiilisovelluksiin markkinoilla.</p> <p>Työn tärkeimpinä tuloksina käyttäjää pyydetään miettimään vastaustaan ennen monivalintavastausvaihtoehtojen paljastamista käyttäjän ajatteluprosessin tukemiseksi, tarjotaan yksinkertaisia ja syvempiä reflektiota sekä mahdollisuus hienosäätää aiempia vastauksia käyttäjän ymmärretyksi tulemisen tunteen tukemista varten sekä annetaan käyttäjän olla aina hallinnassa autonomian tarpeen tukemisen tähden. Lisätutkimusta kuitenkin tarvitaan tutkimaan käyttöliittymäratkaisuja oikeiden käyttäjien kanssa oikeassa käyttötilanteissa sekä tulosten vaikuttavuutta käyttäytymisen muutoksessa.</p>		
Avainsanat	Suostuttelevat teknologiat, itseohjautuvuusteoria, motivoiva haastattelu, muutospuhe, reflektiivinen kuuntelu, käyttäjän autonomia, puhelinkäyttöliittymä	

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1 Introduction

This thesis discusses the possibilities of technology in facilitating a behavioral change. More specifically, this thesis introduces ways to evoke user's inner motivation by eliciting change talk and making the user feel that he or she is understood while simultaneously supporting user's autonomy in a mobile application. The features introduced in this thesis are features of a mobile application called "Precious". The overall goal of the application is to facilitate user's behavioral change into a healthier lifestyle. Self-determination theory and motivational interviewing are applied as a theoretical background for the features introduced. Moreover, persuasive technology principles are discussed and mobile user interface design principles are taken into account in the design process of this thesis.

1.1 Research background and motivation

Obesity and physical inactivity are one of the greatest causes of premature death and they increase the risk of several diseases of affluence, such as coronary heart disease and type 2 diabetes, as well as breast and colon cancers. (Lee, et al., 2012; Schroeder, 2007.) Lifestyle factors have a great influence in people's life expectancy (Mathers, Stevens, and Mascarenhas, 2009) and they affect people's health and well-being (Schroeder, 2007). For example, being physically active provides several benefits, including physical and mental well-being, better quality of life, sense of purpose and value, and improved sleep (Das and Horton, 2012). Unfortunately, over 30% of adults worldwide are inactive and

do not reach physical activity recommendation levels (Hallal, et al., 2012). Therefore, promoting physical activity is a priority for public health agencies worldwide (Glasgow and Emmons, 2007; Heath, et al., 2012).

Behavioral patterns and lifestyle factors have an important role in people's health and wellbeing. Hence, the greatest potential for improving population health is to reduce the amount of behavioral risk factors, such as physical inactivity, smoking, and obesity. (Schroeder, 2007.) Supporting behavioral change in lifestyle factors is an important feature of chronic disease management. For example, increasing the level of physical activity is one aspect of lifestyle modifications having a positive impact on hospital admission rates and risk of mortality. (Matthews, et al., 2016.)

Although supporting behavioral change towards a healthy lifestyle is important for chronic disease management, face-to-face treatments and interventions are usually neither very cost-effective nor easy to organize. Thus, they are difficult to scale-up. (Garrett, et al., 2011; Thomas and Bond, 2014; Wu, Cohen, Shi, Pearson and Sturm, 2010.) However, the increasing amount of smartphones and the access to Internet becoming more common (Matthews, et al., 2016), mobile applications can provide an alternative to inefficient face-to-face counseling sessions in large populations.

Mobile technologies provide an opportunity to improve disease management through the developing field of mobile health. Mobile health applications can be used to inform, educate and persuade users and influence their behavior through persuasive technology. (Matthews, et al., 2016.) Davies, et al. (2012) conducted a meta-analysis of Internet-based interventions to increase the level of physical activity. They found that Internet-based interventions certainly have small but significant effects on increasing the level of physical activity.

In order to be effective, automatic interventions should be grounded in theory (Brug, et al., 2005; Lustria, et al., 2013; Lustria, et al., 2009). Most of the interventions studied focused on theories such as social cognitive theory, self-regulation theory, transtheoretical model, and theory of planned behaviors (Davies, et al., 2012). Nevertheless, encouraging autonomous motivation is important for promoting physical activity (e.g. Friederichs, 2014; Teixeira, et al., 2012). Self-determination theory (SDT) highlights autonomous motivation in predicting good outcomes (Deci and Ryan, 2008), but SDT was not included as a background theory in any of the interventions studied by

Davies, et al. (2012). However, it seems that automated interventions could benefit from having SDT and MI as a theoretical background since it emphasizes the importance of autonomous motivation.

SDT is a theory of human motivation (e.g. Deci and Ryan, 2008; Ryan and Deci, 2000), whereas MI is a clinical approach to strengthening an individual's motivation and commitment to change (Miller and Rollnick, 2002). SDT and MI emphasize the importance of supporting individual's autonomy in order to evoke inner motivation (Miller and Rollnick, 2002, p. 34; Ryan and Deci, 2000). MI also introduces some specific techniques to evoke an individual's motivation, such as eliciting change talk and reflective listening. Change talk refers to the individual arguing for change him or herself instead of hearing the reasons to change from outside. Reflective listening means reflecting the thing the individual said back to him or her to support his or her need to feel related to others among other things. Both techniques are important in MI when evoking an individual's motivation for change. (Miller and Rollnick, 2002)

Friederichs, et al. (2014) developed a web-based intervention based on self-determination theory (SDT) and motivational interviewing (MI). However, they did not include usability as a part of the design process. In addition, developing features to support eliciting change talk was not included in the study. Furthermore, a mobile interface has its own special characteristics and challenges compared to a desktop interface, such as the fact that a mobile phone is available all the time and feels personal. Moreover, specific to mobile devices is their limited input and output possibilities. (Fogg, 2003, pp. 187, 190.) Therefore, additional research for evoking user's motivation and implementing the techniques of eliciting change talk and reflective listening in a mobile application context is needed.

1.2 Research aims

This thesis describes ways in a mobile application that aim at evoking users' inner motivation to change their lifestyle healthier. Design implications are based on self-determination theory (SDT) and motivational interviewing (MI) since they emphasize the importance of evoking one's inner motivation and resources for behavioral change.

Because eliciting change talk, reflective listening, and supporting autonomy talk are core features of MI, the user interface being designed aims at supporting them.

More specifically, the goal of this thesis is to find ways to structure a mobile user interface so that the design aims are met. The design of the user interface aims at evoking user's inner motivation and resources in order to facilitate behavioral change by

- Eliciting change talk
- Making the user feel that he or she is understood by the use of reflective listening
- Supporting user's autonomy

Implementing the techniques of eliciting change talk and reflective listening are the main design goals of this thesis. In addition to that, the spirit of supporting autonomy is taken into account when discussing eliciting change talk and reflective listening. Autonomy is chosen as an underlying spirit to take into account because it seems to be the most important of the universal needs described in SDT (Deci and Ryan, 2012). Eliciting change talk, reflective listening, and supporting autonomy are described in chapter 3.

1.3 Research approach

In order to find answers to the research goals, this thesis has *a constructive approach*. A constructive approach means problem-solving through the construction of new innovations, such as models, plans, or methods, based on existing theoretical knowledge. A constructive approach aims at answering questions concerning e.g. building new innovations and intentionally changing e.g. behavior. (Järvinen and Järvinen, 2000.) Because this thesis aims at finding new ways to structure a mobile user interface in order to elicit change talk and make the user feel understood (i.e. intentionally changing user's behavior), a constructive approach is suitable for this thesis. Self-determination theory and motivational interviewing are used as an existing theoretical background. Moreover, persuasive technology and mobile user interface design principles are taken into account in the design process.

To further define the constructive approach of this thesis, a *Research through Design* –approach and its applicability to this case are discussed. The Research through Design –model (RtD) was introduced by Zimmerman, Forlizzi, and Evenson (2007) and is based originally on Frayling’s (1993) research through design –model. The model is an approach for conducting academic research that results in generating new knowledge through design. A few points that separate the RtD –model from non-academic design practices consist of three issues: the goal of generating new knowledge, the intention to resolve a novel, problematic situation, and the focus on making the right thing instead of e.g. creating something purely commercially beneficial.

Applied to this case, the research goals of this thesis seem to fit the goals of the RtD –model. First, the aim of this thesis is to generate new knowledge about how to structure a mobile user interface in a way that it elicits change talk, makes the user feel understood by reflective listening, and simultaneously supports user’s autonomy. In addition, the aim of this thesis sets a new problem to which existing theories or solutions do not provide self-evident answers. Finally, this thesis aims at finding the right way to implement MI techniques and does not discuss whether or not the solutions are commercially beneficial. Thus, the RtD –approach is well suitable for this study.

Next, the principles of the RtD –model are shortly introduced in relation to the structure of this thesis.

In the model of RtD, researchers work to integrate three types of knowledge in order to design new things: how, true, and real (Zimmerman and Forlizzi, 2014). The ”how” knowledge refers to the latest technical possibilities adapted from engineers, the ”true” knowledge refers to the models and theories of human behavior adapted from behavioral scientists, and the ”real” knowledge refers to descriptions of the world currently works adapted from anthropologists. See Figure 1 for demonstration.

This thesis concentrates on the ”how” and the ”true” perspectives of the model while the ”real” knowledge is left out of the scope of this study. In this thesis, the ”how” knowledge refers to persuasive computing perspective and the possibilities and limitations of a mobile user interface. The ”real” knowledge in this thesis concentrates on the behavioral theories and methods, SDT and MI, and their implementation into mobile features. The theoretical framework of this thesis is introduced in chapter 2 and

the key concepts of eliciting change talk, reflective listening, and supporting autonomy are described more in detail in chapter 3.

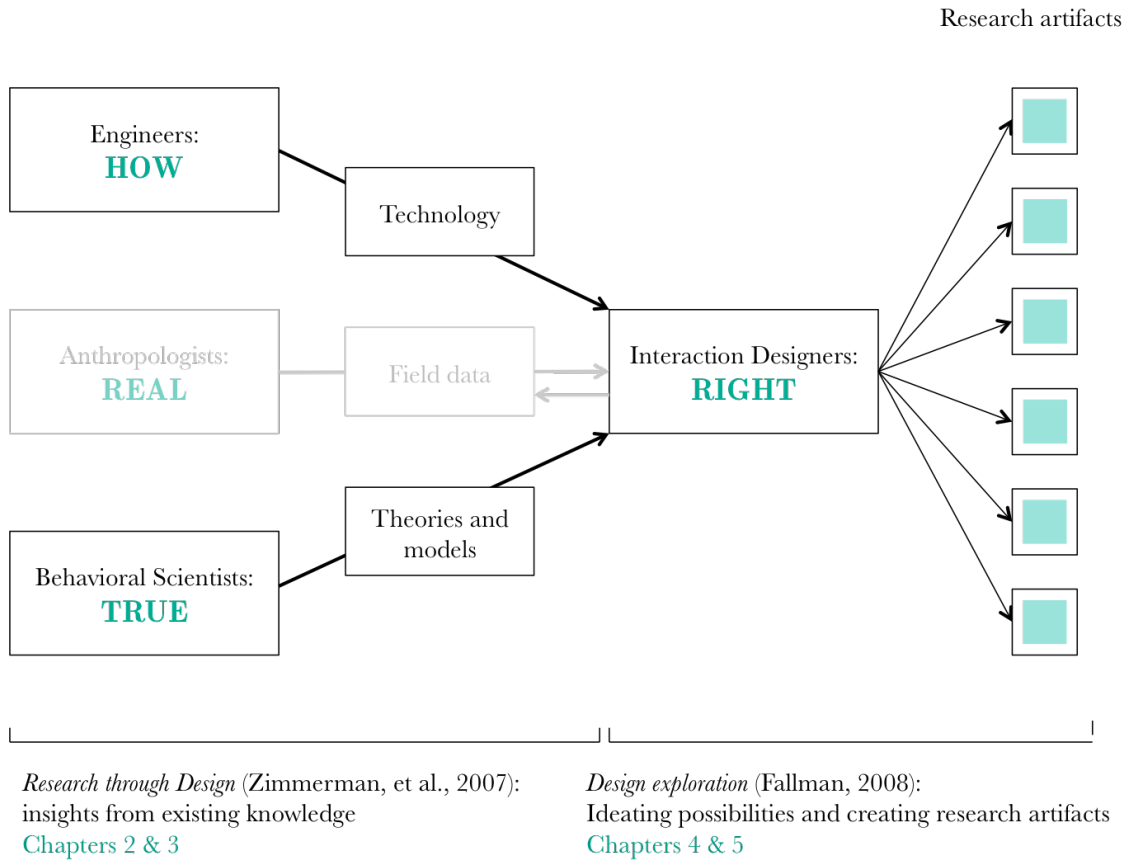


Figure 1. The research approach of this thesis. A simplified version of the figure illustrating *Research through Design* -model (Zimmerman, et al. 2007) completed with the *design exploration* –perspective by Fallman (2008) and their relation to the structure of this thesis.

According to the RtD –model, the design researchers utilize the inputs from the ”how”, ”true”, and ”real” knowledge and ideate many possible visions to solve the research problem (Zimmerman and Forlizzi, 2014). In this thesis, only inputs from the “how” and “true” perspectives are applied. However, Zimmerman and Forlizzi (2014) do not describe in detail how this phase of the model is performed. Hence, this thesis applies the *design exploration* –perspective from the *Interaction Design Research Approach* introduced by Fallman (2008). The design exploration –perspective of Fallman’s (2008) approach utilizes the introduced theories in search of ideas and examples of possible alternatives for the design. It also is also the phase of problem setting, in which possibilities are

explored outside of the known paradigms. It discusses topics such as what is possible, what would be desired or ideal, or just shows alternatives and examples. In this thesis, chapter 4 starts by discussing design challenges and continues then into exploring design possibilities by combining topics from the theoretical framework. After exploring different design possibilities, a more concrete phase is exploited in chapter 5, where more concrete design artifacts for the design and interactions are presented.

Finally, after constructing the new design, it is evaluated in chapter 6. Essential to any constructive approach is *the evaluation of the results*: were the research aims set in the beginning achieved? According to Järvinen and Järvinen (2000), a new innovation has to be evaluated by comparing it to the most suitable existing contenders, if possible. Therefore, chapter 6 evaluates the design constructed in this thesis by comparing it to existing solutions. The design results are discussed in chapter 7.

1.4 Research context

This thesis was written as a part of the PREventive Care Infrastructure based On Ubiquitous Sensing (PRECIOUS) project funded by the European Union. The main goal of the project is to create a preventive health care system that improves its users' health and therefore delivers cost savings in the public health sector. In order to do that, the project aims at designing a mobile application that both evokes user's motivation and helps to find a way to change user's life.

The author of this thesis was responsible for the user interface design in co-operation with other project team members. More specifically, the requirements and features of the application were already determined before an intense design process. However, the implementation of MI and SDT spirit and principles were still to be considered. Therefore, the role of the author of this thesis was to design the user interface taking those principles into account and bringing usability and user experience perspectives to the design process.

2 Theoretical framework

This chapter presents the theoretical framework of this thesis. It consists mainly of three areas: Persuasive computing, Self-Determination Theory (SDT) and Motivational Interviewing (MI). This chapter presents those respectively. In addition, relevant mobile user interface design principles are presented.

2.1 Persuasive computing

Oinas-Kukkonen (2013) suggests that all systems aiming to change user's behavior are persuasive systems. Changing user's behavior is also the overall goal of the Precious-application, which makes it a persuasive system. Persuasive technology or persuasive computing refers to interactive computing systems aiming to change user's psychological attributes, such as attitudes or motivation and behaviors (Fogg, 2003, p. 1; Hamari, Koivisto, and Pakkanen, 2014). Fogg (2003) defines persuasion as “an attempt to change attitudes or behaviors or both (without using coercion or deception)”. The difference between persuasion, coercion, and deception is important since affecting attitudes or behavior through persuasion is always based on voluntariness, while, by contrast, coercion implies force, whereas deception implies taking users' attention with e.g. advertisements flashing on the screen (Fogg, 2003, p. 15). In addition to voluntariness, persuasion also requires intentionality. Persuasive technologies are planned to affect users' attitudes and behaviors, in contrast to just being a side effect of a technology. (Fogg, 2003, p. 16.)

Some domains exploiting persuasive technologies include e.g. commerce, education, occupational effectiveness, and preventive healthcare (Fogg, 2003, p. 3). Oinas-Kukkonen and Harjumaa (2009) argue that persuasive systems could be useful especially in healthcare software applications since they can motivate people toward healthier behavior and therefore delay or prevent medical problems.

Persuasive technologies can be divided into two levels: macrosuasion and microsuasion. Macrosuasion refers to a product designed to have an aim of change users' attitudes or behaviors, while microsuasion refers to smaller persuasive elements to help to achieve a different overall goal of a product. Similar techniques can be used in both levels of persuasion. (Fogg, 2003, pp. 17–18) In the project context of this thesis, the overall goal of the Precious-application is to persuade users to change their behavior healthier, which makes it a macrosuasion product.

Mobile phones as a platform for a persuasive application provide unique opportunities for persuasion. The main reason for that is that the user carries his or her phone with him or her throughout the day. Because of the phone traveling with the user, suggestions can be offered at opportune moments and it is always available. These factors increase mobile phone application's potential to persuade. (Fogg, 2003, pp. 187–189.)

2.2 Four categories of persuasive computing

Oinas-Kukkonen and Harjumaa (2009) suggest four categories for persuasive system principles: primary task support, dialogue support, credibility support, and social support. The Persuasive Systems Design (PSD) framework uses Fogg's (2003) original functional triad and many of its design principles as a foundation. Oinas-Kukkonen and Harjumaa (2009) criticize Fogg's (2003) concept of the functional triad, as it does not explain how the suggested design principles should be converted into software requirements. However, many of the techniques in PSD are similar to Fogg's (2003) suggestions, but they are divided differently.

Matthews, et al. (2016) reviewed the current state of mobile health applications aiming to behavioral change in the field of physical activity. They found that the use of

persuasive mobile applications indicated a positive impact on increasing physical activity. In the next paragraphs, functions and goals of each of the categories according to Oinas-Kukkonen and Harjumaa (2009) are described more in detail. Furthermore, the current status of the use of these categories in smartphone applications is shortly reviewed based on the paper by Matthews, et al. (2016).

Oinas-Kukkonen and Harjumaa (2009) suggest that the first category, primary task support, should help the user to perform his or her primary task with the product. In other words, primary task support features should help the user to achieve the original task which they are using the system for (Matthews, et al., 2016). Some of the techniques in this category include tunneling, tailoring, and personalization. In their review, Matthews, et al. (2016) found that in smartphone applications promoting physical activity, self-monitoring was the most widely used primary task support feature.

The second category, dialogue support, consists of design principles that support the interaction between the user and the computer in a way that users would think to be social or interpersonal interactions (Matthews, et al., 2016). The dialogue support features are designed to help the user to continue towards their original goal or target behavior. Some of the techniques in this category include praise, rewards, reminders, suggestions, and social role. (Oinas-Kukkonen and Harjumaa, 2009). Matthews, et al. (2016) found that many of the dialogue support features are combined with primary task support features to motivate users to engage in physical activity in mobile applications. For example, self-monitoring and tailoring were often combined with reminders, rewards, suggestions, and praise.

Deci, et al. (1999) studied the effect of extrinsic rewards, one of the features of the dialogue support category, on intrinsic motivation. They found that extrinsic rewards do not necessarily promote intrinsic motivation, although Cameron and Pierce (1994) found that they neither decrease intrinsic motivation. In addition, Koestner, et al. (1987) suggest that praise, which is also one of the dialogue support features, can increase intrinsic motivation.

Credibility support is the third of Oinas-Kukkonen and Harjumaa's (2009) categories. It comprises features that indicate to the user that the system is credible and can thus improve the persuasiveness of a system (Matthews, et al., 2016). Trustworthiness, expertise, authority, and third-party endorsements are examples of the

features in this category. Matthews, et al. (2016) found that system credibility support was absent in most of the mobile applications they reviewed. Even though features to increase the system credibility are likely to improve the persuasiveness of a system, they were the least used elements found.

Finally, the fourth category of Oinas-Kukkonen and Harjumaa's (2009) categories is social support. The features in this category motivate users by leveraging social influence, such as by social learning and comparison, cooperation, and competition (Oinas-Kukkonen and Harjumaa, 2009). Matthews, et al. (2016) found that the most used elements from the social support category are social learning and comparison as well as competition.

Despite the fact that persuasive computing aims at changing users' behavior and attitudes, it seems that there is not much attention on the source of user's motivation in such systems. Moreover, it seems that these applications seldom try to evoke user's inner resources and motivation toward a change, although some of the features presented in the categorization by Oinas-Kukkonen and Harjumaa (2009) can facilitate inner motivation. For example, Matthews, et al. (2016) found that self-monitoring is the most used persuasive element in mobile applications aiming to increase user's physical activity. In contrast, this thesis aims at designing a user interface evoking user's inner motivation. Therefore, self-determination theory, including the importance of motivation source and quality, and motivational interviewing are next taken into a closer examination.

2.3 Self-determination theory

Self-determination theory (SDT) is a macrotheory of human motivation that emphasizes the importance of person's own inner resources for personality development and behavioral self-regulation (Ryan and Deci, 2000). Central to SDT is its division of motivation into two categories: autonomous and controlled motivation. Moreover, SDT describes universal psychological needs. (Vansteenkiste and Sheldon, 2006.) The theory has been applied to many health-related domains because it has been noticed that patients having their autonomy supported benefit most from treatment (Vansteenkiste

and Sheldon, 2006). In addition, SDT also describes life goals and aspirations, energy and vitality, and the importance of social environments on human motivation, affect, behavior and well-being (Deci and Ryan, 2008). However, these concepts are not covered in this thesis.

