

UTRECHT UNIVERSITY

# Short Message Service for Healthy Living

Thesis

**Master Thesis - Content and Knowledge Engineering**

**20-08-2010**

Hans-Eric Noyons – 3308723  
H.E.A.Noyons@students.uu.nl  
Cohort 2008

Daily supervisor: Rogier van Eijk  
Second supervisor: Robbert-Jan Beun  
*Inf/scr-09-101*

## PREFACE

This research has been performed as graduation research for the master Content and Knowledge Engineering at Utrecht University. The topic directly appealed to me as I am interested in new technologies and have been connected with health care solutions since my bachelor graduation project which was performed at a local hospital. I enjoy investigating new research areas and the different disciplines of the research made the research challenging and interesting.

Thanks go out to both my supervisors Rogier van Eijk and Robbert-Jan Beun for guiding me through the process and by providing help when it was needed. I would like to specially thank Rogier van Eijk for connecting me to the project and providing a global outline of the research approach.

I would also like to thank all participants who participated in this research and provided valuable information to the design of the service. Special thanks go out to the administrator of exoft.net who provided access to the server during the 10 months of the studies.

Lastly, I would like to thanks family and friends who have supported me during the course of the research and attended the final presentation of the research.

## ABSTRACT

The physical inactivity of individuals is a burden to public health concerns. Changing the lifestyle of individuals into a more physically active lifestyle is beneficial for both public concerns as for the perceived quality of life and well-being of individuals. By applying persuasive self-supporting systems the lifestyle of individuals can gradually be changed into a more physically active lifestyle. This research investigated the dimensions of health behaviour change and created a short message service that was aimed to persuade people to take health exercises into their daily lives. Two three-week test runs were performed to acquire relevant user feedback and to evaluate the effectiveness of the persuasive design. The created short message service was evaluated to be successful in generating short-term changes, but lasting change was only measured at highly motivated users. Improvements are suggested on interaction engagement, relationship building, and to extend the scope of the created behaviour change model. Longer testing periods could lastly provide a more accurate view on the quality of the created relationship and whether real change is achieved by the service.

# CONTENTS

|   |           |
|---|-----------|
| <b>1. INTRODUCTION.....</b>             | <b>6</b>  |
| <b>2. PROBLEM DEFINITION.....</b>       | <b>7</b>  |
| <b>3. BACKGROUND .....</b>              | <b>9</b>  |
| 3.1 TEXTING IN HEALTH CARE.....         | 9         |
| 3.2 PERSUASIVE TECHNOLOGY .....         | 10        |
| 3.3 SOCIAL DYNAMICS .....               | 11        |
| 3.4 RELATIONSHIPS.....                  | 12        |
| 3.5 ETHICS .....                        | 13        |
| 3.6 SUMMARY .....                       | 13        |
| <b>4. BEHAVIOUR CHANGE MODEL .....</b>  | <b>15</b> |
| 4.1 STAGES OF CHANGE.....               | 15        |
| 4.2 HEALTH BELIEF MODEL .....           | 16        |
| 4.3 THEORY OF REASONED ACTION.....      | 16        |
| 4.4 BEHAVIOUR MODEL OF FOGG .....       | 17        |
| 4.5 RESULTING MODEL .....               | 17        |
| <b>5. PERSUASIVE DESIGN .....</b>       | <b>18</b> |
| 5.1 DESIGN METHOD .....                 | 18        |
| 5.2 TARGET BEHAVIOUR .....              | 19        |
| 5.3 TARGET AUDIENCE.....                | 19        |
| 5.4 BARRIERS .....                      | 20        |
| 5.5 TECHNOLOGY CHANNEL.....             | 21        |
| <b>6. RELATED WORK .....</b>            | <b>23</b> |
| 6.1 LITERATURE FINDINGS .....           | 23        |
| 6.2 LITERATURE IMPLEMENTATION .....     | 25        |
| <b>7. DESIGN TESTING .....</b>          | <b>28</b> |
| 7.1 TRIAL FINDINGS .....                | 28        |
| 7.2 EXPAND DESIGN.....                  | 31        |
| <b>8. EXPERIMENT METHOD.....</b>        | <b>34</b> |
| 8.1 PARTICIPANTS .....                  | 34        |
| 8.2 MATERIALS.....                      | 34        |
| 8.3 EXERCISE PROGRAM .....              | 37        |
| 8.4 MEASURES .....                      | 38        |
| 8.5 PROCEDURE .....                     | 39        |
| <b>9. RESULTS.....</b>                  | <b>40</b> |
| 9.1 PERFORMANCE ANALYSIS.....           | 40        |
| 9.2 CONVERSATION HISTORY ANALYSIS ..... | 40        |
| 9.3 QUESTIONNAIRE ANALYSIS .....        | 41        |
| <b>10. DISCUSSION.....</b>              | <b>46</b> |
| 10.1 USER ANALYSIS .....                | 46        |
| 10.2 SERVICE ANALYSIS .....             | 48        |