The following subsections describe SDT's perspective to optimal motivation and basic psychological needs more in detail.

2.3.1 Autonomous and controlled motivation

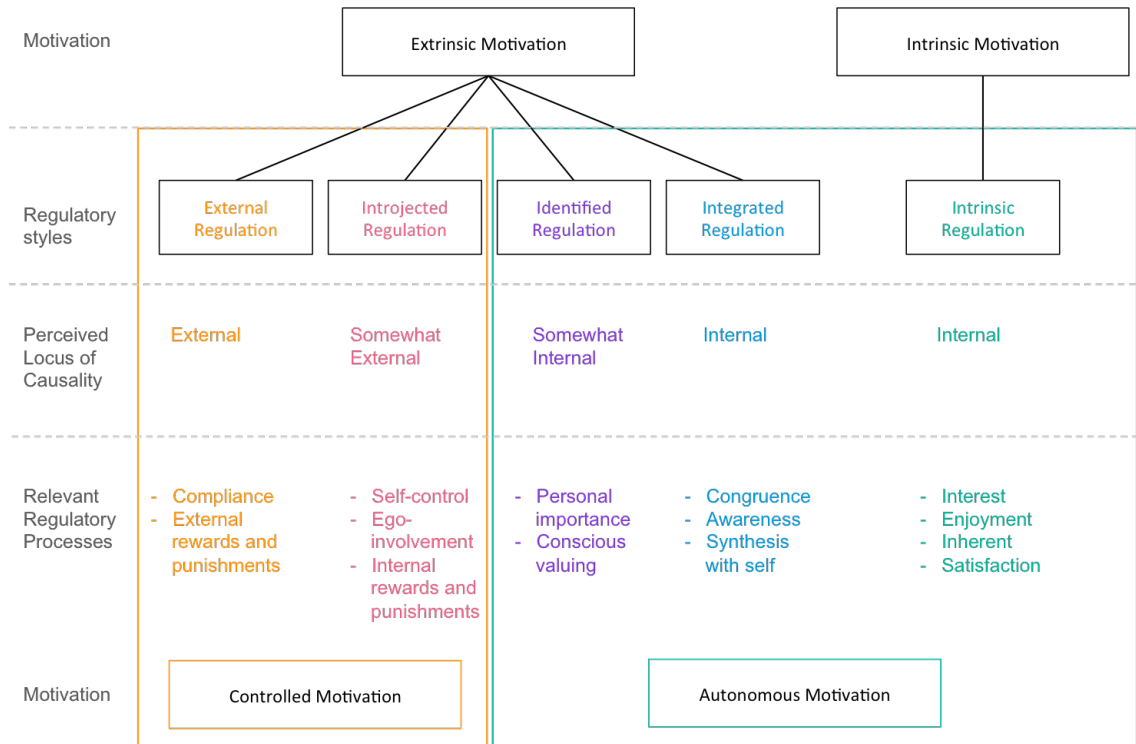
Instead of paying too much attention to the quantity of motivation, SDT's central idea is to differentiate types of motivation and take the quality of motivation into account. SDT argues that the type of motivation is more important for predicting good outcomes, such as psychological health, effective performance, or well-being, than the amount of motivation. (Deci and Ryan, 2008.)

SDT separates motivation into two categories: autonomous and controlled motivation. An opposite to both autonomous and controlled motivation is amotivation, which refers to a lack of motivation and intention (Deci and Ryan, 2008). Table 1 presents different motivation types in SDT according to Ryan and Deci (2000).

First, autonomous motivation includes both intrinsic motivation (e.g. activities and behaviors experienced fun or enjoyable themselves) and well-internalized extrinsic motivation (Deci and Ryan, 2012). Deci and Ryan (2008) define well-internalized extrinsic motivation as a motivation in which people experience an activity being integrated into their sense of self. Moreover, in autonomous motivation the perceived locus of causality toward an action or behavior is internal. The types of extrinsic motivation belonging to autonomous motivation are integrated regulation (e.g. synthesis with self) and identified regulation (e.g. behavior or act meeting personal importance or being consciously valued). (Ryan and Deci, 2000.)

According to SDT, another type of motivation is controlled motivation. It includes both external regulation (e.g. external rewards and punishments) and introjected regulation (e.g. ego-involvement and internal rewards and punishments).

Table 1. Motivation types according to SDT (Ryan and Deci, 2000).



In controlled motivation, the perceived locus of causality toward an action or behavior is external in contrast to autonomous motivation. (Ryan and Deci, 2000.) When one experiences controlled motivation, he or she feels the pressure to feel, think, or behave in a particular way, whereas being autonomously motivated, one experiences volition or self-endorsement of his or her actions. The central idea of SDT is that people autonomously motivated achieve better outcomes and greater long-term results in physical activity. (Deci and Ryan, 2008.) This thesis concentrates on evoking user's autonomous motivation instead of controlled motivation.

2.3.2 Basic psychological needs

According to SDT, all people have three basic psychological needs: the needs for autonomy, competence, and relatedness. Autonomy refers to experiencing psychological freedom and not acting alone (the definition of autonomy will be discussed more in detail in chapter 3). Competence means experiencing a sense of effectance, or, in other words, the feeling that "I am able to do this". (Vansteenkiste, Williams, and Resnicow,

2012). Lastly, the feeling of relatedness refers to the human need to feel connected to other people (Baumeister and Leary, 1995).

When these three basic psychological needs are being fulfilled and supported by social environment, an individual's well-being is enhanced, whereas in contrast, if something prevents these needs to be satisfied, well-being is reduced and performance is poorer. (Chirkov, Ryan, Kim and Kaplan, 2003; Deci and Ryan, 2008) As the feelings of autonomy, competence and relatedness form the foundation to universal human well-being, they are required for effective and optimal human functioning and psychological health in all cultures (Deci and Ryan, 2008). According to Deci and Ryan (2012), many studies have established that the satisfaction of these three psychological needs predicts human well-being applies to all regardless of gender, age, socioeconomic status, and culture.

When all three are supported, patients in health care engage in treatments more volitionally and additionally, maintain better outcomes over time. (Ryan, et al., 2008.) Furthermore, supporting autonomy typically promotes also the needs for competence and relatedness. This usually happens for two reasons: firstly, people supporting other's autonomy tend also to support their needs for competence and relatedness. Secondly, when autonomy is supported, the person is likely to make decisions and behave so that his or her needs for competence and relatedness get supported as well. (Deci and Ryan, 2012.)

Supporting autonomy is one of the design goals of this thesis because it seems to promote support for other needs as well. Although supporting competence and relatedness are not central to the goals of this thesis, all of the design solutions should be consistent with these concepts, too.

2.4 Motivational interviewing

Motivational interviewing (MI) is a counseling method aiming to elicit individual's behavioral change by enhancing his or her intrinsic motivation so that the wish to change arises from the person himself or herself. MI has been used in healthcare and public health settings (Resnicow and McMaster, 2012). It is a way to help patients to

identify their problematic behaviors. Moreover, MI aims at helping to identify and mobilize patient's life goals and to reflect his or her current behavior to that. (Rubak, et al., 2005). MI can be effective especially among patients that are in the early states of change, such as being reluctant to change, or ambivalent about changing their behavior (Rubak, et al., 2005; Vansteenkiste and Sheldon, 2006).

MI can be divided into two phases, both having different goals. The first phase concentrates on evoking and building patient's intrinsic motivation. Phase two takes place after the decision to change has been made. In phase two, talking about strategies to change is central rather than talking about reasons for a change. (Miller and Rollnick, 2002, p. 52.) Since this thesis focuses on design that evokes user's inner resources for change, the focus of this thesis is the first phase of motivational interviewing.

Miller and Rollnick (2002), the creators of MI, describe the technique as “a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence”. Being a client-centered method means that motivational interviewing concentrates on the person's present interests, concerns, and perspectives instead of e.g. teaching new coping skills or reshaping cognitions (Miller and Rollnick, 2002, p. 25). Additionally, MI has been described as both a communication style and a set of techniques (Rubak, et al., 2005). The emphasis is on MI being a style of therapy instead of just a set of techniques (Miller and Rollnick, 2002, p. 25; Miller, 1996) and MI being a “facilitative approach to communication that evokes natural change” (Miller and Rollnick, 2002, p. 25). Both the style and more specific principles of MI are described next.

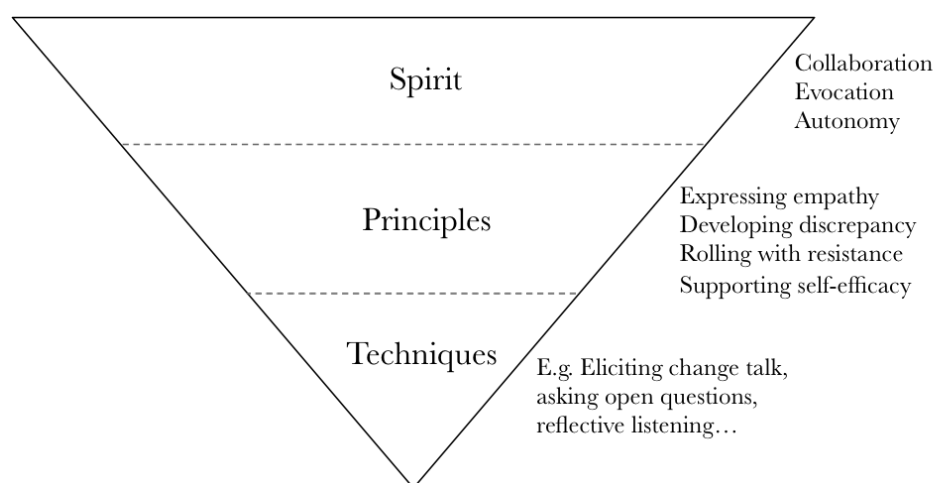


Figure 2. MI described as a pyramid. See text for details.

2.4.1 The spirit of motivational interviewing

As described earlier, MI is also a communication style in addition to providing specific techniques. The creators of motivational interviewing have put more emphasis on the fundamental spirit that underlies the specific techniques. Understanding the spirit of MI is vital for the process because the method is all about being with people and understanding the human nature. The spirit of MI consists of three components: collaboration, evocation, and autonomy. (Miller and Rollnick, 2002, p. 34.)

The first key component of the spirit of motivational interviewing is communicating in a partner-like relationship instead of counselor being authoritarian. The counselor tries to create a positive interpersonal atmosphere that supports the person being interviewed and promotes the change. (Miller and Rollnick, 2002, p. 34.)

The second key component of the spirit of MI is creating evocation. The idea of evocation is to elicit intrinsic motivation from the inside of the person and finding his or her own reasons for the change. (Miller and Rollnick, 2002, p. 34.) Since the overall goal is to elicit the person's intrinsic motivation, no behavioral change is going to happen if it is not in some way in the person's inherent interest (Miller and Rollnick, 2002, p. 26).

Lastly, autonomy as a key component means that the patient is responsible for the change him- or herself. The patient is always free to decide to take the counsel or not. The idea of autonomy is based on increasing intrinsic motivation as change arises from the person and his or her own personal goal and values. (Miller and Rollnick, 2002, p. 34.) This is also why the client is the one naming the arguments for change rather than the counselor: one is more likely to believe in his or her own words rather than someone else's sayings (Miller and Rollnick, 2002, p. 39).

2.4.2 Principles of motivational interviewing

Besides of a certain spirit, motivational interviewing provides also more concrete principles and specific techniques. The four principles consist of expressing empathy, developing discrepancy, rolling with resistance, and supporting self-efficacy. (Miller and Rollnick, 2002, p. 36.) The principles of MI are described in this subsection.

The first principle is expressing empathy. The idea of this is to create a feeling for the client that his or her needs, feelings, and concerns are understood and accepted. The counselor is not supposed to judge, criticize or blame the client. Instead, the idea of expressing empathy is to understand his or her thoughts and perspectives. The reason for that lays behind the fact that acceptance facilitates change. This happens because expressing empathy supports the client's self-esteem, which further facilitates change. (Miller and Rollnick, 2002, p. 36.) However, expressing empathy and understanding the client does not mean that the counselor should agree with the client on everything or approve his or her behavior or thoughts: it is possible to understand someone's situation and perspective without endorsing it or agreeing with it. (Miller and Rollnick, 2002, p. 36.)

Skillful reflective listening is the key for expressing empathy. It is a specific MI technique where the counselor reflects the client's thoughts back to him or her in order to demonstrate that the counselor has heard the client and is trying to understand him or her. (Miller and Rollnick, 2002, p. 36; Resnicow and McMaster, 2012.) Reflective listening is described more in detail in chapter 3.

The second of the four general principles of MI is developing discrepancy. Although the counselor tries to hear and understand the client, the idea of MI is not to accept the client as he or she is but rather lead him or her to the direction of change. This happens by creating discrepancies between the client's current behavior and his or her values and broader life goals. A skillful counselor can make the client notice these discrepancies on his or her own without directly telling the client to change: instead, the client him or herself presents concerns of his or her current state and reasons for a change. (Miller and Rollnick, 2002, pp. 38–39.)

The third principle is to roll with resistance. Instead of directly arguing against the client's resistance toward the change, the counselor should roll or flow with it. A direct argument can be counterproductive and might guide the client in the opposite direction. When the counselor does not directly oppose the resistance or argue for the change, but rather considerably invites new perspectives and involves the client actively in the process of problem solving, resistance can be turned into new momentum toward change. By rolling with the resistance and turning questions or problems back to the client, the counselor also respects the client as an autonomous individual who is capable

of finding his or her own answers and solutions for change. (Miller and Rollnick, 2002, pp. 39–40.)

The last of the four general principles of MI is supporting self-efficacy. Self-efficacy means person's belief of his or her own capability to succeed with a specific task. A sufficient amount of self-efficacy is a key element in motivation for change. Therefore, one of MI's goals is to increase and support the client's confidence toward succeeding in the change process. Methods for supporting self-efficacy include e.g. reminding the client of his or her past success or even telling about others who have succeeded in changing behavior, or giving the client a message that "if you wish, I can help you". (Miller and Rollnick, 2002, pp. 40–41.)

In sum, the four principles (expressing empathy, developing discrepancy, rolling with resistance, and supporting self-efficacy) are all core elements of motivational interviewing and often needed for a successful change in behavior. They have been shown to be effective in various fields of study, such as addiction treatment, diet, physical activity, diabetes, and hypertension. (Vansteenkiste and Sheldon, 2006.)

2.4.3 Key techniques of motivational interviewing

The spirit and principles of MI create the foundation of the technique. However, correctly used specific techniques and strategies under the spirit help to evoke patient's intrinsic motivation toward the change. The most important techniques consist of reflective listening and eliciting change talk. (Resnicow and McMaster, 2012.) Shortly, reflective listening refers to listening to the patient and reflecting his or her own sayings back to ensure e.g. that the counselor has understood the client's perspective correctly (Miller and Rose, 2009). Moreover, eliciting change talk refers to getting the patient arguing for the change by him or herself (Miller and Rollnick, 2002, p. 76). Both reflective listening and eliciting change talk are discussed more in detail in chapter 3.

2.5 Comparison of self-determination theory and motivational interviewing

Even though self-determination theory and motivation interviewing were developed separately, they have a lot in common. Counseling in both of the approaches is about eliciting individual's own motivation by supporting their inner resources and own perspectives. (Deci and Ryan, 2012; Vansteenkiste and Sheldon, 2006.) They have similar concepts e.g. about supporting autonomy and competence, and they are both non-judgmental and supportive (Deci and Ryan, 2012). Moreover, Vansteenkiste and Sheldon (2006) showed that the two approaches can be integrated.

Both of the approaches share the positive idea of an individual being an active, growth-oriented organism who has the potential toward personal development and change. Rather than trying to impose the change or force the individual to motivate for the change, the clinician tries to strengthen and evoke the patient's inner resources that are already inherent in the individual. (Vansteenkiste and Sheldon, 2006.) In particular, supporting autonomy is important in both SDT and MI (Deci and Ryan, 2012).

Regardless of many similarities between SDT and MI, they also have different viewpoints. First of all, SDT is a top-down approach as in its development the theory has driven the intervention. In contrast, MI is a bottom-up approach where the intervention was developed first from clinical intuition and experience instead of being driven by any particular theoretical framework. (Vansteenkiste, et al., 2012.)

In addition to different origins, SDT and MI also have different perspectives on the motivation that drives people to change. MI emphasizes the importance intrinsic motivation for change, whereas SDT has a more careful grouping of different types of motivation affecting to the willingness to change. More specifically, SDT divides extrinsic motivation into four categories as well as it divides motivation into controlled and autonomous motivation (Deci and Ryan, 2008). Vansteenkiste and Sheldon (2006) argue that instead of eliciting intrinsic motivation, MI more likely promotes the internalization of extrinsic motivation and results in greater identified or integrated motivation for change. This is because of the nature of intrinsic motivation: they argue that it is not realistically possible to change an individual's perception of something being fun or enjoyable themselves.

Besides of a different approach to the quality of human motivation, SDT and MI also have differences in concepts of autonomy support and the quality of change talk. Chapter 3 gives a more detailed view on both the key concepts of this thesis and differences in those concepts according to SDT and MI.

2.6 Automated interventions

This thesis aims at finding a way to bring some of the techniques of MI into a mobile user interface. Therefore, a few topics are first covered in order to understand the possibilities of automated interventions as well as existing solutions. First, studies about short intervention times in MI are shortly discussed and compared to mobile usage times. Then, a short introduction of an existing web-based intervention based on SDT and MI is given.

2.6.1 Short intervention times

The effectiveness of MI intervention typically decreases with contact time (Emmons and Rollnick, 2001). However, Emmons and Rollnick (2001) argue that it is possible to provide support for behavioral change goals also in short intervention sessions, such as in 7 to 10 minutes or even in 1 to 2 minutes. Similarly, Rubak, et al. (2005) found that motivational interviewing can be effective even in brief sessions of 15 minutes.

Success with shorter intervention times suggests that MI interventions could be effective also in automated applications, such as in mobile environments. Böhmer, et al. (2011) studied the usage time of mobile applications. They found that the average session with an application is shorter than a minute. However, an average time using health-related applications was found to be approximately 2,5 minutes. Thus, shorter intervention times can be useful in starting the motivation evoking process, but engaging in the process and repeated contact might be required in order to gain good overall results in the behavioral change process. Therefore, an automated intervention, such as a mobile application, should engage the user to visit the application frequently and engage in the process. (Emmons and Rollnick, 2001.)

The next subsection shortly introduces an automated, web-based intervention based on SDT and MI. After that, the following section describes some of the most important mobile user interface features for this thesis.

2.6.2 The I Move: a web-based intervention created from self-determination theory and motivational interviewing

Friederichs (2014) developed a web-based computer tailored physical activity promotion intervention in his doctoral thesis. The intervention is called the I Move (originally Ik Beweeg in Dutch). The goal of the intervention is to improve and maintain adults' physical activity. Self-determination theory and motivational interviewing were used as theoretical insights for the development. Similarly to the goal of this thesis, also Friederichs et al. (2014) tried to bring reflective listening into an automated platform.

Friederichs (2014) also studied the effectiveness of the I Move intervention both in short (6 months) and long (12 months) terms. He found that the I Move can have a small but significant positive effect on physical activity levels compared to a control group. He also suggests that web-based computer tailored physical activity interventions should include elements of both self-determination theory, motivational interviewing as well as traditional health behavior theories, such as the theory of planned behavior and social cognitive theory. He suggests further research on the effectiveness of web-based interventions in maintaining physical activity levels.

According to Friederichs, et al. (2014), a web-based system can be similar to a face-to-face counseling setting because of its high interactivity and the possibility to create very specific feedback messages. However, creating skillful reflections is more difficult because of the lack of a human counselor interpreting answers to reflections and open questions. Friederichs, et al. (2014) tried to accomplish a high degree of similarity to a face-to-face setting by creating a unique feedback message for each combination of multiple-choice answers.

In contrast to the aim of this thesis, Friederichs (2014) and Friederichs, et al. (2014) did not concentrate on how eliciting change talk can be optimized in computerized interventions. However, Friederichs, et al. (2014) conducted a pilot study comparing different options for asking open questions. The alternative ways included an

open text field only, a multiple-choice list only, and a multiple-choice list with an open text field possibility. A multiple-choice list combined with an open text field returned the best results because users' commitment towards physical activity increased and they perceived the intervention the most positive. However, Friederichs, et al. (2014) did not discuss the roles of autonomy or eliciting change talk when conducting the pilot study.

In addition to not discussing autonomy and eliciting change talk as deeply as this thesis aims to, Friederichs (2014) did not consider usability as a factor in the development process. In contrast, this thesis takes the usability as well as autonomy supportive perspective into account when exploring different design possibilities for eliciting change talk and reflective listening. The design exploration is discussed in chapter 4. Moreover, differences between the I Move intervention and the design in this thesis are discussed in chapter 6.

2.7 An overview of mobile user interface guidelines

This thesis aims at bringing the techniques and spirit of MI and SDT into a mobile user interface. Therefore, a short overview of existing mobile user interface guidelines is discussed. Moreover, an important aspect of this thesis is input methods of mobile devices. Thus, a short overview covering different input possibilities is also presented.

2.7.1 Simplicity and efficiency of use

Shitkova, et al. (2015) argue that poor usability can cause a decrease in user productivity and loss of users in mobile applications. Similarly, Lee, et al. (2015) argue that an effective user interface is needed for mobile applications because of the high level of effort in interacting with a mobile device. Moreover, simplicity is a key antecedent of mobile phone usability (Lee, et al., 2015). Thus, efficiency and simplicity are both important characteristics of a usable mobile interface.

The design principles for mobile applications also support the concepts of simplicity (Lee, et al., 2015) and efficient use. For example, the design should be simple and clear. Similarly, long texts should be avoided and simple sentences preferred

instead. The navigation should be as easy and simple as possible and the number of clicks needed should be minimized. In addition, controlling the user interface by touch can be imprecise, which is why it should be optimized for the user. (Shitkova, et al., 2015.)

Optimizing the touch control is also a key factor in entering user input to a mobile application. Therefore, one of the greatest challenges in mobile applications is their limited input capability. However, that does not exclude the potential of persuasion. (Fogg, 2003, p. 190.) The following subsection introduces some key aspects of voice and text input as well as multiple-choice options as an input method. In the end, a short discussion of multiple-choice options facilitating higher-order thinking is presented.

2.7.1 Mobile input methods

Smith and Chaparro (2015) studied different smartphone input methods and their effectiveness as well as perceived user experience. Voice input was found to be one of the best options for input, whereas text input was perceived to be less accurate and usable. However, even though voice input was perceived as the best way to enter information, it was tested in laboratory settings instead of real usage situations. Participants were hesitant about using voice input in noisy settings or in situations where privacy is not secured. (Smith and Chaparro, 2015.) In contrast, the reason for bad ratings in the usage of text input resulted from the small screen and keyboard size and the lack of haptic or audio feedback. Moreover, Zamri and Al Subhi (2015) found a mobile user interface guideline suggesting that selection should be used instead of text input for keeping the user input as simple as possible.

Selection can be provided with multiple-choice answer options, where the user chooses an input from a given list. Albert, Tullis, and Tedesco, (2010) discuss the use of “None of these” and “I don’t know” answer options in a multiple-choice list. They argue that having such options better supports cases in which users cannot find the desired option from a list and thus can prevent frustration among users.

Similarly to the efficiency of use and simplicity of input methods being significant to mobile user interfaces, an important design goal of this thesis is to elicit change talk from

the user. Cheong, Bruno, and Cheong (2012) studied higher-order thinking for learners at school context. They argue that multiple-choice options do not typically support higher-order thinking because users are usually better able to choose an answer from a multiple-choice list instead of actually developing one of their own.

3 Key concepts

This chapter further continues to define the theoretical framework of this thesis by giving more detailed descriptions of the key concepts of this thesis: eliciting change talk, reflective listening, and supporting autonomy. Both eliciting change talk and reflective listening are key techniques of MI to evoke user's inner motivation and resources toward a behavioral change. Moreover, supporting autonomy is a key spirit of MI as well as a universal need according to SDT. Each of the terms is first defined carefully. After that, a description of how they are used in traditional face-to-face interventions is shortly described.

3.1 Eliciting change talk

Eliciting change talk is one of the key skills for MI counselors to use for evoking patient's intrinsic motivation toward a change (Miller and Rollnick, 2002, p. 67). Change talk refers to having patient talking about his or her behavior change (Deci and Ryan, 2012). Different types of change talk include acknowledging disadvantages of present behavior and advantages of change, expressing optimism about change or intention to it (Miller and Rollnick, 2002, pp. 77–78), plans of when and how to do the change, as well as possible effects on patient's next of kin (Deci and Ryan, 2012). Opposite of change talk is sustain talk, which favors present behavior and argues against change (Miller and Rose, 2009).

According to Clark, et al. (2006) linguists have studied the content of speech in relation to positive behavioral change. They found five categories of motivational speech

that actually facilitate behavioral change: desire, ability, reason, need, and commitment language. The categories can be remembered from an acronym of “DARN-C” that stands for

- **D**esire (I want to, I prefer, I wish...)
- **A**bility (I can, I am able, I could, possible...)
- **R**easons (I should, why to do it...)
- **N**eed (I must, I got to, importance...)
- **C**ommitment (I will, I am going to...) (Clark, et al., 2006)

Change talk is important for change because people are more likely to believe their own arguments and opinions rather than someone else's. According to Bem's (1972) self-perception theory, people tend to be more committed to what they hear themselves argue. Similarly, the more an individual argues for the change, the greater his or her commitment to it often becomes. (Resnicow and McMaster, 2012.) Moreover, change talk is preferentially reflected in MI sessions so that the patient hears his or her ideas at least twice. (Miller and Rollnick, 2002, p. 72.) Thus, when individuals argue for a change and express their desires, abilities, reasons and needs for change, they hear themselves explaining their own motivation for change (Hettema, Steele, and Miller, 2005).

MI places a great emphasis on change talk and its effectiveness in evoking motivation for change (Deci and Ryan, 2012). The amount, intensity, and sequence of change talk are all important elements of the change process within MI, whereas SDT places greater importance on the quality of change talk. (Resnicow and McMaster, 2012.) More in detail, from SDT perspective, controlling forces can also prompt change talk (Vansteenkiste, Williams, and Resnicow, 2012), e.g. when the patient describes why others would want the patient to change. In comparison to that, change talk based on autonomous motivation might end in better overall results, in contrast, to change talk that e.g. has introjected tone or it reflects external pressure. (Resnicow and McMaster, 2012.)

Different methods to elicit change talk include asking evocative questions, elaborating previous change talk, exploring the decisional balance, querying extremes, looking back or forward, using importance and confidence rulers, and exploring goals and values (Miller and Rollnick, 2002, pp. 78–83). The simplest way to elicit change talk

is to ask the person for such statements e.g. arguing for a change or exploring his or her perceptions and concerns. (Miller and Rollnick, 2002, pp. 78, 80.) Thus, open questions are important in MI. Open questions allow the patient to come up with his or her own answers. Moreover, Ryan, et al. (2010) argue that asking open questions instead of providing a set of response options better supports patient's autonomy from SDT perspective.

Another easy way to elicit change talk is to simply ask the patient to elaborate more on the previous change talk e.g. by asking a follow-up question to tell more about a topic or asking more specific reasons behind previous change talk. It can also be useful to have the patient to consider both the negative and positive aspects of their present behavior to help to resolve ambivalence. Moreover, elaborating both sides of their change can make the patient more comfortable than if he or she was just asked to elaborate the negative effects. (Miller and Rollnick, 2002, pp. 78, 80.)

In an MI session, change talk is literally talking one's ideas aloud. In contrast, when change talk is promoted with a mobile application, the user does not necessarily talk his or her ideas aloud. Instead, he or she likely thinks quietly and thus, "change talk" refers to internal thinking. Hence, this thesis refers to change talk in a mobile application use context as a change talk instead of "change thinking".

3.2 Reflective listening

As well as eliciting change talk, reflective listening is a key technique of MI for facilitating behavioral change and creating discrepancy (Miller and Rollnick, 2002, pp. 78, 83; Resnicow and McMaster, 2012). For reflective listening being possible, the patient should do most of the talking during an MI session. Moreover, the atmosphere in the session should be approving and trustful so the patient would feel comfortable sharing his or her perspective and concerns. In order to create such an atmosphere and making the patient talk more, most of the questions asked should be open questions instead of closed ones. (Miller and Rollnick, 2002, p. 65.) Commonly in MI sessions, open questions are asked first to set the topic of exploration and elicit the patient to do the talking, and then follow patient's answers with reflective listening.

The critical part of reflective listening is how the counselor responds to the patient's sayings (Miller and Rollnick, 2002, pp. 67–68.) Resnicow and McMaster (2012) describe reflective listening as a form of hypothesis testing, where the counselor reflects the patient's thoughts back to him or her in order to ensure that he or she understood the patient correctly.

Some examples of reflective listening include e.g. the counselor saying “If I heard you correctly, this is what I think you are saying...” or, often when the counselor is more skilled, just by phrasing the reflections in more truncated form, e.g. “You are having trouble with...”. Simpler level reflections just repeat what the patient just said, possibly in different words, to demonstrate that the patient has been understood. In contrast, deeper level reflections try to understand the meaning or feeling behind the patient's statement. (Resnicow and McMaster, 2012.) Another form of deeper reflections is to try to continue the patient's paragraph. In that way, reflections actually take the discussion further instead of just echoing what the patient has just said. (Miller and Rollnick, 2002, p. 70; Resnicow and McMaster, 2012.) In addition, reflections should be provided often in order to avoid series of questions and question-answer roles: as a rule, no more than three questions should be asked in a row without sufficient reflections (Miller and Rollnick, 2002, p. 56).

The goals of reflective listening include demonstrating to the patient that the counselor is listening and is trying to understand what he or she is saying. Affirming the patient's thoughts, feelings, and concerns without judgment, critique, arguing against or for a change is included in the concept of reflective listening (Miller and Rollnick, 2002, p. 68; Resnicow and McMaster, 2012). Reflections are supposed to help the patient to get involved and to continue in the process of self-discovery. Furthermore, reflective listening is a way to ensure that the MI session remains patient-driven. (Resnicow and McMaster, 2012.)

Sometimes the counselor needs to guess the meaning behind the patient's sayings (Miller and Rollnick, 2002, p. 69; Resnicow and McMaster, 2012). Even if the reflections prove to be inaccurate, the patient can correct the counselor and therefore have his or her thoughts more clarified. Explaining and illuminating his or her thoughts to the counselor can also move the discussion forward. (Resnicow and McMaster, 2012.)

Moreover, elaborating his or her answer can elicit further change talk (Miller and Rollnick, 2002, p. 88).

Resnicow and McMaster (2012) describe seven different types of reflections that also support autonomy and patient volition. Reflections described vary from simply rephrasing the patient's words or summarizing what he or she has told during the discussion to more complex reflections focusing on e.g. patient feelings, rolling with resistance, acknowledging ambivalence, or incorporating a potential courses of action (Miller and Rollnick, 2002, pp. 71, 74; Resnicow and McMaster, 2012). Resnicow and McMaster (2012) give specific instructions on how and when to use each of the reflection types: for example, content reflections can be useful when trying to understand patient's background, whereas double-sided reflections can help the patient to see both their feeling for and against the change.

3.3 Supporting autonomy

This section starts by defining autonomy more in detail before defining the concept of autonomy support from both SDT and MI perspectives. Moreover, differences between supporting autonomy in MI and SDT are shortly discussed.

In SDT, autonomy is one of the three basic psychological needs that must be satisfied for psychological health and effective functioning (Ryan and Deci, 2000). Similarly, autonomy is one of the three key elements in defining the spirit of MI (Miller and Rollnick, 2002, p. 34). Both SDT and MI aim to support patient's autonomy to evoke motivation for change (Deci and Ryan, 2008; Resnicow and McMaster, 2012).

The definition of autonomy relates to people's need to feel volitional (Resnicow and McMaster, 2012). Someone being autonomous means that he or she experiences willingness and a sense of volition rather than someone controlling him or her. Autonomy can also be described as experiencing a sense of psychological freedom instead of being pressured to think, feel or behave in particular ways. (Deci and Ryan, 2012; Vansteenkiste, Williams and Resnicow, 2012.) However, from SDT perspective, being autonomous does not necessarily mean acting independently, but instead, the person should feel volitional to choose whether to act or not. Therefore the person being

autonomous should have the feeling that he or she is free to make his or her own decisions without any pressure from other people. This is why autonomy in SDT is described as “autonomy-as-volition” instead of “autonomy-as-independence”. (Deci and Ryan, 2012.) In MI, autonomy is referred as the patient’s right and capacity for self-direction (Miller and Rollnick, 2002, p. 35).

According to SDT, supporting autonomy in health care means encouraging patients to make their own choices about their behavior by providing them the information they need to make an informed decision, and respecting their decision. Because autonomy does not mean acting independently, leaving patients alone to make decisions is not autonomy supportive. Instead, it is important to support patient’s feeling of making the decision volitionally and not being controlling with him or her. In practice, SDT defines ways of supporting autonomy e.g. by providing the patient all relevant information and by helping them to find a way to commit to the decision they have made. (Deci and Ryan, 2012.) In addition to those, MI also emphasizes shared decision-making, linking the change to the patient’s broader goals and values, and a lack of coercion or direct persuasion from the counselor (Resnicow and McMaster, 2012).

The concept of “supporting autonomy” differs slightly in SDT and MI (Vansteenkiste, et al., 2012). MI emphasizes personal choice throughout the treatment and that the reasons for change should always arise from the patient’s own values and goals (Miller and Rollnick, 2002, pp. 27, 91). For example, advice should be given mostly after the patient gives permission to that (Miller and Rollnick, 2002, p. 132). In SDT, the emphasis is on the experience of volition rather than making decisions independently. Vansteenkiste, et al. (2012) argue that it is unclear if such a differentiation is made within MI. In SDT, the source of the decision-making process (i.e. deciding by oneself vs. deciding with the help of others) is not as strongly emphasized as in MI, but rather the experience of volitional decision making is important. (Vansteenkiste, et al., 2012.) However, both SDT and MI highlight that external advice should not be judgmental and it should include the possibility to not change the behavior (Miller and Rollnick, 2002, p. 131; Resnicow and McMaster, 2012).

Although it is important to let the patient make his or her own decisions, supporting autonomy in SDT does not mean letting the patient do whatever he or she

wants or being permissive of everything. Instead, it means providing patient all the relevant information to use for making their own informed decisions and telling the consequences of different behaviors. In contrast to SDT's perspective to providing advice, in MI viewpoint advice should be given only when the patient requests it or when the counselor has asked for a permission to give advice (Miller and Rollnick, 2002, p. 131). However, the idea is not to scare the patient with the information or using it to push his or her into a specific decision, but instead, provide the information in a neutral way without judging or scaring him or her. (Deci and Ryan, 2012.)

Supporting autonomy is not limited to just being one technique, but instead all MI techniques should be autonomy supportive as the spirit of MI suggests (Miller and Rollnick, 2002, pp. 33–34). Therefore, all the techniques used in the mobile application should also be autonomy supportive. Supporting autonomy is one of the points of comparison in the next chapter discussing eliciting change talk and reflective listening.

3.4 Chapter summary

The main points of previous chapters concerning the implementation of eliciting change talk, reflective listening, and supporting autonomy are shortly repeated in this section. The issues presented are also the most relevant in the following chapters discussing the implementation of MI techniques into mobile application features. Main points are first listed and then shortly explained.

Eliciting change talk

- The patient argues for a change him or herself
- By asking open questions and further elaborating previous answers

Change talk refers to the patient arguing for his or her desires, ability, reasons, and needs for change. This is important because people are more likely to believe what they hear themselves argue compared to someone else's arguments according to self-perception theory. Ways to elicit change talk include e.g. asking for such statements with open questions and asking the patient to further elaborate previous change talk.

Reflective listening

- Interpreting the patient's answers into reflections
- Both simple or deeper reflections. Deeper reflections better move the discussion forward
- Reflections should be provided more often than questions are asked

Reflective listening is closely related to eliciting change talk because the patient's answers are interpreted into reflections that aim to understand what he or she just said. Moreover, reflections repeat the patient's change talk so that he or she hears his or her arguments again. Reflections can be either simple, such as when repeating or rephrasing what was just said, or deeper, when a meaning or feeling is added to the reflection. Deeper reflections better move the discussion forward and thus, better elicit further change talk. For example, the patient can clarify or correct inaccurate reflections. Reflections should also be provided quite often in order to avoid long question-answer chains, which put the patient and the counselor into undesirable question asking and answering roles.

Supporting autonomy

- Autonomy refers to the need to feel volitional
- Autonomy is an underlying spirit
- The patient is not pressurized in any way

Supporting autonomy refers to supporting the patient's need to feel volitional. Thus, the patient is the one to argue for change and he or she makes his or her own decisions. The patient is not pressured to think, feel, or behave in a certain way. For example, advice is given only when the patient asks for it or when permission is first asked. However, all techniques used should support patient's autonomy since it is a spirit of MI instead of a specific technique.

4 Design exploration

This chapter is the *design exploration* part of this thesis. The design exploration – perspective discusses design possibilities drawn from SDT, MI, and user interface design features in order to implement the techniques of MI into mobile application features. Main MI concepts discussed in this thesis consist of eliciting change talk and giving the user the feeling that he or she is understood by reflective listening. Moreover, supporting autonomy is a central feature of the user interface designed.

This chapter begins by providing a more detailed description of the approach. After that, different design challenges arisen from the integration of face-to-face counseling techniques into a mobile user interface features are discussed. Next, different design alternatives for eliciting change talk and reflective listening are discussed and compared from five perspectives: their support for eliciting change talk, reflective listening, autonomy, persuasive technologies, and mobile user interface design principles.

4.1 Exploration approach

After studying different types of knowledge, the Research through Design –model by Zimmerman, et al. (2007) suggests utilizing this information and ideating many possible visions to solve the research problem. Similarly, Fallman (2008) suggests in his Interaction Design Research Approach (IDRA) that different design possibilities should be explored. This thesis combined the two approaches so that the underlying framework

of RtD by Zimmerman, et al. (2007) is supplemented with the design exploration – perspective from the IDRA –model by Fallman (2008).

The concept of “design exploration” refers to finding out what is possible, what would be desirable or ideal, or just showing alternatives and examples. Design exploration can be driven e.g. from ideals or theory. (Fallman, 2008.) In this thesis, design exploration is driven mostly from SDT, MI, and mobile user interface principles since the key concepts to be implemented into mobile features are MI techniques, SDT being the theoretical framework.

According to Zimmerman and Forlizzi (2014), a RtD –project aim at solving a problematic, novel situation and thus, creating new knowledge. Hence, the next section starts the design exploration by describing the kinds of challenges that an implementation of traditionally a face-to-face situation into mobile features causes. After that, the actual design exploration part of this thesis is described and different design alternatives are discussed.

4.2 Design challenges

Eliciting change talk, reflective listening and supporting autonomy are the key concepts to be implemented into mobile application features. However, while motivational interviewing is a face-to-face counseling method that relies heavily on the interaction between the patient and the counselor, the Precious application is a mobile application with interaction between the user and the mobile interface. This difference forms the foundation to the challenges in implementing MI techniques into a mobile user interface. Limited input and output possibilities, different use situations compared to interviewing sessions and the lack of real-time human interaction are the main differences and thus, reasons for the design challenges.

The first difference is the small screen size of a mobile phone. The small screen size limits user’s input possibilities as well as the application’s output possibilities, such as typing in answers and providing information and advice. Shitkova, et al. (2015) recommends keeping texts short and sentences simple in a mobile UI, which can be challenging when providing deeper reflections and feedback for the user. Moreover, as

Lee, et al. (2015) pointed out, limited input possibilities and small screen size in a mobile UI call for effective user interface design. For example, in an MI session the patient is supposed to do most of the talking (Miller and Rollnick, 2002, p. 65), but in a mobile application requesting the user to type in long answers is not fast and effortless. Thus, the first challenge for the design is to find a way to ask open questions in an efficient way.

The second difference is the different use situation of a mobile application compared to a traditional MI session. For example, the user can be on the road when using the application (Lee, et al., 2015) without much time or willingness to concentrate on his or her thoughts. Therefore, it can be challenging to make the user truly think his or her answers to open questions in a possibly busy use situation. Moreover, even if the user thinks about his or her answer, he or she cannot be assumed to enter long texts to answer, as discussed previously. However, Cheong, Bruno, and Cheong (2012) point out that multiple-choice questions and answers, an alternative to typing in open answers, limit higher-order thinking, as users would just select a suitable option from a list rather than really developing their own answer. Therefore, the second challenge is to find a way to answer open questions that both is effortless and also elicits higher-order thinking and change talk.

The third difference is the lack of human analyzing the user's answers and forming reflections, affirmations, and summaries based on his or her answers. Unlike a human counselor, a mobile application is not capable of interpreting answers into open questions or profound reflections. This is challenging especially for making the user feel that he or she is understood: automatic, simple reflections just repeating what the user has just said does not necessarily express empathy or support relatedness, as MI and SDT core principles request (Friederichs, 2014, p. 170). In contrast, deeper and more complex reflections can better express empathy. Thus, the third design challenge is to find ways to make the user feel understood.

An element of reflective listening is to make guesses about what the patient means or feels and then let the patient correct these assumptions in order to further elicit change talk (Resnicow and McMaster, 2012). However, a mobile UI should be effortless to use (Shitkova, et al., 2015), which suggests that long guess-correction-chains should not be used. Therefore, the fourth challenge is the question of how to allow

deeper reflections for eliciting change talk and moving the discussion forward without taking too much user's time and effort.

In sum, the key design challenges for implementing eliciting change talk, reflective listening, and simultaneously supporting autonomy into mobile application features are as follows:

1. How to ask open questions in a way that supports both efficiency of use and user's autonomy and promotes change talk?
2. How to make the user really think about his or her answers without a presence of face-to-face human interaction?
3. How to provide reflections in order to make the user feel understood?
4. How to allow deeper reflections for eliciting change talk and moving the discussion forward without taking too much user's time and effort?

4.3 Eliciting change talk

In motivational interviewing, change talk is often elicited by asking open questions or, after answering an open question, by reflective listening. Thus, all the questions provided in the application should be open instead of closed questions because they better elicit change talk and move the discussion further. This section discusses different possibilities to implement asking open questions in a way that also elicits change talk in a mobile phone application. Reflective listening is the focus of the next section.