|                                       |           |
|---------------------------------------|-----------|
| 10.3 TRIAL GUIDELINE EVALUATION ..... | 49        |
| 10.4 RESEARCH ROUNDUP .....           | 50        |
| 10.5 FUTURE RESEARCH .....            | 51        |
| 10.6 RESEARCH CONTRIBUTIONS .....     | 52        |
| <b>11. CONCLUSION .....</b>           | <b>53</b> |
| <b>REFERENCES .....</b>               | <b>54</b> |
| <b>APPENDIX.....</b>                  | <b>58</b> |
| 1. EXPERIMENT INVITATION .....        | 58        |
| 2. EXPERIMENT PROGRAM STRUCTURE.....  | 59        |
| 3. QUESTIONNAIRE .....                | 62        |

## 1. INTRODUCTION

Levels of inactivity are high in virtually all developed and developing countries. The proportion of adults who are sedentary, or who are nearly so, range from 60 to 85%, all being at risk to adverse health outcomes (Oliveira & Oliver, 2008). As a consequence, daily-life physical activity interventions have become a major focus area of current research aiming to persuade individuals into a more active lifestyle. Numerous studies suggest physical activity to positively influence both mental and physical well-being, thereby improving quality of life and health outcomes. Successfully changing the lifestyle of individuals to a more physical active lifestyle has however shown to be difficult and relies on the degree of scientific insight in the variables relevant to behaviour change (Penedo & Dahn, 2005). Investigating the variables that are influential in behaviour change is therefore key to successfully impact the lifestyle of individuals.

Consolvo, McDonald and Landay (2009) define a lifestyle as a pattern of behaviours that an individual enacts and that characterizes who he or she is and how he or she is perceived. A lifestyle represents the choices and individual makes, and in order to change the lifestyle he or she needs to make different choices. An occasional poor or arbitrary decision is seldom a serious problem, but a pattern of poor decisions are and can lead to avoidance of the desired lifestyle. Influencing the decision-making process is therefore of importance in changing the overall behaviour of individuals and can be achieved by providing individuals with relevant information concerning the problem at points of decision, behaviour, or consequence (Intille, 2004). Technologies intended to change the attitude or beliefs of individuals are referred to as persuasive technologies. By applying the right technology channel, these persuasive technologies can reach beyond traditional implementations and can provide tailored feedback at the appropriate time and place so the user will benefit most.

A fast growing technology suitable for information to be sent to and received from individuals at all time is mobile technology. Adler (2007) identified four attributes of mobile phones that make them particularly well-suited for persuasive interfaces: they are personal, ubiquitous, connected and increasingly intelligent. As individuals carry their mobile phone wherever they go, solutions can monitor individuals at any time and place through simple SMS messages which functionality is available on all mobile phones. Persuasive technologies therefore have great potential to assist in health related prevention services, and are known to successfully impact the overall quality of life and long-term health (Chatterjee & Price, 2009). However, as Intille (2004) states, the challenge is to design just-in-time preventive health solutions for people – old and young – who do not consider themselves to be sick as the technology will only be used if it improves feelings of self-efficacy, well-being, or security without becoming a burden.

This research investigates the different aspects of behaviour change and will apply the eight-step design process of Fogg (2009) to create a persuasive technology aimed to change the lifestyle of individuals who do not consider themselves to be sick. By combining behaviour change guidelines with persuasion, this research aims to increase the impact of the created technology and thereby the impact on the current lifestyle of individuals. Exercise triggers will be applied to invoke behaviour associated to the targeted lifestyle and to gradually change the lifestyle of individuals into a more physically active lifestyle.

## 2. PROBLEM DEFINITION

The public health burden of inactivity is problematic and expensive (Fox, 2007). Persuading individuals into a more physical active lifestyle is therefore beneficial for both individuals as for public concerns. All lifestyle decisions related to diet, exercise, dental care, stress management, and maintaining social relationships are known to positively impact overall quality of life and long-term health (Intille, 2004). The primary focus of this research lies in improving the health conditions for individuals who find themselves in stressing moments. By applying small and simple exercises, which are stated by Lacroix, Saini, and Goris (2009) to lead to many health gains, individuals can gradually get used to performing the behaviour on a regular basis and thereby the intended lifestyle.

Apart from the social relevance the research can also prove to be valuable for the domain of health care. In this domain, more providers see the potential of using wireless technology to monitor and support their patients remotely. These health care applications can improve health care delivery, reduce costs, increase the efficiency and effectiveness of health care providers, and make services more convenient for patients (Adler, 2007). By using timed health information, reminders and support, providers persuade health behavior change to individuals aiming to live a more balanced and healthy lifestyle. From a user perspective, self-supporting systems are observed to be less demanding and less insistent than frequent contact with a professional (Anhoj & Moldrup, 2004).

As stated before, this study will apply the eight-step design process of Fogg (2009) to create the persuasive technology that will be implemented in this study. This design process outlines the steps to follow when creating persuasive technologies and has the basic principle to start small and fast, and expand when successes have been achieved. Feedback is key in this user-centred design, and input is maximized by performing rapid trials to test the effect of each finding. The design is reinforced with a tailored behaviour change model that is based on concepts of models that have proved to be successful in general behaviour change, health behaviour change, and triggering change in persuasive designs. By combining the persuasive design and the tailored behaviour change model, this study aims to create a complete design to persuade individuals to change their lifestyle. Additionally, relationship elements will be investigated as these elements can improve the degree of respect, liking, and trust of users in the service which is desired to initiate and maintain change (Bickmore & Picard, 2005).

The theoretical, scientific contribution of this study is multidisciplinary as it concerns information science, psychology, and health sciences. First of all, this research contributes to information science as it applies a user-centred design to create a persuasive technology that can be seen as an interactive computer system designed to change the attitude, or beliefs of individuals. The findings can be used in future studies that aim to apply a persuasive technology, and to reflect on the effectiveness of the eight-step design process created by Fogg (2009). Secondly, this research is connected to psychology as it investigates the dimensions of health behaviour change and how to maintain change by providing social support with relationship elements. The created model can be valuable to academic research as it combines successful existing behaviour change models to a tailored model that aims to change health behaviour with the use of persuasion. Lastly, in relation to health sciences individuals will be presented with simple but effective exercises that can be performed by any individual. These exercises will be

aimed to generate quick effect as it can entice individuals to continue with the new behaviour. The form, structure, and perceived effect of the exercises can be analyzed and used in future health programs that aim to relieve individuals of tension in stressing moments. Also, the user perception of using mobile phones in health care delivery can be of value to any future health care implementation.

Overall, inactivity of individuals is problematic and expensive to the current society. By applying persuasive self-supporting systems, which are observed to be less demanding and less insistent than frequent contact with a health care professional, the lifestyle of individuals can gradually be changed into more physically active ones. The goal of this research is to investigate the dimensions of health behaviour change and to create a short message service to persuade people to take health exercises into their daily lives. The research question that will be studied is whether individuals can be persuaded to change their lifestyle with timed SMS triggers containing simple but effective exercises.

The research will first discuss related background literature to acquire more information on aspects that are relevant to the study. After this, the different dimensions of health behaviour change are investigated to create a tailored behaviour model aimed to be applied in persuasive designs. When the behaviour model is completed, the research will use the eight-step design process of Fogg (2009) to create an initial version of the persuasive technology. The design process starts with defining the scope of the initial version, followed by additional literature concerning relevant persuasive technologies, and is ended with the testing and evaluation of the derived guidelines concerning behaviour change and persuasive technologies. The resulting implementation is then tested in a controlled experiment, and the derived results will be presented afterwards. The research is ended with the discussion of the results and the conclusions in relation to the goal and the research question.



### 3. BACKGROUND

The first step in determining whether individuals can be persuaded with timed triggers is to gain knowledge on the different topics that are relevant to the research. The starting topic is the effect of wireless health implementations in the domain of health care, followed by additional information on persuasion and persuasive technologies, social dynamics, relationships elements, and ethical questions that arise when applying persuasive technologies.

#### 3.1 TEXTING IN HEALTH CARE

The penetration of cell phones use into the daily activity of people is growing each day. At the end of 2008 there were estimates of 4.1 billion mobile phone subscriptions worldwide. The growth in subscriptions is particular high as the mobile phone use in developing countries is increasing fast (Tryhorn, 2009). Apart from providing simple mobile voice communications, mobile phones have become a platform for delivering a growing variety of applications. They are particularly well-suited for the domain of health care as their attributes enable the *remote monitoring* of patients. Cell phones are *ubiquitous* and *personal* implying that users take them wherever they go and one cell phone is associated with one particular person. Health care application can therefore deliver information to patients when and where it will be most effective (Adler, 2007).