There are five different options for implement asking open questions into a mobile application feature: voice input, text input, multiple choice list without and with an open answer possibility (an "other"-option), and multiple choice list with the extension to ask the user think about his/her own answer before revealing the multiple choice list. Each option is evaluated from following perspectives: its support for the key concepts (supporting autonomy, eliciting change talk and reflective listening) and the viability into a mobile application feature. See Table 2 for a summary of all the options.

Table 2. Options to elicit change talk in a mobile UI by asking open questions.

Option	Autonomy support	Reflective listening	Eliciting change talk	Persuasive technology principle	Mobile UI
Voice input	Yes	Application cannot interpret answers to skillful reflections	Elicits change talk	-	Can be efficient
Text input	Yes	Application cannot interpret answers to skillful reflections	Elicits change talk	-	Against efficient use
Multiple choice list	No - User should have the possibility to not answer or answer differently	Answers can be interpreted to reflections, but providing deeper reflections based on short answers can be difficult	Does not make the user really think (higher order thinking)	-	Efficient, but does not allow choosing outside of the suggested options
Multiple choice list with “other”-text field	Yes – user can type his or her own answer or leave it empty	Answers can be interpreted, except the “other” field answer. Providing deeper reflections based on short answers can be difficult	Does not make the user really think (higher order thinking)	-	Efficient, allows typing own answer. Not possible to utilize the open answer
Asked to think first and showing multiple choice options after with “other”-field	Yes - user can type his or her own answer or leave it empty	Answers can be interpreted, except the “other” field answer. Providing deeper reflections based on short answers can be difficult	Better promotes change talk compared to just multiple choice list	-	Requires e.g. waiting or an extra step, allows typing own answer. Not possible to utilize the open answer

4.3.1 Text and voice input for answering open questions

First two options of the implementation of asking open questions consist of voice and text input. More in detail, voice and text input mean asking the user to enter his or her answer to a question either by recording voice or typing in an answer in a text field. Both voice and text input possibilities are consistent with the concept of autonomy support because the user is free to answer whatever he or she wants.

These options are different from the perspective of the viability into a mobile UI feature. Voice input can be efficient for the user since it is perceived effective and accurate. However, the sensitive nature of some of the questions (e.g. covering user's outcome goals in life) would limit the use situations if voice input were used for answering open questions because the user might not want to elaborate his or her thoughts in public.

Text input, by contrast to voice input, is a less efficient input method. With text input, typing in answers is slow with a small screen and keypad size. The user should not be forced to enter possibly long answers because that is in contravention of efficient use e.g. in a situation where the user is on the road (Lee, et al., 2015). Even if the user would have a long answer in mind, it is not certain that he or she would type it because of the lack of efficiency. Furthermore, in an automated mobile application it is not possible to interpret either voice or text input answers into reflections because of the lack of a human analyzing the answers. Moreover, simply repeating everything the user entered does not necessarily provide the user the feeling that he or she is truly understood, because simple reflections only repeat and rephrase what the user just said instead of trying to understand the deeper meaning of what was said.

In spite of their limitations, voice and text input are the most similar to the traditional MI situations in which the patient thinks about his or her own answers to an open question. Additionally, voice and text input methods for asking an open question would most likely best promote change talk in contrast to different types of multiple choice lists. However, since the interpretation into meaningful reflections is impossible from voice and text input answers but yet a core skill of MI and thus an essential feature of the application, voice and text input options are not suitable to be implemented in this case.

4.3.2 Multiple-choice list options for answering open questions

Besides of voice and text input, an option for implement asking open questions and providing an efficient way to answer to them is a list of multiple-choice options. In contrast to text input, the user can efficiently choose the option that is best suitable for him or her. This makes the use of multiple-choice list compatible with mobile UI recommendations. Moreover, Friederichs, et al. (2014) found that users having the possibility to either choose an answer from a multiple-choice list or type their own answer increased their commitment towards physical activity.

Providing multiple-choice options for answers is not truly answering an open question because limited answer options make the question closed. Therefore, an opportunity to answer outside of the provided list of answer options is needed to make the question open. This is also compatible with UI design principles because the user should be able to choose outside of the list in case any of the options is not suitable for him or her. Thus, an option for “Other” or “None of these” should be provided.

However, “None of these” as an answer option provides the user an opportunity to not answer at all. This is not compatible with the principle of eliciting change talk. Therefore, an option for “Other” should be provided with the possibility to enter user’s own answer. Naturally, this answer cannot be interpreted into a meaningful reflection, as is the case with text input only. If the user chooses to type an answer outside of the list, the answer can be repeated as a simple reflection such as “You said that ‘[user’s answer]’”.

Even though it is possible to convert multiple-choice answers into reflections, another problem with a multiple-choice list is the interpretation of answers into reflections in a way that makes the user feel that he or she is understood. In order to fit into a small screen, multiple-choice options should be short. However, short answers can be difficult to convert into meaningful and deep reflections because the meaning and feeling behind the answer can be interpreted in many ways. This problem is discussed more in detail in the next section covering reflective listening.

The last problem with multiple-choice options as answers is the difficulty of making the user to really think his or her answers. If the user is asked to think about his or her answer and then immediately shown different options for answers, it is likely that the user simply chooses the closest option from the list without thinking his or her

answer more carefully and without evoking higher-order thinking. Therefore, if the most accurate option for the user was not on the list, the user would most likely not type it but instead, just select the most suitable from the existing options. That leaves the possibility of the user not really thinking his or her answers and therefore not truly elicit change talk. Thus, the last option in Table 2 consists of multiple-choice list combined with a suggestion to think before revealing the options.

Autonomy can also be supported with multiple-choice options if the user has an opportunity to enter his or her own answer with an open text field. Moreover, from MI perspective, multiple-choice options could be interpreted as suggested answers and therefore the source for the answer would not be entirely internal as MI demands. From SDT perspective, however, it is permissible to provide suggestions as long as the user has the possibility to answer differently.

4.4 Reflective listening

Reflective listening is one of the key skills of motivational interviewing. A few of the main goals of reflective listening include eliciting further change talk after an open question and making the user feel that his or her perspectives, concerns, and problems are understood.

This section focuses on two things: first, the depth of reflections implemented into a mobile application is discussed. Then, more concrete ways of implementing reflective listening are evaluated. The main concentration of different implementation possibilities is on mobile UI viability, eliciting further change talk, and making the user feel that he or she is understood. In addition to those, different MI and SDT principles are discussed as well as links to persuasive technologies are examined within the different implementation possibilities.

4.4.1 Depth of reflections

Although there are multiple numbers of different types of reflections (see e.g. Resnicow and McMaster (2012)), this thesis concentrates reflections in four categories: repeating,

rephrasing, deep reflections, and complex reflections. Repeating and rephrasing are both simple reflections, as they just either repeat what the user has just said or reflect it with different words. Deep reflections, in contrast, can e.g. express a guess of the meaning or feeling behind what the user said. In addition to that, complex reflections can also combine user's statements from earlier, for example combining the user's feeling now with his or her values and goals stated previously. See Table 3 for a summary.

Table 3. Possible depths of reflections in a mobile UI.

Option	Autonomy support	Reflective listening	Eliciting change talk	Persuasive technology principle	Mobile UI
Repeating—simple reflections	Yes	Does not necessarily express empathy	Does not elicit further change talk	Personalization	Easy to implement if based on multiple choice answers, Text should be short
Rephrasing – simple reflections	Yes	Does not necessarily express empathy	Does not elicit further change talk	Personalization	Easy to implement if based on multiple choice answers, Text should be short
Deep reflections (e.g. feeling or meaning reflections)	Yes	Expresses empathy better, quick way to build rapport. The user should have a possibility to correct if the reflection is inaccurate	Can elicit further change talk if there is a possibility to correct reflections	Personalization, Reminders	Difficult to create accurate reflections automatically based on multiple-choice answers. Also, where to get answers to create an illusion of understanding? Text should be short
Complex reflections	Yes – e.g. reflecting goals and values	Expresses empathy better, creates discrepancy The user should have a possibility to correct if the reflection is inaccurate	Can elicit further change talk if there is a possibility to correct reflections	Personalization, Reminders	Difficult to create accurate reflections automatically based on multiple-choice answers. Also, where to get answers to create an illusion of understanding? Text should be short

Before discussing different characteristics of each option, the concept of autonomy support and the length of reflections are shortly covered. First, because autonomy support depends mostly on the content of the reflection, all reflection types regardless of the depth can be autonomy supportive. The user should feel accepted and understood instead of e.g. judged, persuaded, argued, or pushed to do something. This applies to both Table 3 and Table 4 options.

Another issue concerning all reflection types is the length of the text when providing reflections. Mobile UI guidelines suggest that the length of all texts should be short and sentences simple in mobile UIs because of the limited space of the screen and to facilitate efficient use in different situations. However, since MI is traditionally a face-to-face interview method, long texts cannot be completely avoided in order to provide necessary reflections, feedback, information, and advice. Moreover, nuances and deeper meanings can be easier to provide within longer texts compared to short sentences. In spite of that, long texts should be used only when necessary and long texts should be avoided everywhere it is possible.

If open questions are asked with multiple-choice answer options as described in the previous section, both repeating and rephrasing are possible to implement. As a reflection, the user can be provided with the same answer he or she chose from the multiple-choice list, or the multiple-choice answer can be rephrased with different words. However, in traditional MI simple reflections are primarily used to ensure whether the counselor understood the patient's statement. In contrast to a normal discussion where the patient can explain his or her e.g. perspectives or concerns properly, in a mobile application the multiple-choice answer is always short. Simply repeating or rephrasing does not necessarily make the user feel that his or her thoughts and feelings are properly understood and accepted. Therefore, simple reflections may not express empathy as strongly as one of the MI principles suggest and hence there is a need for elaboration in reflections.

In addition to poor quality of empathy, simple reflections do not move the discussion further and elicit further change talk the same way as deeper reflections do. In contrast, deeper and more complex reflections are useful when expressing empathy, creating discrepancy, and building rapport between the user and the application. (Resnicow and McMaster, 2012). However, in traditional MI sessions, the patient

always has a possibility to correct inaccurate reflections, which elicits change talk and moves the discussion forward. In a mobile application, on the other hand, asking the user to correct reflections or creating long question-answer chains might create inefficient use situations if the user is constantly asked to correct reflections before moving forward.

Another challenge for deep and complex reflections is the content of reflections. If the user answers with short multiple-choice options, guessing the meaning or feeling behind user's statements accurately can be difficult. Thus, having a possibility to correct inaccurate reflections is important in order to make the user feel that the application is trying to understand him or her.

Persuasive technology features that can be exploited in most reflections include personalization, reminders, and expertise. Personalization applies to all reflections since the requirement of personalization according to Oinas-Kukkonen and Harjumaa (2009) is "System should offer personalized content and services for its users". Reflections are based on user's answers and are therefore personalized. Moreover, with deep and complex reflections, the content of reflections can be interpreted as reminders as the requirement for a reminder is "System should remind users of their target behavior during the use of the system." (Oinas-Kukkonen and Harjumaa, 2009.) For example, a reflection can be a reminder when it highlights user's values and goals stated earlier in the application and thus create discrepancy between current and target behavior. Finally, expertise refers to "System should provide information showing knowledge, experience, and competence." (Oinas-Kukkonen and Harjumaa, 2009.) The content of reflections can create a feeling of expertise e.g. when providing useful, accurate, and relevant advice for the user.

4.4.2 Reflective listening as mobile features

The next paragraphs discuss more concrete ways of how to implement reflective listening into mobile application features. The first of the options discussed concentrate on the source of the reflections, whereas others provide more concrete ideas for the implementation. Different options evaluated consist of human-based reflections and different ways to implement automated reflections. See Table 4 for a summary.

Persuasive features are similar to what was discussed in the previous section since the persuasive element depends mostly on the content of the reflection in this case. In some of the options, additional persuasive technology features are evaluated.

Table 4. Options for reflective listening in a mobile UI.

Option	Autonomy support	Reflective listening	Eliciting change talk	Persuasive technology principle	Mobile UI
Human analyzing answers and providing reflections	Yes	A good quality of reflections possible	Does not elicit further change talk without a possibility to correct	Reminders, expertise, personalization	Requires human analyzing
Feedback provided after answering every open question	Yes	Reflections are provided more than questions	Does not elicit further change talk without a possibility to correct	Reminders, expertise, personalization	Efficiency might suffer
Feedback provided at the end of each sub-application	Yes	Reflections are not provided more than questions	Does not elicit further change talk without a possibility to correct	Reminders, expertise, personalization	Efficient
Possibility to correct reflections with open answers	Yes	Deeper understanding of the user's thoughts can be gained Not possible to further interpret corrections into reflections	Elicits further change talk	Personalization	Efficiency might suffer
Possibility to correct reflections with multiple choice list	Yes	Deeper understanding of the user's thoughts can be gained	Elicits further change talk	Personalization	Efficiency might suffer

First, a good way to create accurate and meaningful reflections would be a human analyzing user's answers because a human can interpret answers skillfully. However, since the goal is to design an automated application, a real human creating reflections at every moment the user uses the application is not possible. The other options described

in Table 4 are designed based on the assumption that the application is fully automated and does not require any real-time human analyzing.

The next options compare the placing of the reflection: either after every question asked or at the end of series of questions. MI suggests that reflections should be provided more than questions asked (Miller and Rollnick, 2002, p. 66). Thus, from this perspective, reflections after every question would be better than only providing reflections in the end of series of questions. However, if the user is provided with constant reflections, the efficiency of use may suffer as suggested in the mobile UI guidelines. This is more the case if the reflections are long or complex. Fortunately, there is no need to limit to either one of these options: short, simple reflections can be used after every question, whereas longer and deeper reflections can be provided as a form of feedback at the end of series of questions.

As mentioned earlier, the user should have a possibility to correct inaccurate reflections at least with complex and deep reflections. An example of a reflection that might need user's clarification include e.g. if the reflection states that "You feel that you are not ready to do it", but the user actually means that he or she would rather need a friend to do it with him or her. In a mobile application, there are two ways to implement this feature: either with multiple-choice options or text input. Same principles apply to both of these options as discussed in the previous subsection concerning different ways to implement open questions, such as the impossibility of interpreting answers into further reflections with open text input and limited options with a multiple-choice list. However, in contrast to open questions, a multiple-choice list correcting reflections does not necessarily require a request to think before revealing options, because the user most likely already knows how he or she wants to correct the previous reflections.

Additionally, correcting reflections should be optional in order to both support autonomy and efficiency of use. The user should not be forced to correct the reflections because they can be accurate in the first place, or the user does not want to correct them for some reason, such as a busy use situation or other unwillingness.

A potential way to implement the possibility to correct reflections is a separate view suggested to the user after reflections in a way that the user can easily skip it if needed. That way, the user could be provided an opportunity to correct reflections

without impairing the efficiency of use in the original task. Furthermore, a separate view would support user’s autonomy because the user can choose whether to open the view or not.

4.5 Chapter summary

The features presented in Table 5 and Table 6 summarize the design exploration. Presented features are also chosen for further processing in this thesis. First, features to elicit change talk are summarized in Table 5 and after that features to support reflective listening and users’ feeling that they are understood and accepted are summarized in Table 6

Table 5. Chosen features to elicit change talk.

Feature	Why?	Challenge No.
Multiple-choice list for answers	To enable skillful reflections and to support efficiency of use	1
An open text field possibility	To support autonomy	1
A recommendation to think before revealing answer options	To elicit higher-order thinking	2

“Challenge No” refers to challenges in section 4.1 to which the feature in question provides a solution.

Besides of its few limitations, a multiple-choice list is better suitable for an implementation of answering open questions in a mobile application compared to voice or text input mostly because of its efficiency. Moreover, multiple-choice answers are easier to further modify into skillful reflections in contrast to answers with open input possibilities. However, an option for entering an open answer should be supported from both usability and autonomy perspectives: the user has an option to choose an option outside of a suggested list, which prevents frustration and further supports autonomy.

Furthermore, a recommendation to think before revealing the multiple-choice list in order to elicit change talk is chosen for the prototype. Different ways to implement these features in the prototype are discussed more in detail in chapter 5.

Table 6. Chosen features to make the user feel understood by reflective listening.

Feature	Why?	Challenge No.
Simple reflections with each new question	To avoid long question-answer –chains	3, 4
Deep and complex reflections at the end of series of questions	To express empathy, develop discrepancy and make the user feel understood	3
A separate view to correct reflections by fine-tuning answers	To make the user feel understood, further elicit change talk and support autonomy	3, 4

“Challenge No” refers to challenges in section 4.1 to which the feature in question provides a solution.

These options were chosen for implementation because they are the best combination to support autonomy, reflective listening, and eliciting change talk. Simple reflections are provided with each new question in order to avoid putting the user and the application into question-answer roles. In addition, deeper reflections are provided in order to elaborate a deeper meaning behind user’s answers and thus support relatedness and user’s feeling that he or she is understood. Finally, a possibility to correct reflections is provided in order to allow the user to further elaborate his or her thoughts and to support user’s autonomy by providing a possibility to clarify what he or she actually meant. Different ways to implement these features in the application are discussed more in detail in chapter 5.

5 Design artifacts

This chapter presents the design artifacts of this thesis. More specifically, this chapter focuses on the challenge of how to arrange content to best support the three design goals of this thesis: eliciting change talk, making the user feel understood and accepted by reflective listening, and supporting user's autonomy.

The structure of this chapter is divided into four sections: first, the research approach is shortly introduced. Next, eliciting change talk and supporting reflective listening are discussed in their own sections, whereas autonomy support is discussed together with the two other concepts. After that, the navigation in the application is presented to the extent that it concerns eliciting change talk, reflective listening, and autonomy support.

5.1 Design approach

A part of Zimmerman's, et al. (2007) RtD –model is to create design artifacts. Thus, this chapter focuses on that. This chapter continues from where the design exploration in the previous chapter ended: creating design artifacts and more concrete ideas for the design.

The creation of the design artifacts presented included paper prototyping and early expert evaluations. Early sketches were evaluated and discussed with the Precious-team that consists of experts in the behavioral change –field. Moreover, the sketches were discussed with User Experience (UX) Designer colleagues of the author.

The part of the application presented is about finding out user's most important outcome goal in life. It is asked in order to guide the user on his or her way in the behavioral change process throughout the application. Rasmussen, et al. (2006) say that goals can be divided into different categories based on e.g. their level of abstractness. Outcome goals are higher-level goals. For instance, a person might want to feel healthy. A lower-level goal related to feeling healthy could be exercising five times a week. The Precious-application aims at finding user's outcome goals and further defining lower-level goals in order to be able to provide the most suitable tools for the user. Thus, the part of the application presented in this chapter is about finding the user's most important outcome goal and linking it to a more specific, lower-level goal that could help the user to achieve the outcome goal.

However, this chapter concentrates on how to arrange a mobile user interface in order to support eliciting change talk, reflective listening, and user's autonomy. Thus, the focus is not that much on the content of what is being asked or what should be reflected, but instead, what kinds of features should be provided and what kinds of gestures the user should be asked to do. However, when the content affects the feature, it is discussed in the following sections (as in e.g. in subsection 5.3.1).

5.2 Arranging content to elicit change talk

This section first discusses two alternative ways to arrange content in order to elicit change talk. Two dimensions are primarily considered when comparing and choosing between the alternative options: how they elicit change talk and how they support user's autonomy. Other characteristics are discussed briefly. After that, answering an open question is presented.

As decided in the previous chapter, multiple choice answer options are not revealed to the user immediately in order to elicit change talk and higher-order thinking. There are two main possibilities to implement this feature:

- First, the options can be hidden for a certain amount of time before revealing them in the same view, or

- Second, the options can be shown in a different view so that the user can choose when to see them.

See Figure 3 and Figure 4 for demonstration.

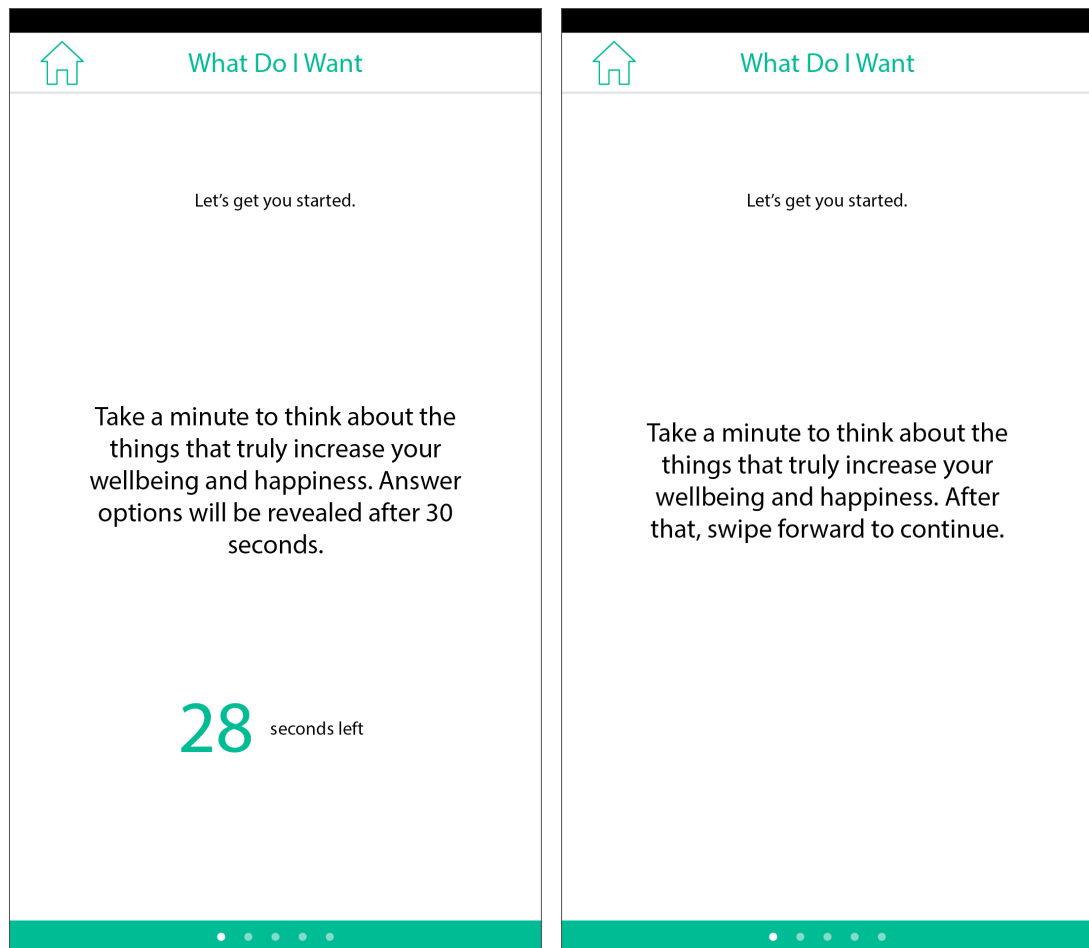


Figure 3. Answer options are revealed only after a certain amount of time in the same view. The user has to wait in order to see them.