The added value of wireless health care implementations is the extended reach in comparison to traditional services in cost, access, and convenience. Health care services can be designed for monitoring and counselling services, or to provide information to users through a variety of media. Services can also be designed to elicit information from patients regarding their health status (Bickmore & Picard, 2006). As the services are automated, the monitoring and counselling of patients can become *continuous*, providing relevant feedback and advice when problems are detected. The required user information can be kept to a minimum (i.e. numeric values) while still enabling the appropriate output of the health care service. As the interactivity between patient and service consists of short messages, most studies chose the texting feature of the mobile phone as technology channel. Advantages of SMS are the familiarity to most users, and the service does not require the development of new client software (Anhoj & Moldrup, 2004).

Several researches in health behaviour have been conducted using the texting feature of mobile phones as technology channel. Anhoj and Moldrup (2004) investigated the feasibility of collecting diary data from asthma patients through texting. Participants using the diary were enthusiastic about the SMS diary, and the researchers concluded that collection of diary data through SMS is feasible. However, the results were hard to generalize as the group of participants was diverse and the participants were found to be highly motivated to use the diary. Rodgers, Corbett, Bramley, Riddell, Wills, Lin and Jones (2005) determined the effectiveness of a mobile phone text-messaging smoking cessation programme for young smokers at six weeks and at six months. Significantly more participants reported quitting at six weeks compared to participants without the programme and the quit rates remained high at six months. The programme was concluded to offer potential in helping young smokers to quit, with the advantages of being relatively inexpensive, personalised and age appropriate. Franklin, Waller, Pagliari and Greene (2006) investigated the use of texting to support young people with diabetes. The study assessed Sweet Talk for the communication with the user, originally designed to enhance self-efficacy of patients. The participants scored significantly higher on self-

efficacy and the self-reported adherence score, but failed to improve the diabetes control. It was however concluded to be an effective means to provide support.

Summarizing, applying mobile phone text-messaging to health solutions is reported to have great potential. Additionally, Fogg and Allen (2009) state that texting is an efficient and effective approach to trigger health behaviour change. Through texting basic reminders can be send that trigger the desired behaviour, and relevant information can be gathered to provide feedback or to find behavioural patterns. Both sending and retrieving information take little time or energy from the users and is therefore *less demanding and less insistent* than frequent contact with a professional (Anhoj & Moldrup, 2004).

### 3.2 PERSUASIVE TECHNOLOGY

Technologies intended to change a person’s attitude or belief are referred to as persuasive technologies. *Persuasion* is part of our every day experience as for example advertisement, leadership and propaganda all have elements of persuasion. In persuasion, the preferences of people are subconsciously affected to the desires of the persuader (Etzioni, 2000). However, as Kelly (1987) points out, one must already be open to some form of persuasion to be persuaded. Persuasion can be used for different purposes, but it must not tend to coercion. Coercion can be seen as an unethical subset of persuasive design, with its boundaries inevitably subject to debate. The line between persuasion and coercion can be a fine one, importantly persuasion implies a *voluntary* change of behaviour or attitude or both (IJsselsteijn, De Kort, Midden, Eggen and Van den Hoven, 2006).

Lockton, Harrison and Stanton (2008) created a dimension space to investigate how persuasive technology fits in the context of designing behaviour change. A common factor in persuasive designs is the *intent* of the designer to change behaviour. Looking at the created dimension space (DwI), the space consists of three dimensions: *intended social benefit*, *intended commercial benefit* and *impact on immediate user* (See figure 1). The dashed line in the DwI space shows that persuasive technology is appropriate for both intended commercial and non-commercial implementations with intended social benefit and which are helpful to the immediate user. Health implementations are particularly well-suited according to the model as they have social benefits and are helpful to the immediate user.

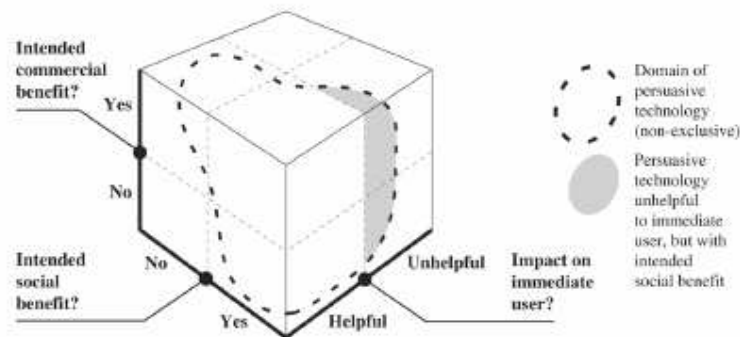


FIGURE 1 - DWI SPACE (LOCKTON, HARRISON & STANTON, 2008)