Figure 4. Answer options are revealed in the next view. The user has to swipe in order to see them.

In both options, the user is asked to think about his or her answer first. The greatest difference between these options is the way in which the answer options are revealed. In the first option (Figure 3), options are shown after a certain amount of time without the user being able to affect their appearing. In contrast, in the second option (Figure 4) the user has to make an extra step before the options are visible, but he or she can decide

the timing of revealing the options. Both of the options have their advantages and disadvantages. The next two subsections introduce these options and their advantages and disadvantages more carefully.

5.2.1 Answer options hidden for a certain amount of time

The first option delays the revealing of the answer options (Figure 3). It has the advantage of forcing the user to think. The user cannot just skip the thinking process by moving to the next view, but he or she has to wait until the answer options are revealed. However, the greatest challenges of the first option relate to this very same feature. Firstly, it might be difficult to define a suitable delay in revealing the content. For some users, the answer might be clear even without thinking whereas for others thinking about the answer takes more time. Similarly, the time for answering might vary even within one user in different use situation. If the delay is same for all users and situations, sometimes the user might get frustrated when the content is hidden even though he or she already knows his or her answer. Moreover, if the answer options are revealed too soon, the thinking process might be interrupted by the appearance of the answer options.

In addition to difficulties in defining a sufficient delay, the sudden appearance of answering options is not completely in agreement with the MI principle of supporting autonomy. This is because the user does not have the freedom to choose when the options are revealed and therefore is against the user having the control in the use situation. Furthermore, MI requests that a permission to provide e.g. advice is always asked. Thus, delaying the answer options and possibly interrupting the user's thinking process do not support user's autonomy since he or she cannot choose the timing of revealing the options.

As mentioned previously, forcing the user to think is the greatest advantage of the first option. However, even if the user must wait to see the answer options, it does not necessarily force the user to think about the desired answers. The user can, for example, think or do something else while waiting for the options to appear.

5.2.2 Answer options presented in a different view

The challenge of the user truly thinking what is being asked occurs also in the second option, in which the answer options are shown in a different view (Figure 4). The user can easily move to the next step without necessarily thinking his or her answer and therefore skip the thinking process. However, in this option, the user has the control to decide when to see the answer options, which better supports user's autonomy compared to the first option. Moreover, the user can think about his or her answer as long as needed without the thinking process being interrupted.

Another challenge within the second option is an extra step the user has to take in order to see the answer options. It is recommended to minimize the steps that the user has to take in order to complete a task. However, in order to elicit change talk and facilitate higher order thinking, it seems necessary to somehow delay or hide the multiple choice options instead of just revealing the answer options immediately. Moreover, taking the extra step has been done as easy as possible by allowing the user quickly swipe to the next view.

In sum, the second option is chosen for implementation since it better supports user's autonomy. Additionally, it has better possibilities to elicit change talk since it does not interrupt user's thinking process accidentally. However, it seems that there is no guaranteed way to ensure that the user truly thinks answers to the asked question because he or she can always think about something else instead.

5.2.3 Answering an open question

In the next view, the user is first asked: "Ready?" (Figure 5). This is done in order to make sure that the user really thought about his or her answer. If he or she just swiped to the next view without reading through the prompt, the question "Ready?" indicates that there was a task in the previous view. Following to that, short instructions to choose up to four options from a multiple-choice list are provided.

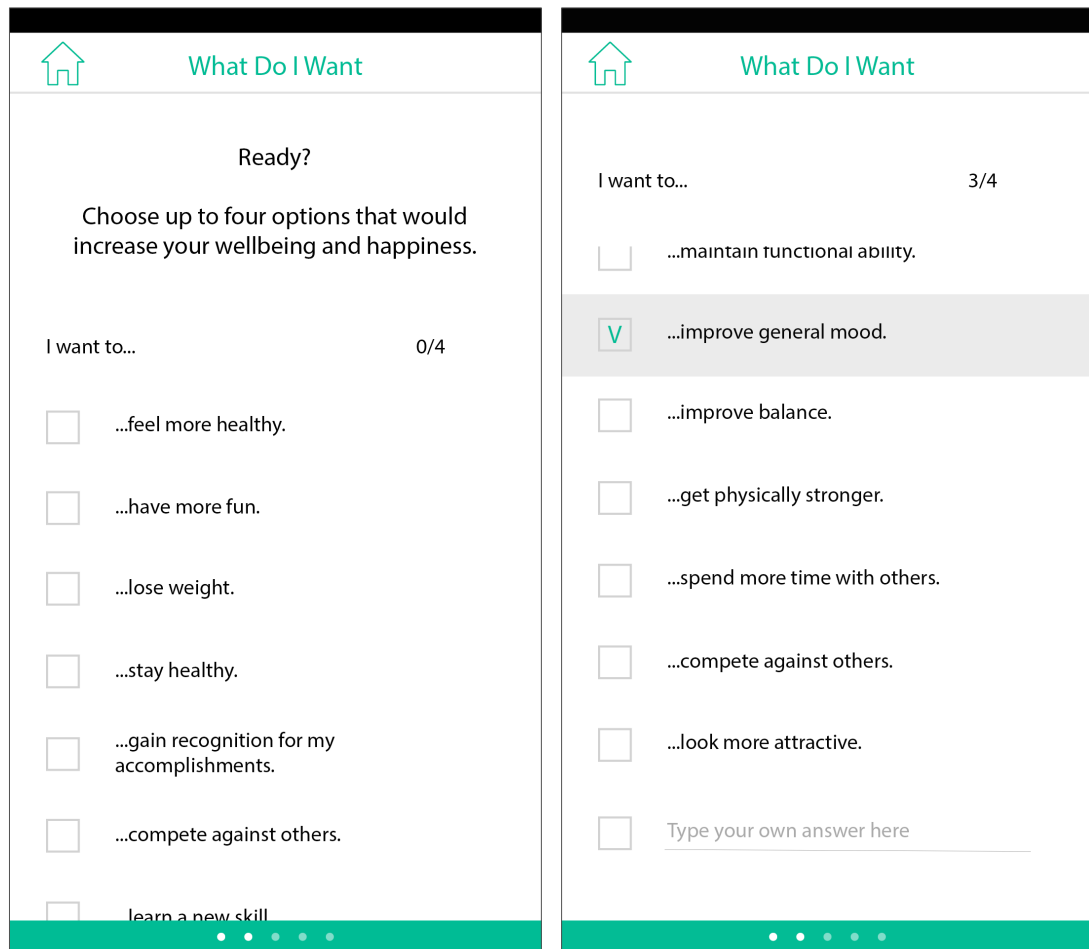


Figure 5. The user is first asked: "Ready?" to remind about the task in the previous screen.

Figure 6. The "Other" option is the last of the multiple-choice options.

The answer options are shown below the instructions. Options include both multiple-choice options as well as an option to enter user's own answer into an empty text field. The open answer is left as the last option in the list in order to encourage the user to go through all other options first (Figure 6). This is done because skillful reflections are only possible to form based on multiple-choice answers, whereas open text answers could only be used as simple reflections. Therefore, choosing an option from the list better enables following reflections. However, the open answer possibility is provided in order to support user's autonomy and prevent user's frustration if the desired answer is not on the list.

The need for the possibility to answer with text input differs in different questions asked. In a case such as presented in Figure 5 and Figure 6, the user is offered initial answer options. The user has thought about his or her answer before seeing

answer options and thus the desired answer might not be in the list. Therefore, having a possibility to enter his or her answer is important to support autonomy. However, in a case presented in Figure 7 and Figure 8, the user is asked to specify his or her answer by choosing the most important out of those that were previously selected. In this case, the user is asked to rate the most important of the previous answers instead of coming up with new answers. Thus, a possibility to open answer is not needed for this sub-task.

The answer options in the multiple-choice list should be arranged so that in the default view the last option is only partly visible (see Figure 5 for an example). This is done in order to indicate that the view is scrollable and there are more options below. In contrast, if the options fit perfectly into the view, the user might not notice that there are more answer options below and the view is scrollable.

5.3 Arranging content to support reflective listening

In chapter 4, it was chosen that both simple and deep reflections are used in the application. This section starts by introducing and comparing two possible approaches to providing simple reflections. After that, the way to provide deeper reflection in the end of a question-answer-reflection –chain is presented. Finally, the possibility to correct reflections by fine-tuning previous answers is introduced.

5.3.1 Two approaches to provide simple reflections

As decided in chapter 4, simple reflections are provided in every view at the same time when asking a new question. This is done in order to avoid long question-answer chains and provide reflections more often, as suggested in MI.

First, the user chooses up to four options (Figure 5 and Figure 6) based on what he or she thinks would improve his or her wellbeing and happiness. Alternative next views are presented in Figures 5 and 6, which are the first views when reflections can and should be provided. Although there are probably various ways to arrange and adjust reflections, two different ways are discussed here. The first one reflects the user's

answer shortly before the next question (Figure 7), whereas the second one provides reflections as specifications for each of the previous answer (Figure 8).

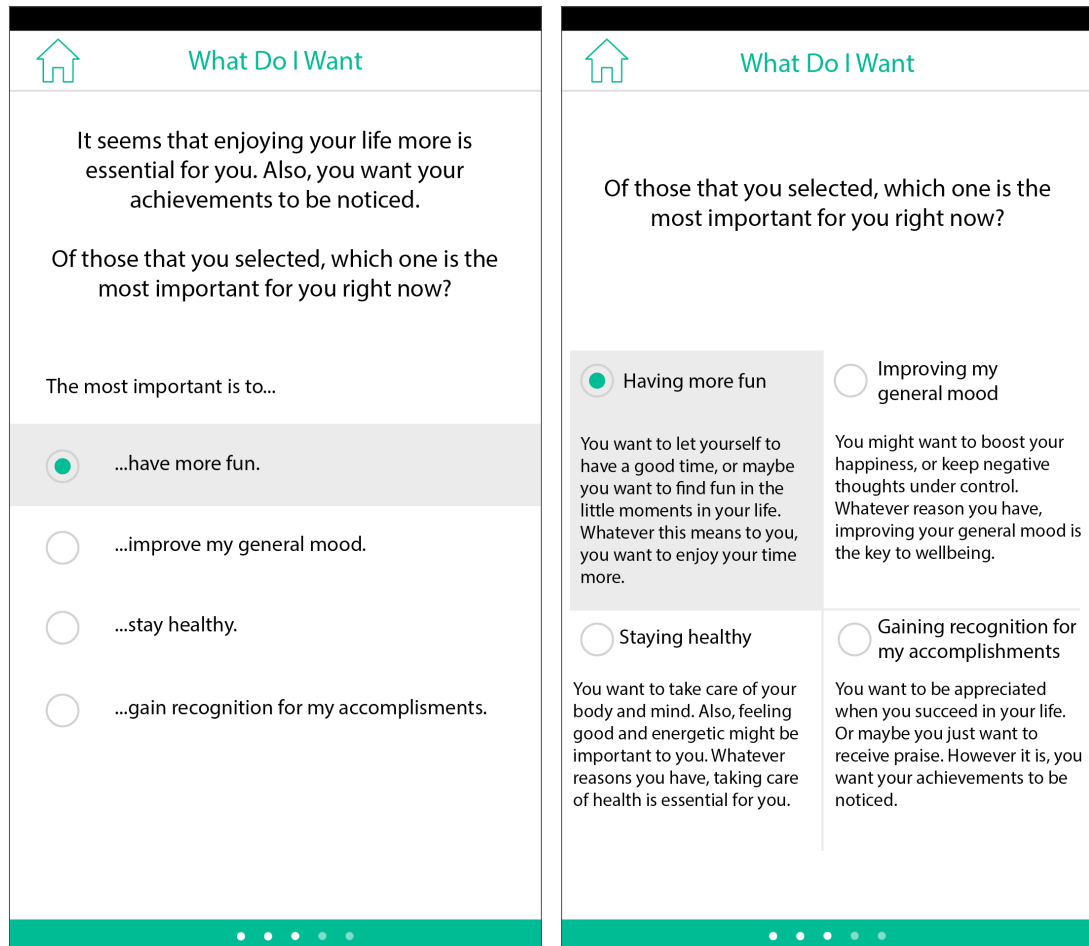


Figure 7. A shorter reflection combining previous answers is provided before asking a new question.

Figure 8. Longer reflections are provided as specifications for each previous answer.

In Figure 7, the reflection is provided in a way that more resembles a traditional discussion. The reflection is delivered on the top of the view simply as a text before asking a new question, as would happen in a face-to-face situation. However, because of little space on a mobile screen, the reflection combines answers from the previous view instead of reflecting all of them separately back to the user. For example, in Figure 7 the reflection states “It seems that enjoying your life more is essential for you”, which combines answers from having more fun, improving mood and staying healthy. In contrast, Figure 8 represents a different approach. In this option, reflections are

provided only after a question as specifications for the answer options in the previous view. Next, advantages and disadvantages of these two approaches are discussed as well as the applicability of the approaches in different situations.

The difference in these two approaches is due to the different purpose of reflections. In Figure 7 and Figure 8, the user is asked to choose the most important of those that he or she already chose in the previous view. In contrast, in Figure 9, the user is asked to link the chosen goal to a behavior that would help him or her to achieve it. Thus, the first approach is about clarifying what was answered previously, whereas the second approach is about linking previous answers to new information. Hence, they can be used in different use situations.

What Do I Want

So, enjoying your life more is a priority for you right now.

Which one of these would best help you to achieve that?

A change in...

☒ ...my physical activity...

☐ ...my eating habits...

☐ ...my stress levels...

☐ ...my sleeping patterns...

☐ Type your own answer here

...would help me to have more fun.

Figure 9. Reflection asks the user to link the chosen outcome goal to a behavior that might help him or her to achieve the goal.

Advantages of the first approach presented in Figure 7 consist of a natural order of the reflection and a new question as well as the shortness of text. In contrast, disadvantages of the first approach include difficulty to reflect multiple answers in one, short sentence and unnecessary repetition.

The advantage of the natural order, reflection appearing before a new question, is that the user more likely reads it compared to the second approach because the reflection is on the top of the view. Moreover, the reflection is quite short in order to support the efficiency of use.

However, the shortness of the reflection is also its greatest disadvantage. If the user chose e.g. four options from the previous view, they can only be reflected back to the user in one sentence. If the answer options differ significantly (e.g. if the user has chosen “improve general mood”, “improve balance” and “compete against others”), they can be difficult to summarize in one sentence because finding a common factor behind the different answers can be difficult without follow-up questions. Another disadvantage of the second approach concerns unnecessary repetition. When the reflections are provided as simple summaries on the top of the view when clarifying the previous answer repeating the answer could be a problem. Reflecting user’s answers first in the reflection and then again when providing the answer options would just repeat the same content twice.

However, the first approach can be utilized in situations where the question aims at linking the previous answer to new information instead of clarifying the previous answer (as in Figure 9). In that case, extra repetition can be avoided, because new answer options provide new information compared to just choosing the most important of the previous answers (as in Figure 7). Moreover, the reflection on the top of the view can be a rephrase instead of a repetition of the previous answer.

The advantages of the second approach where reflections are provided as specifications to the user’s previous answers (as in Figure 8) include providing longer and possibly slightly deeper reflections to support user’s need to feel related. In contrast, disadvantages of the approach consist of possibly making the user not choosing any of the options because of inaccuracy in reflections and inefficient use because of longer texts.

The second approach provides a natural way of rephrasing answers in a mobile UI. All previous answers can easily be reflected to the user because they can be presented in their own boxes instead of trying to squeeze them into one sentence. This way, slightly deeper reflections can be provided already in between questions. In addition, more nuances can be enabled when using longer texts. However, specifications should be expressed carefully to avoid misinterpretations. This is important in order to avoid a situation where the user neglects to choose an option only because the reflection is not precisely correct. Therefore, the language used should not suggest strict clarifications. Instead, softening words, such as “maybe” and “might” are used to allow the user to choose an option even if it is not perfectly accurate.

Another disadvantage besides of inaccurate reflections is the length of texts in the second approach. There is a risk that the user does not read all of the reflections and thus, the need to be understood is not necessarily achieved. Moreover, long texts are against the efficiency of use in a mobile UI. In addition, long texts take plenty of space on the screen.

5.3.2 Three parts of a deep reflection

Figure 10 presents the last view of a question-answer-reflection –chain. That view is the last one in the series of questions presented in Figure 8 and Figure 9 in the previous subsection. The last view provides the user deeper reflections based on what he or she answered previously. Depending on where the user is in the application, also more complex reflections can be provided here. Complex reflections can be presented when information from different parts of the application can be utilized and merged. In the case presented, this is the first task the user is asked to do. Therefore, combining reflections from previous tasks is not possible in this example. Instead, a deeper meaning is added to the reflection in order to add a dimension of understanding.

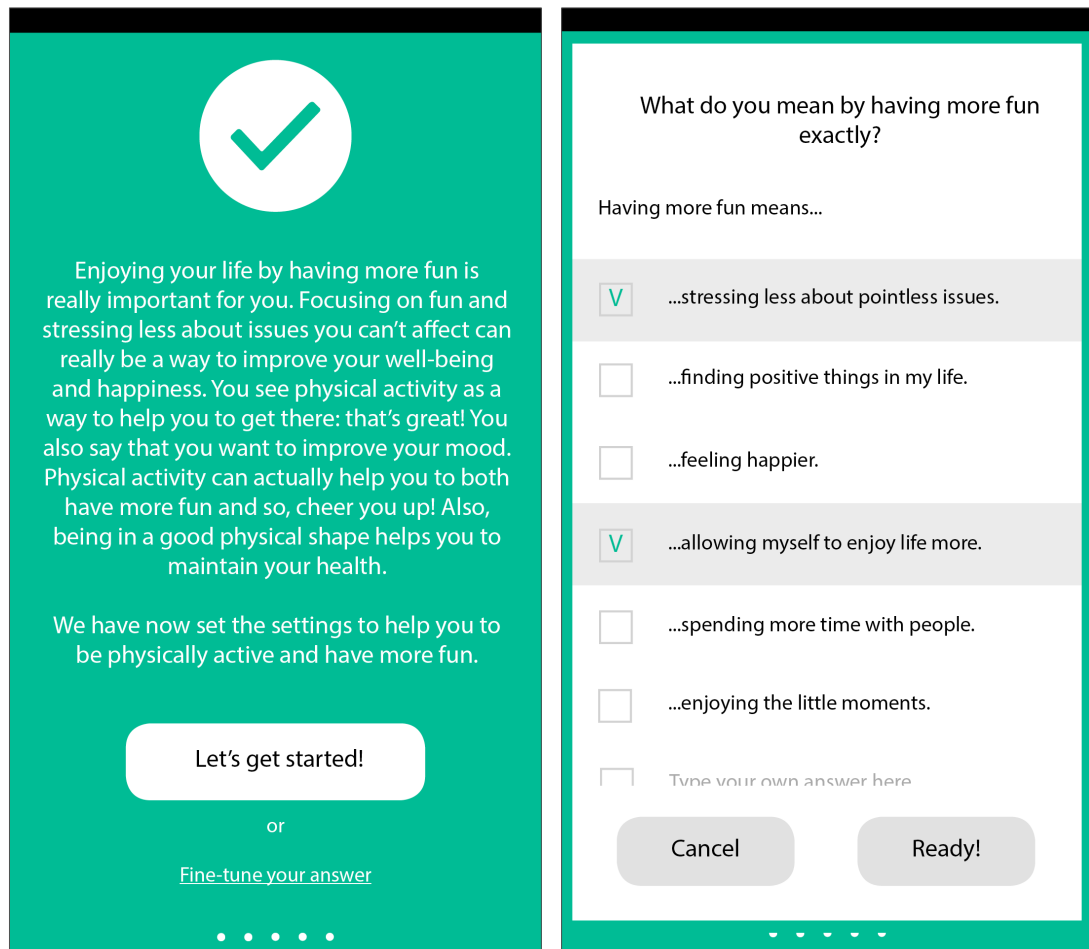


Figure 10. Deeper reflection consists of three parts: the reflection itself, a description of how the information is used, and a prompt to get started.

Figure 11. The link to fine-tune answers opens a new view on the top of the final view.