Mobile persuasion in health applications is also researched to be well-suited in the behavioural grid of Fogg (2009d). It is most effective to target familiar behaviour that needs to be performed, or increased, a number of times. Additionally, as mentioned before, the ubiquity of mobile computing devices, used by an increasing number of users, allows persuasive feedback to be provided *at the appropriate time and place* so the user will benefit most. Appropriate health related messages can be send when decisions are made or behaviour is executed (Ijsselstein et al., 2006). Another advantage of persuasive computing is that unlimited amount of data of past experiences can be recorded and used to *tailor feedback* to users applied to the current context. Messages both timely and tailored are known to be most effective at motivating behaviour change (Intille, 2004).

### 3.3 SOCIAL DYNAMICS

When applying persuasion, it is important to understand the basic principles of decision-making. Cialdini (2004) explained different tendencies of human behaviour that come into play in generating a positive responses. Three tendencies that can be applied to this research are the rule of *social validation*, *reciprocity* and *authority*. To start with social validation, if many individuals favour a particular idea one is likely to follow. So if many individuals favour an idea, it is observed to be socially valid by the environment and can motivate others to follow that idea. In the case of behaviour, if the behaviour is generally accounted for as being desirable and thereby socially valid, it can motivate individuals to perform the behaviour. The second tendency has proven to generate positive response in cases where information is delivered to users. Information, touted with experience, expertise or scientific credentials, is marked by the power of authority. According to Cialdini (2004), persuaders use this power of authority to influence to decision-making process of individuals, as the opinion of authority is valued as important. The third tendency has shown to be powerful. The rule of reciprocity implies that one should provide help, favours, and benefits to those who have previously helped them (Nass & Moon, 2000). Fogg (2002) states the rule of reciprocity as an important social dynamic that can be used to influence users through computing technology. "People will feel the need to reciprocate when computing technology has done a favour for them." Reciprocity can be applied in scenarios where a user action needs to be performed that are of no value to him or her, but that is of value to the computing technology at hand.

As stated, the rule of reciprocity can be applied to computing technology. According to Nass & Moon (2000), individuals' exhibit these dynamics through computing technology as these responses are '*overlearned*'. When object are presented with enough and appropriate contextual cues, they mindlessly apply *social responses*. The fact that people respond socially to computers has significant implications for persuasion as cues that initiate social responses in human-human interaction can be tested in the context of human-computer interaction. Fogg (2002) describes five types of social cues that can be applied to persuasive technology. Apart from the cues also described by Cialdini (2004), the article explains the influence of language by using praise in messages towards the user. Praise from computers was concluded to generate the same positive effect as *praise* from humans. In the extensive research by Fogg and Nass (1997), three feedback conditions were tested: sincere praise, insincere praise (flattery) and generic feedback. In both the sincere as the insincere condition users felt better about themselves, their performance, the interaction and the computer offering the evaluations. In another study by Lee and Nass (2003) introvert and extrovert language was used through voice to investigate the social presence in computing products. The study concluded that when highly social presence is

required the use of extrovert language is appropriate and when clear social presence is required an introvert voice is appropriate. These findings are valuable for studies that need to communicate in different ways, achieving different goals. Importantly these studies show that computers evoke similar social responses as humans, suggesting the computer to be a social actor.

### 3.4 RELATIONSHIPS

The previously mentioned social dynamics are often used in short-term studies. Bickmore and Picard (2005) investigated the long-term effects by constructing and maintaining a long-term *relationship* with the user. Although the research focused on the development of an embodied software agent, the used techniques are not solely for these agents. Creating a relationship is important as it could *provide social support* to users and *keep the interaction engaging* so that they want to continue using the software. Additionally, research in the social psychology field has found significant association between social support and health behaviour. Important aspects for interaction are the ability to remember relational information between interactions and avoiding repetitiveness (Bickmore, Caruso, Clough-Gorr & Heeren, 2005). The research of Bickmore and Picard (2005) investigated the effects of the use of a relational agent by conducted an experiment that targets 30 minutes of psychical activity a day over a six-week period. The agent significantly increased the users' perception of the quality of the relationship expressed in measures of liking and trust, but failed to achieve an increase in task performance. Different causes in failing to achieve a significant increase in performance were noted including the low amount of subjects and the short length of the study.