The final reflection consists of three parts: the reflection itself, a description of how the information is used, and a prompt to get started. First, the user's answers from the previous series of questions are gathered together to reflect his or her answers back. This is the part where deeper meaning to previous answers is added in order to make the user feel that he or she is understood. The challenge is to create reflections that both are meaningful and accurate. However, the user is also given a chance to correct his or her answers (presented in the next subsection), which supports that the user feels understood even if the first reflection is inaccurate.

The second part of the final reflection tells the user how the information gathered will be used. This is done by stating: "We have now set the settings to help you to achieve having more fun by being physically active". This way, the user is let to know

that the information gathered is used to tunnel the user through the application toward the desired behavioral change. This also supports user’s autonomy, because an explanation of why the questions were asked is offered. Thus, the user can understand the source of forthcoming tasks suggested to him or her later in the application. Moreover, this part of the reflection shortly repeats the user’s goal back to him or her.

The final part of the reflection is a prompt to get started. The idea of this is to indicate that the series of questions has come to an end. To make clearer that this view is the last one, the background color of the view is different to others and a “ready” icon is set on the top of the view. Moreover, a button stating “Let’s get started” is located on the bottom of the view. The button takes the user back to the home menu, where a new task is suggested to him or her. In addition to that, below the button is another button offering a possibility to correct reflection in case they are inaccurate. The next subsection focuses on this feature.

5.3.3 Fine-tuning answers

As discussed in chapter 4, the user should be offered a possibility to correct inaccurate reflections. The main reasons for that are to enhance user’s feeling that he or she is understood and to further elicit change talk. Other than that, the possibility to correct reflections also supports user’s autonomy, because the user can further define his or her answer. Moreover, the possibility to correct is separate from the question-answer-reflection –chain in order to support efficient use. In addition, the user can also fine-tune his or her answer even if the original reflection was accurate. This opportunity has the same advantages as correcting inaccurate reflections.

Figure 10 and Figure 11 demonstrate the possibility to correct reflections. Below the reflections and the “Let’s get started” –button in Figure 10, the user is provided an opportunity to fine-tune his or her answer by opening a new view on the top of the last view of the question-answer-reflection –chain. The term fine-tuning is used because the user can specify what he or she meant with a previous answer. Figure 11 presents the view that reveals the fine-tuning possibilities. For example, if the user has previously answered that “having more fun” is the most important for him or her, the options shown are specifying what having more fun means to him or her.

Similarly to open question answer options, the possible corrections are listed as a multiple-choice list. This way, the user can choose as many options as he or she feels suit his or her situation. Moreover, an “Other” possibility is provided on the bottom of the list. The possibility to enter an own answer supports user’s autonomy. Furthermore, the option to choose an option outside of a suggested list prevents user’s frustration.

By contrast to open question answer options, the user is not asked to think his or her answer before revealing the fine-tuning options. The user has already thought about his or her answer previously when the original questions were asked. Thus, if the user wants to correct the reflection, he or she presumably knows how he or she wants to do it.

After the user has fine-tuned his or her answer, the reflection on the last view of the questions-answer chain (Figure 10) is automatically changed to cohere with his or her fine-tuning answers. Moreover, the fine-tuning answers can be exploited later in the application. For example, the user can be reminded of his or her outcome goal, and more complex and varying reflections can be created later in the application.

5.4 Navigation in the horizontal views

The navigation between question, answer and reflection views is introduced next. Different phases of the question-answer-reflection –chains are visualized as horizontal step-by-step views that the user can swipe back and forth between different views. This way, the user does not need to click a button in order to reach the next phase, but instead he or she can swipe the screen.

Horizontal step-by-step views have also other benefits: first, swiping back and forth between views is fast if the user wants to change his or her answers. Second, different parts of horizontal step-by-step views are easily perceived as phases. By using horizontal step-by-step views, the user knows that there are more phases to follow. Similarly, horizontal step-by-step views and view indicators provide a natural way to visualize where the user currently is in the application. View indicators, the small bubbles on the bottom of the view, show the current view and its relation to all the views. The last benefit of using horizontal step-by-step views is to allow the user to

concentrate his or her attention only on specific items visible instead of showing all the content in one view.

The navigation is intentionally left somewhat unobvious. The reason for this is to elicit change talk and facilitate thinking process as much as possible. The navigation is made explicit by the use of a prompt “swipe forward to continue”. Moreover, the view indicators on the bottom of the view represent the stage of the horizontal step-by-step views (see e.g. Figure 5 and Figure 6). The suggestion to swipe forward is placed at the end of the prompt in order to ensure that the user really reads through the whole prompt text. If the hint to swipe forward was placed in the beginning of the text, the risk of the user not reading the prompt entirely might increase. Similarly, if there were too clear indicators, e.g. arrow buttons, enabling the user to skip reading the prompt, the thinking process might be ignored as well. Thus, the navigation should not be too obvious in order facilitate the user’s thinking process as much as possible.

In the next views, where the user is either answering a question or receiving reflections, he or she is most probably already familiar with the swiping navigation. There are two possible navigation options depending on the question type presented: either manual or automatic swiping. When the user can choose as many options (or e.g. up to four) he or she wants, navigation should be manual. In that case, the answer options are presented as checkboxes in order to indicate that the user can choose as many (or up to e.g. 4) options as he or she wants. Thus, the user should be navigated to the next view automatically after he or she has selected the answer options most suitable. In contrast, when the user can choose only one option from radio-button-options (e.g. when rating the most important option), the navigation should be automatic. In this case, the application should automatically take the user to the next view after an answer has been chosen. If needed, the user can still go back by swiping to the right. This way, taking an extra step is avoided and the efficiency of use is improved.

5.5 Chapter summary

Figure 12 and Table 7 present a summary of the chosen features to support eliciting change talk and the user's need for relatedness and autonomy. First, the following figure presents an overview of the chosen features in order to make Table 7 easier to read.

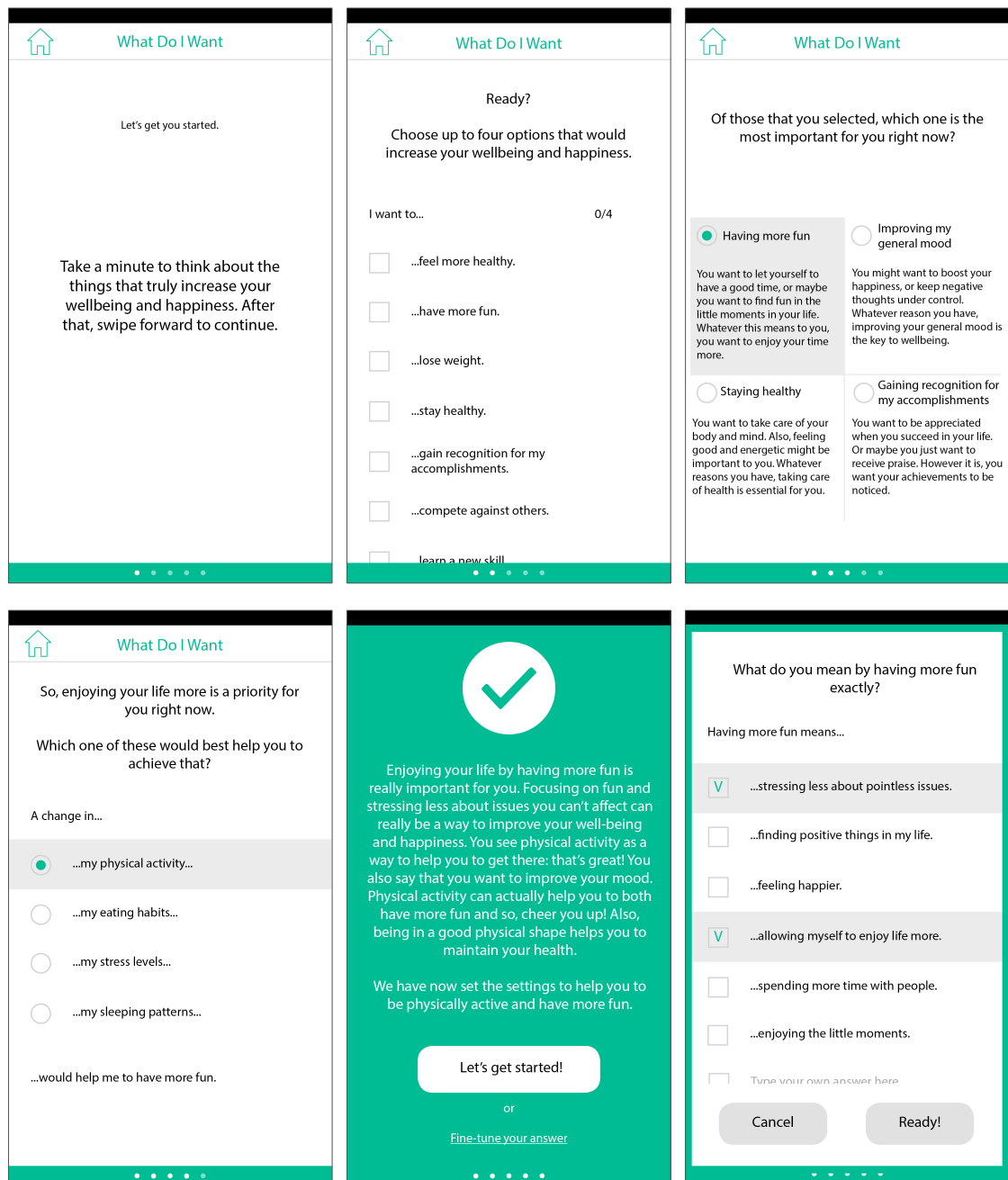


Figure 12. Six views to summarize the chosen features to elicit change talk and to support relatedness and autonomy.

The next table (Table 7) summarizes and explains chosen features presented in Figure 12. Six views to summarize the chosen features to elicit change talk and to support relatedness and autonomy. Table 7 also presents where to find more in-depth explanations for each feature.

However, the table does not explain features that were already presented in the design exploration- perspective of this thesis (chapter 4). Summary for those features can be found in section 4.5. The next chapter (chapter 6) evaluates the chosen features.

Table 7. Summary of chosen UI features to elicit change talk and support relatedness and autonomy.

Feature	Why?	Explained in (sub)section
View 1: Navigation to the next view to see answer options (instead of revealing them after a certain amount of time)	To support autonomy and let the user think for as long as necessary	5.2.2
View 1(-6): Unobvious navigation	To direct the user to read the whole prompt	5.4
View 2: Asking “Ready?” before further instructions	To remind about the task in the previous view and thus, elicit change talk	5.2.3
View 2: Open answer as the last one after multiple-choice options	To direct the user to go through of multiple-choice options in case some of them is suitable for him or her: in order to enable skillful reflections	5.2.3
View 3: Simple reflections as specifications	To summarize the previous answers	5.3.1
View 4: Simple reflection before a new question	To summarize previous answer before linking it to new information	5.3.1

Feature	Why?	Explained in (sub)section
View 5: Three parts of a deeper reflection	To support relatedness and autonomy, to repeat user's arguments, and to indicate that the series of questions has come to and end	5.3.2
View 5: Different background color and a prompt to get started	To indicate that the series of questions has come to and end	5.3.2
View 6: Fine-tuning options separately from other questions behind a link	To support efficient use and autonomy	5.3.3
View 6: Fine-tuning options as multiple-choice options	To enable skillful reflections	5.3.3
View 6: A free text field for open answer	To support autonomy and prevent user's frustration	5.3.3

6 Evaluation

This chapter starts by introducing and arguing for the evaluation approach of the design. After that, a short overview comparing applications in the motivating users into healthy lifestyle field is provided. Four characteristics are evaluated for each of the application: its support for eliciting change talk, reflective listening and autonomy, and main persuasive elements. Next, two of the applications are selected for closer comparison. Finally, differences in the design presented in this thesis and in the design of the application in the Precious-project are shortly discussed as well as the reasons for the differences.

6.1 Evaluation approach

According to Järvinen and Järvinen (2000), an important part of a constructive study is to evaluate the new innovation created. A way to evaluate new innovations is to compare it to existing solutions. The idea is to compare the new innovation and the existing solutions to the research aims set in the beginning. Thus, this chapter evaluates the design introduced in the previous chapter by comparing it to other applications.

The aim of the evaluation is to discuss how well the new innovation achieves the design aims set in the beginning compared to the other applications. To recap, the aim of this thesis is to find a way to design a mobile user interface that elicits change talk and makes the user feel understood by the use reflective listening while supporting user's autonomy.

The evaluation approach utilized in this thesis resembles traditionally used heuristic evaluation of user interfaces. According to Nielsen and Molich (1990), a

heuristic evaluation means going through an interface and trying to come up with an opinion about the advantages and disadvantages of the interface. However, traditional heuristic evaluation concentrates on the usability of an interface by comparing it to e.g. usability heuristics by Molich and Nielsen (1990). In contrast, the evaluation of this thesis concentrates on evaluating the chosen applications on four criteria: how it elicits change talk, how it supports reflective listening, how it supports user's autonomy, and how it supports mobile UI design principles instead of evaluating applications based on universal heuristics.

Nielsen and Molich (1990) state that empirical evaluations with real users provide the best and most thorough evaluation of a user interface. However, they also say that empirical evaluations with users are not always conducted because people lack e.g. in time, expertise or inclination to do so. Similarly, empirical evaluation with users is not conducted in this study for two reasons: first, the “real” –perspective of the Research through Design (Zimmerman, et al., 2007) was excluded from this study. Second, the actual Precious-application of the Precious-project differs from the design of this thesis and thus, it could not have been utilized for the evaluation. In addition to that, evaluating e.g. users' feeling of being understood with only a paper prototype (or some other lo-fi prototype) would have been difficult because of the huge amount of reflections that should have been created and handed for the evaluation. Thus, a heuristic approach is more suitable for this study.

The applications chosen for the evaluation were selected from Android's Google Play (Google, 2016) application store in May 2016 in search for e.g. “healthy lifestyle” and “motivation health”. The selection of applications aimed at representativeness and coverage in applications motivating users into a healthy lifestyle. Thus, the applications include e.g. most downloaded and starred applications, applications with poorer evaluations, and applications with different ways to motivate user. See Table 8 for details. Moreover, all selected applications cover at least diet and exercising tracking. Thus, applications concentrating only on one aspect of a healthy lifestyle were excluded, leaving out e.g. Sports Tracker and Google Fit, the most downloaded physical activity trackers. In addition, many of the selected applications cover also other fields, such as sleep and stress. All nine applications selected for the evaluation are listed and shortly described in Table 8.

Table 8. An overview of applications motivating users into a healthy lifestyle on Google Play.
E = eliciting change talk, R = reflective listening, A = autonomy support

Application	Description	Support for key concepts	Main persuasive technology elements	What else?
My Diet Coach	Helps to find inner motivation and maintaining habits to lose weight	E, R	E.g. self-monitoring, reminders, personalization, suggestions, rewards	Good ratings on Google Play: 4,3/5
S Health	6 th best-selling automated personal coach that can be found from Samsung-phones by default	-	E.g. self-monitoring, suggestions, reduction	
Fabulous – Motivate Me	Automated personal coach that supports many areas of health: e.g. exercise, diet, sleep, stress...	E	E.g. self-monitoring, suggestions, reduction, tunneling	Good ratings on Google Play: 4,6/5
Vida Health Coach	Provides a personal, real-life health coach to help to achieve health goals	E	E.g. self-monitoring, reminders, suggestions, real-world feel, expertise, authority	
My Health Compass	Automated personal coach	E, A	E.g. self-monitoring, personalization, suggestions, reminders	Low ratings on Google Play: 2,2/5
Fitness Quote Wallpapers	Reminds user every day by sending a motivational quote	-	Reminders	
Pact	Earn cash by staying active, paid by members who don't	R	E.g. self-monitoring, social comparison, competition	
AIM	Improves motivation to change lifestyle. Includes e.g. exercising, studying, diet, and drinking	E, R, A	E.g. authority, social role	Based on MI
The I Move	Improves motivation to increase physical activity	E, R, A	E.g. rewards, real-world feel, reminders	Based on MI and SDT

The applications selected were superficially evaluated from four perspectives: its support for eliciting change talk, reflective listening and autonomy, and main persuasive elements. However, the evaluation of the applications in Table 4 is not extensive e.g. concerning the persuasive elements, since the main goal of this chapter is to compare the Precious design to two specific applications more closely.

Applications' support for the key concepts of this thesis (eliciting change talk, reflective listening, supporting autonomy) were included in Table 8 if the application even somehow supported the concept, e.g. by asking for motivation or providing choices for reasons to change. Autonomy was only analyzed in relation to eliciting change talk and reflective listening. Thus, if the application does not support eliciting change talk or reflective listening, supporting autonomy was not analyzed and listed in Table 8. However, this does not mean that the application does not support autonomy in general.

Next, short descriptions of all applications and their support for key concepts is provided. After that, two of the applications are chosen for a closer comparison in order to profoundly compare the design of this thesis to existing solutions and their relation to the design aims of this thesis.

6.2 Overview of applications motivating users into a healthy lifestyle

This section presents all the applications selected for evaluation before proceeding into a closer evaluation of the design of this thesis.

My Diet Coach is described in Google Play as an application that helps to find inner motivation and maintaining habits to lose weight. It covers both support for better eating habits and physical activity. The application was chosen for the comparison because, in addition to logging meals and exercises, the user can receive motivational tips and it has good ratings (4.3 out of 5 stars).

My Diet Coach has a weak support for both eliciting change talk and reflective listening. A user can set a reminder to remind about his or her goal and the reason for it: in connection with setting the reminder, the user can choose a motivation for his or

her goal from a multiple-choice list. However, the user can only choose one of the options, and there is not possibility to enter user's own reason. Thus, autonomy is not supported when eliciting change talk. In addition to somehow eliciting change talk, user's answer is visible as a simple reflection and thus, My Diet Coach weakly also supports reflective listening.

S Health is the 6th best-selling automated personal coach that can be found from Samsung-phones by default. It provides different tasks and challenges to improve e.g. physical activity, eating habits, sleep quality, and stress levels. However, the application is mostly founded on tracking user's habits instead of evoking motivation. The user is not asked for reasons or desires to change and neither are they reflected back to him or her.

Fabulous – Motivate Me is an automated personal coach that supports many areas of health, such as exercise, diet, sleep, and stress. It was chosen for the comparison because of its coverage of features and because it is one of the most popular applications (37th most sold of all health-related applications) that covers a wide range of lifestyle areas.

Fabulous weakly supports the concept of eliciting change talk as it asks user's outcome goal in life in the beginning of the application. However, the application only provides four different answer options and does not let the user type in his or her answer. Thus, the feature does not support user's autonomy when selecting an outcome goal. In addition, Fabulous asks the user how he or she would like to change his or her life e.g. by asking "Would you like to build the habit of exercising when you wake up?". However, all of these questions seem to be closed instead of open questions and thus, they do not truly elicit change talk or support user's autonomy. Moreover, Fabulous weakly supports reflective listening by summarizing user's answers (e.g. wanting to build the habit of exercising in the morning) as symbols and icons.

Vida Health Coach provides a personal, real-life health coach to help to achieve health goals. The user can choose whether he or she wants to improve e.g. eating habits or exercising activity. The special feature of the application is that it offers real-life coaches with both video and chat connection to help the user to achieve his or her goals. Thus, Vida Health Coach is not truly an automated application. Its support for eliciting change talk, reflective listening, and supporting autonomy depend largely on the coach

since each of them can help the user in their own way. However, Vida Health Coach asks a few automated questions before offering coaches' help. For example, it asks "How committed are you?". The user can answer with multiple-choice options, but an option to enter free text or an "Other" option is not provided, which does not support user's autonomy. Moreover, the application does not ask for reasons, needs, or desires to change, but only user's commitment to change.

My Health Compass is an automated personal coach that includes features from nutrition and fitness. It also provides a community for supporting the lifestyle change. In contrast to e.g. My Diet Coach, My Health Compass has lower ratings in Google Play (2,2 out of 5 stars). My Health Compass weakly supports the concept of eliciting change talk by asking the user "What is your motivation". The user can enter an open answer. Therefore, the feature to elicit change talk also supports autonomy but is not efficient to use. In addition, the answer is not reflected to the user and thus, the application does not support reflective listening.

Fitness Quote Wallpapers reminds user every day by sending a motivational quote. Moreover, the user can set a quote as wallpaper in his or her phone. Such motivational quotes include e.g. "Go to the gym", "Get sleep, eat clean, drink water, exercise, repeat", and "Train insane or remain the same". The application was chosen for the comparison because it claims to support user's motivation by providing motivational quotes and thus provides a unique way to motivate users compared to other popular applications. However, the application does not support any of the key concepts of this thesis since it only provides pictures of different motivational quotes.

The idea of the next application, Pact, is to pay cash for users who achieve their goals. In contrast, if the user does not achieve his or her goal, he or she has to pay money. The application was chosen because of its unique way to motivate users into healthy lifestyle compared to other existing applications.

Pact does not strongly support any of the key concepts of this thesis. However, it repeats users choices e.g. for the amount of cash being paid to the user. Nevertheless, these reflections do not reflect user's own thoughts, such as reasons or desires to change. In addition, change talk is not elicited in any way e.g. by asking reasons to join the community or motivation to change.

Two of the applications in Table 8 are selected for closer comparison with the Precious application: AIM and I Move. These two are selected because they best support all three key concepts of this thesis: eliciting change talk, reflective listening, and supporting autonomy. Thus, the design created in this thesis can best be evaluated when compared to applications supporting same concepts. Next, these two applications are shortly described. After that, the next section compares eliciting change talk, reflective listening, and supporting autonomy in these two applications and the design in this thesis.