One of the core processes in building and maintaining relationships is *empathy* (Bickmore & Picard, 2005). Empathy is defined as the process of attending to, understanding, and responding to the expressions of emotions from other persons. Feng, Lazar and Preece (2004) investigated the influence of empathy on interpersonal trust as trust is important in settings where information is shared and privacy is at risk. The research investigates whether empathic accuracy – the ability to accurately infer the expressions of emotions – and the response type – supportive or not supportive – influence interpersonal trust. The results suggest that both empathic accuracy and response type have significant influence on online interpersonal trust. So in order to build trust in a relationship, empathic accurate and supportive responses are found to be of significant influence.

One valuable aspect related to relationships and trust is the *credibility* of systems. Tseng and Fogg (1999) state that credibility, or believability is the perceived quality of a system which is important in solutions where information is provided or instructions are given to users. Systems gain credibility by providing accurate information and lose credibility by providing erroneous information. An important finding of their research is that users stop using a computer product when the perceived credibility is low, leaving it no opportunity to regain its credibility. Even small errors can have large effects on the perception of credibility. The evaluation of the send information is therefore needful in order to track the perceived quality of the system.

Last aspect in relationships is the social distance between actors. Spencer-Oatey (1996) investigated different studies concerning the interpretation and effect of distance. Social distance influences the language usage of actors in relation to politeness and the use of pronouns in languages as French, German, Italian and Dutch. The formality of the conversations depends on the distance between the actors, expressed in terms as close and distant with close associated

to informal and distant to formal. The investigated studies have variously interpreted distance as comprising one or more of the following (often overlapping) components: social similarity/difference, frequency of contact, length of acquaintance, familiarity, sense of like-mindedness, and positive or negative affect (Spencer-Oatey, 1996).

### 3.5 ETHICS

Designing social dynamics into computing products raises *ethical* questions, as social cues can mislead users about the true nature of the machine (Fogg, 2002). In the case of applying persuasive technology to initiate health behaviour change, the intended goal of living a healthy life is generally desirable and ethically accepted. However, when persuasive technology is applied, the persuader and the persuaded should always reflect if the intended behaviour change is performed voluntary. Users should not feel tricked into doing something that they did not want to do, nor should it be done under coercion. IJsselstein et al. (2006) therefore claim the need for a continuous and open ethical debate on the pros and cons of persuasive technology.

In conclusion, the design of persuasive technology should be ethically justified. Berdichevsky and Neuenschwander (1999) established a set of eight ethical *principles* for the design and implementation of persuasive designs. The golden rule of their principle set is that the creators of a persuasive technology should never seek to persuade a person or persons of something they themselves would not consent to be persuaded to do. The research asserts that there is an uneasy ground between the persuader and the persuaded in relation to responsibility. The outcome of the persuasive act is therefore important to evaluate. Berdichevsky and Neuenschwander state that, apart from unethical intended outcomes, the persuader is also responsible for unethical reasonably predictable unintended outcomes. Although the outcome is unintended, persuaders should still be held responsible as it is reasonably predictable. In any not reasonably predictable cases however, the responsibility would lie in the hands of the persuaded.

The research of Ham, Midden and Beute (2009) will shortly be described to illustrate a form of persuasion technology open to debate. In their research participants received feedback about the correctness of their choice through the presentation of a smiling or a sad face for either 150ms or 25ms. The 25ms condition prohibited the conscious perception of the stimuli, influencing attitudes *without conscious attention* to the persuasive technology by the participant being influenced. Results indicated that both feedback conditions influenced the answers of the participants. The researchers rightly indicated that interventions that go beyond the control of the receiver should be regulated carefully.

### 3.6 SUMMARY

Overall, the high popularity of mobile phones and their attributes make them particularly well-suited to be applied in remote health care delivery implementations and persuasive designs. By sending timed and tailored messages individuals can be persuaded in lifestyle changes. To support individuals in the change, messages presented with social cues and relationship elements can entice individuals to continue with the daily performance of the exercises and thereby the targeted lifestyle change. Persuasive designers should however never seek to persuade individuals something they themselves would not consent to be persuaded to do. Literature findings are lastly summarized in Table 1.

| <b>Topic</b>      | <b>Technology channel</b>  | <b>Persuasive technology</b>   | <b>Social dynamics</b>  | <b>Relationship</b>   | <b>Ethics</b>   |
|-------------------|--|--|---|---|---|
| <i>Findings</i>   | Cell phones are ubiquitous and personal, and enable the remote monitoring of individuals                           | Messages both timely and tailored are known to be most effective at motivating behaviour change  | When objects are presented with enough and appropriate contextual cues, users mindlessly apply social responses     | Creating a relationship is important as it could provide social support to individuals and keep the interaction engaging so that they want to continue using it | Creators of persuasive technology should never seek to persuade individuals something they themselves would not consent to be persuaded to do |
| <i>Guidelines</i> | Only use individuals familiar to cell phones, and provide relevant feedback and advice when problems are detected. | Tailor information to the needs of each individual by remembering past interaction information and by providing information at appropriate time and place. | Apply social validation, rule of reciprocity, power of authority, praise, and use introvert and extrovert language. | Provide social support and keep the interaction engaging. Determine appropriate social distance to the audience and evaluate the credibility of the service.    | Individuals should not feel tricked into doing something that they did not wanted to do, nor should it be done under coercion.                |