The first application is The App to Improve Motivation (AIM) for smartphones. The application is provided by Canterbury Christ Church University. According to the description of the application in Google Play, AIM is based on the clinical principles of motivational interviewing. The goal of the application is to help the user to achieve his or her personal lifestyle aims. The application starts by asking the user what he or she wants to change in his or her life and continues asking e.g. specific reasons for change as well as importance, confidence, and readiness for a change. After that, it provides the user different tools to help achieve the target behavior.

The second application, I Move is a web-based intervention aiming at increasing and maintaining physical activity among adults. The Open University of the Netherlands provides the intervention. Although the intervention is a desktop application instead of a mobile application, it is best suitable for this evaluation. Similarly to the Precious application, the I Move utilizes both motivational interviewing and self-determination theory as a theoretical background of the application. Unfortunately, the original application is in Dutch and is not freely available on the web. However, Friederichs (2014) describes the application and its functionality carefully in his doctoral thesis and can thus be compared to the Precious application at a sufficient level.

6.3 Comparison of AIM, I Move and Precious

The following subsections compare and discuss asking open questions and eliciting change talk as well as supporting reflective listening and supporting autonomy in all three applications: Precious, AIM, and I Move. Moreover, mobile UI special

characteristics, such as the efficiency of use, are shortly discussed when comparing Precious and AIM. The goal of the next subsections is to evaluate the design solutions of the Precious application introduced previously by mirroring it to the other two applications.

6.3.1 Support for eliciting change talk

Open questions are asked and specific MI techniques, such as evocative questions and importance and confidence rulers, are used in all three applications in order to elicit change talk. However, there are differences in the ways of how question are asked

In AIM, change talk is elicited e.g. by the use of evocative questions as well as importance and confidence rulers. Open questions are asked within these techniques. However, although change talk is elicited by using the specific techniques of MI, it seems that the mobile platform is not taken into account. For example, the chosen input method for the application is to enter text input (Figure 13). Moreover, AIM asks 6 open questions in a row when defining user's goal and readiness for it (Figure 14).

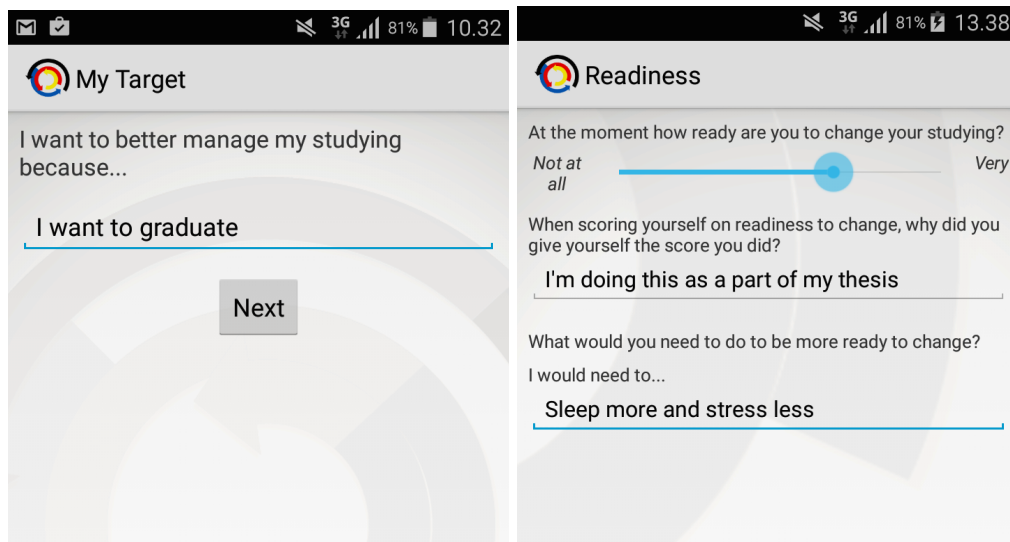


Figure 13. Exploring user's target in the AIM application. Screenshot.

Figure 14. Many questions in a row in the AIM application. One view includes two questions, three similar views in a row. Screenshot.

Other than asking many open questions in a row, the efficiency of use in the AIM application might suffer because of long introductory texts occasionally asked before a new question. For example, the user is prompted as follows: “Please answer the question below about your Studying AIM for the week ahead”. Right below that, a question about study target it asked. This violates the efficiency of use because the user would probably know to answer the question without the prompt to answer to such a question. In addition, there is only one open answer text field after each question, which means that the user either cannot type more than one answer or he or she has to write all of his or her answers to the same open text field.

In contrast to AIM, the Precious application provides multiple-choice selection and an additional option for entering an own answer. This better supports simplicity and efficiency of use compared to only text input. The advantage of the open question asking method of AIM is that the user does not see any suggested answer options and thus has to create his or her own answer. From this perspective, AIM might better elicit change talk. However, typing answer in with an onscreen keyboard does not support efficient use because of the small size of a mobile screen. In addition, AIM asks even 6 open questions in a row (two in a view, 3 views in a row), which might even lower the user’s motivation to properly answer all questions. Also, open answers are difficult to utilize as reflections later in the application. This is further discussed in the next subsection.

The I Move application has a more similar approach to Precious for asking open questions than AIM. Likewise to Precious, also I Move utilizes multiple-choice selection combined with an open text field possibility in the end for answering an open question. In addition to that, the user is sometimes asked to enter his or her answer in an open text field only. This is done e.g. when the user is asked how becoming more physically active can relate to previously chosen values. Other techniques than value clarification include e.g. the use of importance and confidence rulers, asking evocative questions and asking the user to look forward in his or her life.

Although I Move utilizes multiple-choice options and thus better supports efficient use compared to AIM, it does not necessarily truly elicit change talk. Also Friederichs (2014) note in his thesis that optimizing eliciting change talk in computerized interventions should be further studied. In I Move, multiple-choice

answer options are showed right after the question. As discussed in chapter 4, this might not facilitate higher-order thinking as it disturbs the thinking process and allows the user to select the most suitable from the list without thinking further. In contrast, the Precious application first asks the user to think about his or her answer before swiping to the next view where the multiple-choice answer options are revealed.

6.3.2 Support for reflective listening

Similarly to the Precious application, reflective listening is supported in both the AIM and the I Move applications. However, there are differences in the way of how the reflections are offered to the user. Most important differences concern depth and frequency of reflections and a lack of the possibility to correct reflections.

As noticed in the previous subsection, the AIM only asks the user to fill in his or her answers into an open text field when answering an open question. As a natural result, the reflections provided cannot automatically be interpreted into meaningful reflections. Therefore, the AIM application only repeats what the user previously entered (Figure 16).

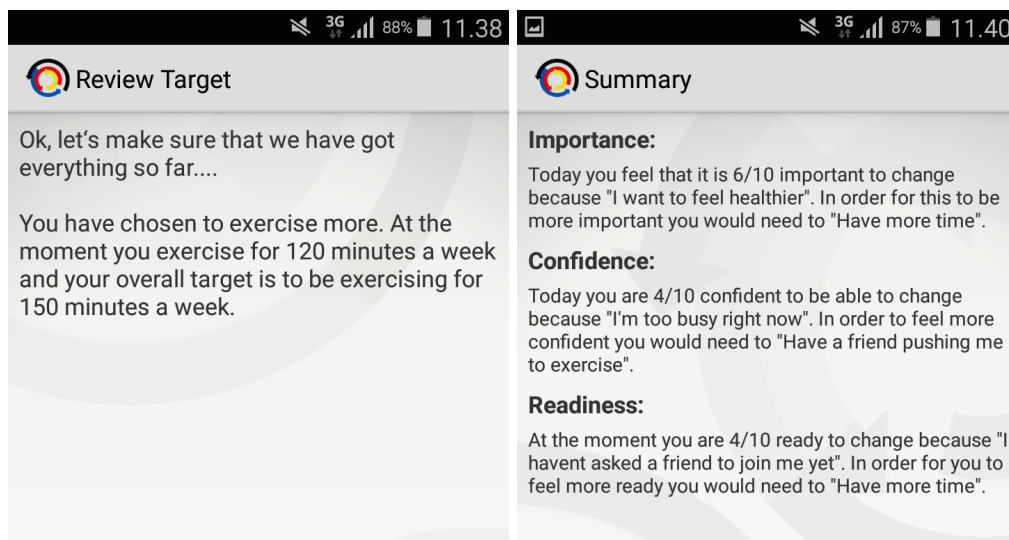


Figure 15. Simple reflections are provided before addressing the importance, confidence, and readiness to change in the AIM application. Screenshot.

Figure 16. Simple reflections repeating what the user has previously entered are provided in the AIM application. Screenshot.

In contrast, the Precious application aims at providing the user also deeper reflections. Moreover, when providing simple reflections, the Precious application targets at offering rephrases instead of just repeating what the user has previously entered. As an exception, repetitions of the answer are provided in the Precious application if the user has typed in his or her answer instead of choosing a multiple-choice answer option. Thus, it seems that the Precious application has a better chance to make the user feel that he or she is understood compared to the AIM application because Precious tries to add a dimension of understanding to the reflection.

Similarly to Precious, also I Move aims at providing meaningful and skillful reflections to the user. The developers of the I Move application have put a lot of effort into creating specific feedback messages for different combinations of answers. For example, there are 80 different feedback messages only after the importance ruler. The feedback messages differ from each others based on the user's score in the ruler: low, medium, and high scores all have different feedback messages.

Both I Move and AIM have a few limitations in reflective listening compared to Precious: the lack of the possibility to correct reflections and the frequency of reflections. First, neither of the applications offers the user a possibility to correct reflections or fine-tune previous answers, as Precious does. This feature would be more important in I Move since it provides deeper and more complex reflections. The lack of the possibility to correct reflections might make the user feel misunderstood if the original reflection is inaccurate. However, in the AIM application the feature to fine-tune answer would probably not be as critical because of the lack of deeper reflections and the possibility to enter answers as a free text input.

The second limitation is the frequency of reflections compared to Precious. It seems that both of the other applications provide reflections only in the end of a question-answer –chain. However, this cannot be properly evaluated for the I Move application since Friederichs (2014) does not take a stand on the frequency of reflections. In contrast, the AIM application can be evaluated from this perspective. AIM provides a short summary of answers given so far approximately halfway of the series of questions (Figure 15). In addition, AIM summarizes user's answers in the end of the questions. However, it asks three to four questions in a row without providing any reflections or

feedback in between. Thus, it seems that the Precious application better provides the user reflections also while answering questions.

6.3.3 Support for autonomy in eliciting change talk and reflective listening

The way to ask open questions is mostly autonomy supportive in all of the three compared applications. In AIM, the user can type his or her answer into an open answer field, and in both Precious and I Move there is an open text field possibility in the end of the multiple-choice option list. One way to violate autonomy supporting would be multiple-choice questions without an open answer field because the user would not necessarily have the control to answer the best suitable answer. Fortunately, none of the applications use this approach and thus are autonomy supportive from this perspective.

However, AIM has a few exceptions in asking open questions that seem to violate user's autonomy. For example, when the user has chosen "exercise" being his or her target behavior, the AIM application assumes that the user wants to exercise more by asking to fill in "I want to exercise more because..." (Figure 17)..

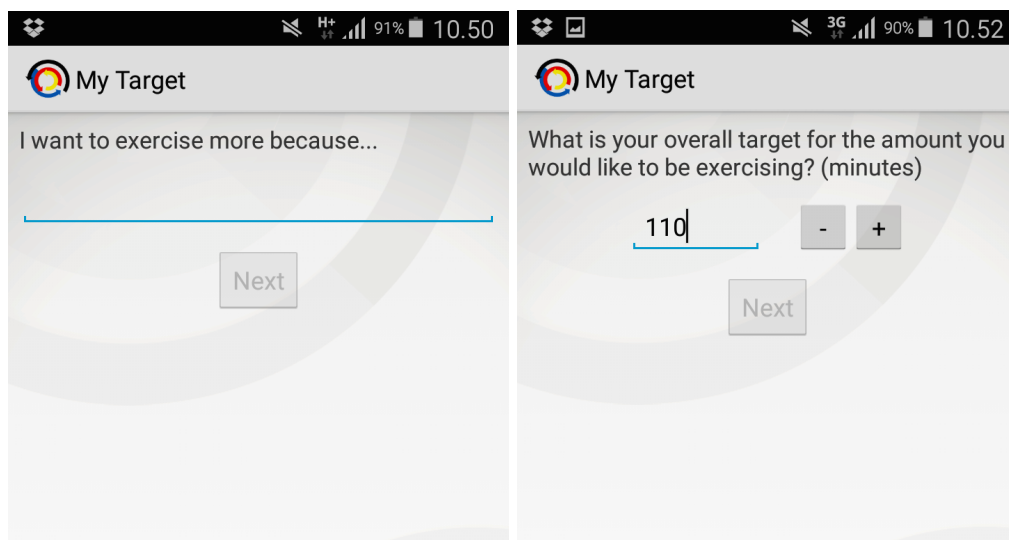


Figure 17. The AIM application assumes that the user wants to exercise more instead of e.g. exercising differently. Screenshot.

Figure 18. The user cannot enter a lower number than what he or she described his or her current amount of exercising in the AIM application. The "Next" button is disabled if the number is too low. Screenshot.

The application does not take into account that the user might want to e.g. exercise less or differently. Moreover, when the application further asks user's target amount for exercising, the user cannot navigate to the next view if he or she has entered a lower number compared to what he or she currently does (Figure 18). Also, the application does not show the previous answer, which means that the user has to remember what he or she entered to the previous view. That demands recall instead of recognition, which is against good usability according to first Molich and Nielsen (1990) and later to Inostroza, et al., (2012)

In contrast, the Precious application starts by asking user's overall goals for the life including e.g. being healthier, having more fun, and getting physically stronger (See more examples in Figure 5 and Figure 6). Only after that, the user can choose physical activity being the behavior that would help him or her achieving the overall goal (Figure 9). Moreover, the user is not asked to specify whether he wants to have more or less physical activity – that is only specified later when the user can set a daily goal. Thus, the Precious application seems to better support user's autonomy than the AIM application when asking open questions and eliciting change talk, since it does not assume what the user actually wants or it does not force the user in one direction.

Reflections in all the three applications are mostly autonomy supportive. Even though the AIM application only provides the user simple reflections, they do repeat what the user has previously answered. Repeating user's statements is autonomy supportive because the user can see what he or she has answered previously. Similarly, the I Move application also provides autonomy supportive reflections to the user. Many of the reflections in the I Move application are deeper compared to the AIM application, but an emphatic style has been implemented to the reflections. Moreover, coercion and blame are consciously avoided in the reflections.

6.4 Comparison of Precious and the design in the Precious-project

This section shortly discusses and evaluates the differences of the design presented in this thesis and the actual, implemented application in the Precious-project. Moreover, the reasons for such differences are shortly covered. The design of this thesis is referred as

“design of this thesis”, whereas the actual, implemented application is referred as “the design in the Precious-project”.

The ways of eliciting change talk in the design of the Precious-project is quite similar to the design of this thesis. In both, the user is first asked to think his or her answer before swiping forward. However, the prompt and the text are slightly different in the designs: the design in the Precious-project first mentions: “before swiping forward”, whereas the design in this thesis suggests that the prompt to swipe should only be mentioned at the end (Figure 19 and Figure 20; Figure 4 and Figure 5). Moreover, the design of the Precious-project does not offer the user a possibility to enter free text in the end of the multiple-choice list (Figure 21).

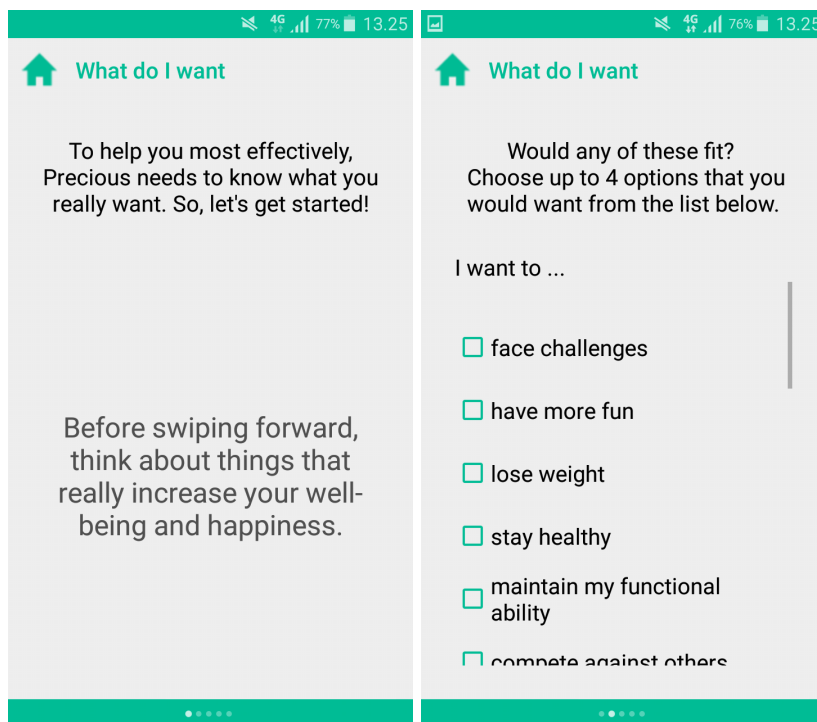


Figure 19. The question and prompt to think are slightly different from the design of this thesis in the Precious-project application. Screenshot.

Figure 20. The prompt to answer is slightly different from the design of this thesis in the Precious-project application. Screenshot.

The main reasons for the differences are the challenging schedule of the Precious-project and the broader perspective of design. The actual implementation of the project started before the design exploration –phase of this study was finished and thus, the design in this thesis was not implemented. Moreover, the goal of the Precious-project

was to develop a full intervention and thus, the functionality of the whole application had to be considered in the design process. The existence of an open answer possibility would have provided a problem of guiding the user through the application since the application would not be able to provide any content based on an open answer. However, the lack of an open answer possibility in the application of the Precious-project can violate user's autonomy because the user does not have the possibility to give an answer outside of a suggested list of answer options.

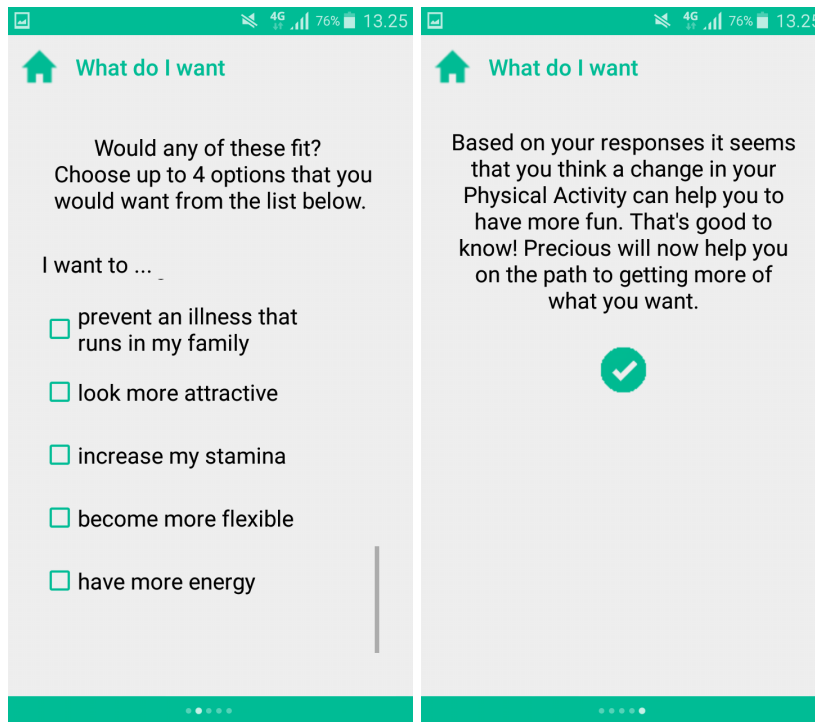


Figure 21. No open answer possibility in the Precious-project application. Screenshot.

Figure 22. The final reflection in the Precious-project application simply repeats and rephrases user's previous answers. Screenshot.

The ways to support reflective listening are also different in the design of this thesis and in the design of the Precious-project. In the design of the Precious-project, only simple reflections are provided and only at the end of a question-answer –chain. Moreover, the design of the Precious-project does not provide an opportunity to correct reflections or fine-tune answers (Figure 22). In contrast, the design of this thesis suggests both simple and deeper reflections and providing them along with each new question, as well as offering a possibility to correct reflections.

The main reason for the differences is the limited time and resources of the Precious-project. Although providing the user with deeper and possibly more complex reflections would be ideal in order to make the user feel that he or she is understood, that is not always possible in real life. Creating accurate and meaningful reflections for each different answer combination probably takes a lot of time. Because of the tight schedule of the Precious-project, either time or resources to create such reflections was not available. Moreover, because of the lack of deeper reflections, the possibility to correct reflections is not so necessary. This is because simple reflections repeating and possibly rephrasing user's answers are more likely to be accurate than deeper reflections. However, the possibility to correct reflections would also further elicit change talk and support user's autonomy. Nevertheless, the lack of it does neither violate user's autonomy nor support it.

6.5 Chapter summary

It seems that the Precious application better takes eliciting change talk as well as asking open questions, higher-order thinking, and the efficiency of use into account when compared to AIM and I Move. Precious exploits all four perspectives, whereas both AIM and I Move have weaknesses in some of the areas: AIM in the efficiency of use, and I Move in higher order thinking. Moreover, Precious asks the user to think before navigating forward in contrast to the design in the Precious-project, in which the prompt to navigate is provided before the prompt to think and thus, Precious forces the user to read the prompt to think first. Thus, the method to elicit change talk in a mobile environment described in this thesis seems superior to other similar applications.