TABLE 1 - BACKGROUND SUMMARY

## 4. BEHAVIOUR CHANGE MODEL

The characteristics that influence behaviour change are important to understand in order to successfully impact the behaviour of users. Different behaviour change models have aroused over the years, each approaching it from a different perspective. As theories will not always fit a particular problem in a specific setting or context, most researches create their own tailored model by combining and integrating information from different existing theories (Ritterband, Thorndike, Cox, Kovatchev & Gonder-Frederick, 2009). This research has an own created model based on the Stages of Change Model, the Health Belief Model, the Theory of Reasoned Action model, and the behaviour model by Fogg (2009c) for persuasive designs. Special focus was given to these models as they can be applied to behaviour change for health solutions in persuasive designs. The resulting model used in the course of the research is shown in figure 2 and will be explained next.

|                  |                         |  |  |   |   |                    |
|------------------|-------------------------|--|--|---|---|--------------------|
| Concepts         |                         | Threat awareness<br>Benefits of behaviour<br>Barriers<br>Self-efficacy<br>Attitude | Ability<br>Motivation<br>Intention   | Ability<br>Motivation<br>Intention<br>Adherence   |   |                    |
| SoG              |                         |  |  |   |   |                    |
| Summary          | <i>Precontemplation</i> | <i>Contemplation</i>   | Acquire an appropriate mindset to start with the intended behaviour change and perform the behaviour a number of times when the individual is evaluated to be ready. | Start performing the behaviour for a longer period and avoid relapses or slips. Use feedback from the individual to adjust the program to the needs of the user. Provide social support to avoid slips. | Maintain the behaviour until he or she feels at ease with it and has a solid self-efficacy. Lower the adherence to the service as the performance advances. | <i>Termination</i> |
| Apply for change |                         |  | Benefits notices<br>Cues to action<br>Goal-setting   | Benefits notices<br>Triggers<br>Goal-setting  | Triggers<br>Goal-setting  |                    |

FIGURE 2 - BEHAVIOUR CHANGE MODEL

### 4.1 STAGES OF CHANGE

One of the major theories in behaviour change is the Stages of Change Model (Clarke, 2007; Denison, 1996). The model consists of six stages, starting with precontemplation and ending with termination. Successful behaviour change travels the course of all the steps in the model. The first three stages of the model can be seen as preparation stages to *acquire an appropriate mindset* for the desired behaviour change. Relevant information and knowledge about the specific behaviour is provided to the individual to influence the decision-making process to consider making a change. Once the individual intends to change his or her lifestyle and therefore the behaviour within the next month, goals have to be set to increase the commitment of the individual towards the behaviour and to create an evaluation criterion. After the goals

have been set change will begin and the user will start to perform the behaviour over a period of time. During this period, the initial effect of the performance of the behaviour is evaluated and is important to retain the commitment to the targeted behaviour. Any feedback from the individual in this period is of importance to determine whether adjustments to the change process have to be made and possibly adjustments to the stated goals. Avoiding relapse or slips is important during the course of the stage and providing (social) support has proved to be successful in avoiding those slips. When relapses and slips are successfully avoided, the individual will need to maintain the behaviour until he or she feels at ease with it and has a solid self-efficacy. The duration of the elapsed periods depend on each unique individual and trying to push this duration is recognized as a common failure in behaviour change (Clarke, 2007).

#### 4.2 HEALTH BELIEF MODEL

The fixation of this research lies in the preparation, action and maintenance stages, as the interactions with the individuals is focused in these stages. However, the other stages are of equal importance for behaviour change as real change starts with thorough thinking and only ends when the individual feels at ease with the lifestyle and has no temptation to resume the old lifestyle. The Health Belief Model is appropriate to apply in the preparation stage, as the model focuses on the attitudes and beliefs of individuals related to health behaviour (Clarke, 2007; Denison, 1996). The key variables in the Health Belief Model are perceived threat, benefits and barriers, cues to action and self-efficacy. To start with the *perceived threat and benefits*, the individual has to become familiar with the threat and has to see the benefits of reducing the threat in order to seriously think about changing. Inevitably the negative consequences that may result from the behaviour will be examined that can lead to evading the behaviour. It is therefore of importance for designers to minimize these *barriers* by reducing the physical, psychological and financial demands. Information concerning the threats, benefits and barriers can be used to activate individuals to start performing the intended change. These so called *cues to action* are aimed to motivate and can be used to remind them of their goal. Another concept influencing the decision to enact or sustain behaviour is *self-efficacy*. It is defined as the perceived ability to successfully reach the intended goals and is commonly used in behaviour change models (Denison, 1996). Self-efficacy can be positively influenced by making goals simple or by establishing short-term goals to build up confidence to succeed (Clarke, 2007).