It also seems that both Precious and I Move are superior in regard to providing deep and meaningful reflections compared to AIM and the design in the Precious-project. Moreover, Precious is the only application to offer the user a possibility to correct reflections. It also seems that only Precious provides reflections after every question instead of just in the middle and end of the series of questions. Thus, it seems that the Precious application has a better chance to make the user feel understood by the use of reflective listening.

Finally, it seems that all of the applications are mostly autonomy supportive in regard to eliciting change talk and reflective listening. However, minor differences occur for the good of the Precious application. Foremost, the Precious application better allows the user to freely answer to open questions without assumptions of user's overall goals, in contrast to the AIM application. Additionally, the design in the Precious-project does not let the user enter a free answer in addition to choosing from multiple-choice options, which violates user's autonomy. Thus, it seems that the Precious application takes autonomy support into account slightly better than the AIM or I Move applications.

7 Conclusions and discussion

This chapter presents and discusses the results of this thesis. Firstly, results are presented concisely. Secondly, the relationship between the results and the theoretical framework of this thesis is discussed. Thirdly, the internal validity and the applicability of the chosen approach for this thesis are discussed along with limitations of this study. Fourthly, the external validity and the generalizability of the results for other contexts are discussed. Finally, implications for future research are considered.

7.1 Results

The aim of this thesis, as framed in section 1.2, was to find ways to structure a mobile user interface in a way that it evokes user's inner motivation and resources in order to facilitate behavioral change. The motivational interviewing techniques to be designed were:

- Eliciting change talk
- Making the user feel that he or she is understood by the use of reflective listening
- Supporting user's autonomy

Next, the results for each of the design goals are shortly presented.

Eliciting change talk

The most important way to elicit change talk after asking an evocative question is *to ask the user to think his or her answer before navigating forward* (Figure 4). This is done in order to maximize user's thinking instead of just allowing him or her to choose the most suitable (possibly leaving out a more accurate answer) option from a multiple-choice list. Both the prompt to think and the navigation are designed to facilitate the user's higher-order thinking process. The instruction to swipe to the next view is only given as a last sentence of the prompt. Similarly, the navigation is intentionally not too obvious to encourage the user to carefully read through the whole prompt. Moreover, the next view starts by asking "Ready?" to indicate that there was a task in the previous view.

Closely related to eliciting change talk, the user answers to an evocative question *by either choosing the most suitable option from a multiple-choice list or entering his or her answer to an open field* if none of the options suit his or her thoughts (Figure 5 and Figure 6). Multiple-choice options are chosen for answering method in order to support efficiency of use. The possibility to enter a free text is offered in order to support user's autonomy.

The last way to elicit change talk is to provide the user *a possibility to correct reflections by fine-tuning previous answers* (Figure 10 and Figure 11). This way, the user has a possibility to elaborate his or her answer further. This possibility is also presented with results of supporting reflective listening.

Making the user feel that he or she is understood by the use of reflective listening

Supporting the user's feeling of being understood is implemented in three ways: by providing shorter and simpler reflections with each new question, by providing deeper and more complex reflections at the end of series of questions, and by providing a possibility to correct inaccurate reflections. *Simple reflections are provided with every new question in order to avoid long question-answer –chains.* They can be provided in two ways: either *before* a new question as a simple line of text or *as a specification* to the previous answer after a new question (Figure 8 and Figure 9).

Deeper and more complex reflections are provided at the end of a question-answer-reflection –chain *in order to provide more skillful and meaningful reflections to further support the user's feeling of being understood.* The deeper reflection consist of three parts: the

reflection itself, a description of how the information is used to both once again repeat the user's goal and to support his or her autonomy, and a prompt to get started to clarify that this is the final view of the question-answer-reflection –chain (Figure 10).

The final way of making the user feel that he or she is understood is to *provide a possibility to correct inaccurate reflections by fine-tuning previous answers* (Figure 10 and Figure 11). This possibility indicates that the application really wants to understand the user. The possibility to correct reflections can further elicit change talk. In addition, it supports user's autonomy, because he or she can further define what he or she means. Finally, the possibility is separated from the question-answer-reflection –chain in order to support efficient use.

Supporting user's autonomy

Supporting user's autonomy is closely related to previous results, as the features of eliciting change talk and reflective listening were designed by keeping supporting autonomy in mind all the time. Thus, many of the ways to support user's autonomy are already presented previously in the previous subsection.

In brief, *the user is always in control*. For example, a possibility to enter free text as an answer instead of selecting an option from a multiple-choice list is always provided, answers are not pushed to the user e.g. by assuming what the user might answer, and advice is given separately from reflections so that the user can decide when to see them. Moreover, the content of reflections is empathic and understanding.

7.2 Interpretation of results

This section discusses the relationship between the results and the theoretical framework of this thesis. First, how these results take place in the field of persuasive technology is discussed. Then, differences and similarities between the results and SDT, MI, and mobile user interface design principles are discussed.

7.2.1 Discussion of persuasive technology and the results

The design presented in this thesis is a part of a persuasive system (the Precious application) because it aims at eventually changing user's behavior by evoking user's inner motivation. Changing user's behavior or attitude is also the definition of a persuasive system according to e.g. Fogg (2003, p. 1), Oinas-Kukkonen (2013), and Hamari, Koivisto, and Pakkanen (2014).

Oinas-Kukkonen and Harjumaa (2009) introduced a Persuasive System Design –categorization, which includes four different categories. The design presented in this thesis seems to be the most similar to the category of dialogue support. That is because the techniques utilized in the design of this thesis are mostly based on a dialogue between the application and the user: asking open questions and reflecting user's answers back to him or her.

However, the design presented in this thesis also differs from the category of dialogue support presented by Oinas-Kukkonen and Harjumaa (2009). The category includes techniques such as rewards, praise, reminders, and suggestions. Nevertheless, most of the dialogue support features do not seem to aim at the target as the design of this thesis: evoking the user's inner motivation. However, for example praise can increase inner motivation according to Koestner, et al. (1987).

The definition of the design principles in the dialogue support category is to support the dialogue between the user and the system “in a manner that helps users keep moving towards their goal or target behavior” (Oinas-Kukkonen and Harjumaa, 2009). In other words, the dialogue support techniques aim at helping the user to maintain the existing motivation to keep moving towards the goal. However, the approach in the design of this thesis is different: it aims at *evoking* the user's motivation and thus, in contrast to the dialogue support techniques, does not assume that motivation already exists.

In addition to just evoking user's motivation, the design of this thesis aims at evoking the user's *autonomous* motivation – most likely based on identified and integrated regulations presented by Ryan and Deci (2000). For example, the design of this thesis aims at asking the user for his or her reasons, desires, and needs for change and thus reminds what is his or her personal importance or values. This is important because autonomous motivation usually yields better results in a behavioral change (Deci and

Ryan, 2008; Friederichs, 2014). Thus, it seems that the design presented in this thesis suggests a new approach on dialogue support of persuasive systems.

The differences in my design and the dialogue support techniques are a result of my design being based on self-determination theory and motivational interviewing. Most of the existing internet-delivered interventions to increase physical activity are based on theories such as social cognitive theory, transtheoretical model, and theory of planned behavior (Davies, et al., 2012). Similarly to what Friederichs et al. (2014) argued, the use of SDT and MI as theoretical background allows a more user-centered approach compared to other automated interventions, because the design in this thesis concentrates on the concerns and perspectives of the individual as is the focus of MI (Miller and Rollnick, 2002, p. 25).

As far as it is known for me, this thesis is one of the first attempts to implement MI techniques into mobile application features. Earlier, Friederichs (2014) has developed a web-based intervention called “The I Move” based on MI and SDT. Moreover, an application called “AIM” based on MI from Canterbury Christ Church University can be found on Google Play. In addition, as far as I know, the design in this thesis is the first attempt to implement eliciting change talk in an automatic system. For example, Friederichs (2014) did not consider how to truly elicit change talk in the I Move intervention.

7.2.2 Discussion of other theories and the results

Although this thesis does not introduce a full intervention, this thesis aims at implementing two MI techniques, eliciting change talk and reflective listening, into mobile features while simultaneously supporting user’s autonomy. SDT was used as a theoretical framework. Due to the differences in a traditional MI use situation in a face-to-face counseling setting and an automated mobile application use, there are some differences in MI and SDT and the design presented in this thesis.

The first difference is the formation of accurate follow-up questions. In the design presented in this thesis, all the questions are fixed and asked from the user in a set order. In contrast, in an MI session, change talk should be further evoked by asking follow-up questions from the same subject (Miller and Rollnick, 2002, p. 87), e.g.

“Could you tell me more about that?”. Follow-up questions to elicit further change talk are probably easier to ask in a face-to-face situation, where a human can immediately respond to the patient’s previous answer. Moreover, the efficiency of use is important in mobile environments, because of the high level of effort in interacting with a small mobile device (Lee et al., 2015). Thus, providing long question-answer-reflection – chains and asking the user to further define every answer is not suitable for mobile environments. Supporting efficiency of use is important because the interaction with a small device already takes a lot of user’s effort (Lee, et al., 2015; Shitkova, et al., 2015).

Although questions are fixed and follow-up questions are not asked after each question, the user is provided an opportunity to fine-tune his or her previous answers or correct inaccurate reflections. In a way, fine-tuning answers and correcting reflections are elaborating previous answers and thus, it can be said that the design in this thesis does sort of ask the user follow-up questions as Miller and Rollnick (2002, p. 87) suggest. Moreover, the feature to fine-tune answers is provided to further elicit change talk as MI suggests. Hence, the user has an opportunity to further elaborate his or her answers.

In spite of the importance of the efficiency of use, a few compromises had to be done in order to meet the design goals of this thesis. For example, the user has to take an extra step in order to see the multiple-choice answer options even though Shitkova, et al. (2015) suggest minimizing the number of steps. This compromise is done to facilitate user’s thinking process and thus, elicit change talk. Cheong, et al. (2012) argue that multiple-choice options do not facilitate higher-order thinking. Because of that, multiple-choice options are first hidden in the design of this thesis in order to enable and facilitate user’s thinking process without providing answers too soon or interrupting his or her thinking process.

To facilitate user’s thinking process, also the navigation is intentionally left slightly unobvious. The prompt to think before swiping forward is the last sentence of a view and might not be too easily noticed. However, Shitkova, et al. (2015) suggest that navigation should be as easy and simple as possible, which is not the case with the design in this thesis. Nevertheless, view indicators on the bottom of the view indicate user’s position in the series of horizontal views.

This thesis applies the term change talk although it supposedly occurs in the user’s thoughts. However, self-perception theory claims that people have to *hear*

themselves argue for a change in order to change talk to occur (Bem, 1972). Thus, *change thinking* is not the same as change talk. Although mobile phone users are asked to think their answers, they probably just think their answers quietly instead of pondering them aloud and thus, users do not hear themselves argue for a change. Moreover, although users are asked to think carefully their answers, it seems difficult to in any way ensure that users truly think what he or she is asked to think: they can easily just skip the thinking phase by navigating to the next view immediately, or they can think about something else than what was asked.

Another difference between a face-to-face MI situation and an automated mobile application use situation is the creation of accurate and meaningful reflections based on multiple-choice answers in a way that makes the user feel understood. Similarly to the creation of follow-up questions, also the creation of accurate reflections is a lot more difficult compared to a face-to-face situation. A real human can easier interpret answers and find concerns, feelings, and hidden meanings behind them. Moreover, in a face-to-face situation, the human counselor most likely has more data available, e.g. vocal cues, body language, and just longer descriptions of the participant's thoughts. Thus, a human is better in providing skillful reflections compared to an automatic system.

However, the design in this thesis aims at creating as accurate and meaningful reflections as possible in an automated environment. Moreover, the design presented better takes reflective listening into account compared to existing solutions, the AIM application and the I Move intervention by Friederichs (2014), e.g. by enabling the user to correct inaccurate reflections and by providing reflections more often. In addition, the user has a possibility to correct reflections, which reminds follow-up questions in traditional MI situations. These features are consistent with the practical instructions of MI (Miller and Rollnick, 2002, p. 56; Resnicow and McMaster, 2012).

According to Miller and Rollnick (2002, p. 56), reflections should be provided more often than questions in order to avoid question-answer roles of the patient and counselor in a traditional MI situation. Similarly, the design of this thesis aims at providing reflections after every question before or with asking a new one. Moreover, the questions asked are open questions instead of closed questions to avoid yes-no answers that do not elicit change talk (Miller and Rollnick, 2002, p. 56).

Although there are some substantial differences in face-to-face MI interventions and in the design of this thesis, the results of this thesis can be utilized when developing complete mobile interventions based on MI and SDT. The benefits of automated interventions, in general, are significant: for example, existing Internet-based interventions can have a positive effect on the level of physical activity (Davies, et al., 2012). In addition, automated interventions are easier to scale-up and more cost-effective compared to face-to-face –counseling situations (Garrett, et al., 2011; Thomas and Bond, 2014; Wu, et al., 2010). Thus, a mobile application evoking user’s motivation towards a healthier lifestyle can provide an alternative to inefficient face-to-face counseling sessions in large populations. However, the effectiveness of SDT and MI based mobile interventions should be further researched.

7.3 Internal validity

This section evaluates and discusses the applicability of the chosen approach for this thesis as well as limitations of the study. In general, this study had a *constructive approach*. More specifically, an *Research through Design* -model introduced by Zimmerman, et al. (2007) was utilized. Moreover, a *design exploration* –perspective from Fallman’s (2008) Interaction design research approach was exploited. Finally, the design was evaluated by comparing it to other similar solutions. A few limitations of the study and chosen methods are discussed next.

Both the design exploration –perspective and creating design artifacts involve a lot of creativity. For example, the design exploration –perspective focuses on exploring different possibilities and ideas for the design based on the existing academic knowledge. (Fallman, 2008.) However, it is difficult to define when the list of different alternatives is sublime and all-inclusive. What if there is a design possibility that was not found when discussing different design alternatives in this thesis?

The lack of users in the design process is the greatest limitation of this study. A more user-centered design approach could have been utilized in this thesis in order to avoid the uncertainty discussed in the previous paragraph. Creating the design artifacts of this thesis mostly consisted of the researcher sketching different design possibilities

and evaluating them both alone and together with the Precious-team as well as with her other UX Designer –colleagues. In addition to those, other user-centered design tools, such as workshops and user testing, could have been exploited. This way, more alternatives could have been found and the uncertainty of the sufficiency of suggested alternatives could have been decreased.

However, the presence of users in the design process would probably have mostly improved the ideas concerning usability as well as simplicity and efficiency of use. In contrast, users would not have had a deep understanding of the theories underlying the design process and the design aims of this thesis – finding ways to elicit change talk and make the user feel understood by reflective listening while supporting user’s autonomy. Thus, an expert developing and assessing design possibilities seems a sufficient approach for this thesis. Moreover, a user interface can be designed in numerous different ways and going through all possible existing alternatives would not fit into the scope of this thesis. Therefore, the alternatives that seemed the most appropriate for resolving the research aim were chosen into a closer examination.

Similarly to the design exploration and the creation of the design artifacts, also the evaluation of the design was conducted without input from real users. The main reason for that were the differences in the actually implemented Precious-application and the design presented in this thesis. Because of the differences, an automated version of the interface could not have been shown to users, but instead, the user evaluation should have been conducted with e.g. paper or some other manual prototype. In addition, testing if the user feels understood only with a paper prototype would have been difficult, because creating all different reflections for the paper prototype would have been time-consuming. Also, managing all the reflections in a testing situation would have been difficult because of the huge amount of different reflections.

A result of this thesis suggests that change talk can be elicited from the user by asking the user to think before proceeding, and by the use of multiple-choice options combined with an open answer. This was evaluated and confirmed by comparing it to other existing solutions exploiting MI and SDT as a theoretical background. However, it can only be said that it *seems* that the result presented in this thesis elicits change talk. This is because of the evaluation method: the feature should have been evaluated with real users in order to claim that change talk truly occurs. Thus, it can only be said that

the design of this thesis elicits change talk better *in comparison* to other similar applications, not that it *absolutely* elicits change talk.

However, even an evaluation with real users could probably not have confirmed the absolute occurrence of change talk. This is because of an artificial test situation. Even if users were asked to think aloud, they might have followed the instruction to think their answers more carefully compared to a real use situation in order to please the instructor of the test situation. Thus, only a real use situation could reveal the occurrence of change talk, but those situations are difficult to observe because the change talk takes place in the user's thoughts.

7.4 External validity

The focus of this study was to find specific ways to evoke user's inner motivation in a mobile application in order to help them achieve a healthier lifestyle. Eliciting change talk and reflective listening while simultaneously supporting autonomy were the MI techniques to be implemented into mobile features. However, the design presented in this study might be beneficial also outside of the evoking motivation into healthy lifestyle –context.

Firstly, the design to elicit change talk could be utilized in educational contexts when students are using tablets or mobile phones for schoolwork. Cheong, et al. (2012) argue that the use of multiple-choice answer options limits higher-order thinking in educational contexts. However, entering an answer as a free text, as Cheong, et al. (2012) suggest, does not support the efficiency of use and is perceived less usable (Smith and Chaparro, 2015). Therefore, the design of this thesis could both support students' higher-order thinking by asking them to think before revealing answer options and the efficiency of use in a mobile environment. However, it would be rather easy for the students to cheat, because the design in this thesis does not prevent users from skipping the thinking process. Thus, more research should probably be done in order to find ways to ensure that users really engage in the thinking process.

Secondly, applications in highly sensitive use contexts, such as patients using mobile applications to report their feelings and symptoms to their doctors, could utilize

the design of reflective listening in this thesis. For example, medical treatment applications could utilize the results of how to make the user feel understood and accepted by reflective listening. However, it seems that little knowledge exists about using a mobile application in such sensitive use contexts.

7.5 Future research

Three logical future research topics are presented. The first one concerns how to further develop and combine the design of this thesis into a full mobile intervention, whereas the second topic concerns the effectiveness of the design developed in this thesis. Finally, different input methods for answering an evocative question are suggested.

First, as this thesis only concentrated on a few specific MI techniques, the next logical step would be to develop the whole mobile intervention. The features presented in this thesis do not take into account the rest of the intervention. For example, the user is able to give an open answer to a question asking the user to determine the behavior that would best help him or her to achieve an outcome goal in his or her life. However, an open answer would be difficult to utilize in an actual intervention, since the user could not be suggested a task to help to maintain the answered behavior. Thus, the whole intervention has more perspectives to take into account than what is presented in this thesis and requires, therefore, more research.

In addition to taking the functionality of the whole intervention into account, other persuasive elements merged into the application could also be further studied. This thesis mostly discusses the similarities of MI, SDT and persuasive technology in chapter 4, but the invocation of other elements was left out. For example, the use of a social role would be interesting to further study in this context.

Another way to continue this study would be to research the content of reflections in a mobile application and actually creating all the reflections. For example, more specific instructions to e.g. what words to use in the reflections and how to achieve an emphatic tone in reflections to make the user feel that he or she is truly understood and accepted. In contrast, this thesis concentrates on how to structure content in order to implement reflective listening and support user's need to feel related, but the content

of reflections is not discussed in depth. However, in a traditional MI situation, the collaborative and respectful tone of the counselor's sayings is crucial (Miller and Rollnick, 2002, p. 107).

In addition to studying the content and language of reflections, also more visual ways to make the user feel understood could be studied. In this thesis, all reflections provided are text-based. However, the possibilities of visual ways, such as use of icons, illustrations, and graphics, to support user's need for relatedness could be further researched.

Outside of the context of further studying the specific features of the application, another future research topic would be to study if the features designed in this thesis actually evoke user's motivation. Moreover, the impact of a mobile intervention into user's behavioral change results should be further studied. Unfortunately, including those topics into the scope of this thesis would have been too time-consuming. Results from Friederichs (2014) suggest that an automated, web-based intervention based on MI and SDT can have an impact on user's physical activity level. However, the use context of mobile applications differs from web-based interventions e.g. because the phone is always with the user (Fogg, 2003) and thus, mobile interventions have advantages compared to web-based interventions. Therefore, more knowledge about the effectiveness of mobile interventions into user's motivation and long-term behavioral change results should be studied.

Semantic processing of voice input methods is the final future research suggestion. This thesis argues that multiple-choice options as an input method for answering open questions are superior to voice input because voice input answers could not be easily interpreted into meaningful reflections. However, users perceived voice input as the most effective input method in the study of Smith and Chaparro (2015). Voice input would also support eliciting change talk and user's autonomy since a list of limited answer options would not limit their thinking or direct them into a particular direction.

If voice input can be automatically analyzed and therefore, reflections could be automatically formed based on voice input answers, voice input as an input method could provide an efficient way to ask users to think their desires, ability, reasons, and needs for change. Moreover, the inconsistency between *change talk* and *change thinking*

could be avoided if the user had to talk his or her thought aloud to answer a question. However, users might hesitate using voice input in noisy use situations or in a situation where privacy is not secured (Smith and Chaparro, 2015). In addition, questions asked in the Precious application probably require privacy, as the questions can be sensitive in nature (e.g. when asking about overall life goals). Thus, a future research proposal is to study how voice input method could be utilized in a similar MI –context as in this thesis in a way that users would feel comfortable answering to possibly sensitive questions. Moreover, the interpretation of such answers into meaningful reflections should be studied.

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