#### 4.3 THEORY OF REASONED ACTION

Related to the Health Belief Model is the Theory of Reasoned Action model that aims to predict the human behaviour. This model places emphasis on the concept of behavioural *intention* that represents a construct of the attitude of an individual towards performing the behaviour and ones perception of other people's opinion regarding it (Elder, Ayala & Harris, 1999). The model has proved to be successful for years and the authors argue intention to be the best indicator that desired behaviour will occur (Denison, 1996). It is therefore valuable to apply in the preparation stage to evaluate the readiness of the individual to start performing the behaviour. However, as attitudes or beliefs can change over time, it will be of value to periodically evaluate intention in the action and maintenance stages. Intention can be improved by highlighting the social value of performing the behaviour when intention is measured to be low. A healthy lifestyle that incorporates exercising and living healthy is generally accounted for as being desirable, so the desired behaviour is socially valid and can motivate individuals to start living healthier.



#### 4.4 BEHAVIOUR MODEL OF FOGG

The last integrated model is specifically aimed to be applied in persuasive design. The Behaviour Model of Fogg (Fogg, 2009c) asserts that for behaviour to be performed three factors must come together at once: *motivation*, *ability* and *triggers*. So, the individual must have sufficient motivation, sufficient ability, and an effective trigger to perform the desired behaviour. Fogg states that motivation and ability are trade-offs of a sort, as people with low motivation may perform behaviour if it is simple enough (ability), and people with high motivation might do difficult things to perform the behaviour. Importantly, both motivation and ability need to have a non-zero level for behaviour to occur and behaviour will not occur without an appropriate trigger. Triggers tell people to perform the behaviour now, and can take forms like alarms, text messages and so on. Creating an appropriate trigger can be difficult, as triggers need to be *well-timed* in order to be successful. Poorly timed triggers can be frustrating and distracting when either motivation or ability is lacking, and can lead people to avoid the desired behaviour. Apart from applying the model to investigate how to initiate behaviour, the model can also be applied to investigate what is preventing the intended behaviour. Once the lacking factor is identified, the designer can temporarily focus the design to increase that factor to initiate the desired behaviour. Often, however, it can be achieved by making the behaviour simple and easy to perform and thereby increasing the ability to perform the behaviour.

#### 4.5 RESULTING MODEL

To summarize, there are several important aspects of the resulting model. First of all, individuals need to acquire an appropriate mindset to start with the lifestyle change. Measuring the attitude of individuals towards the behaviour is an important aspect in evaluating this mindset. Additionally, the service can improve the self-efficacy of individuals by lowering the barriers to perform the behaviour. Secondly, motivation and intention are important aspects to evaluate when individuals are performing the behaviour on a regular basis. Social pressure can be applied when intention is measured to be low (Elder, Ayala & Harris, 1999). Lastly, well-timed triggers and tailored information can successfully infer behaviour performance even for those with low motivation. Guidelines derived from the behaviour change models are shown in table 2, along with the behaviour change stages of the resulting model and the related message types.

| Behaviour model                  | Stages                               | Message types                    | Guidelines   |
|----------------------------------|--------------------------------------|----------------------------------|--|
| <i>Stages of Change</i>          | Preparation<br>Action<br>Maintenance | Informational<br>Goal triggers   | Acquire appropriate mindset for the intended change and set goals to increase commitment. Tailor the exercise program with feedback and provide support to avoid slips. Lower adherence until the user feels at ease with the behaviour. |
| <i>Health Belief Model</i>       | Preparation<br>Action                | Informational<br>Cues to action  | Raise awareness of threat and benefits. Limit the barriers and activate change by sending cues and by improving self-efficacy.   |
| <i>Theory of Reasoned Action</i> | Preparation<br>Action<br>Maintenance | Informational<br>Support         | Evaluate intention by measuring attitude and beliefs towards performing the behaviour. Highlight social value when intention is low.   |
| <i>Behaviour Model of Fogg</i>   | Preparation<br>Action<br>Maintenance | Support<br>Triggers<br>Exercises | Trigger behaviour by sending timed messages/exercises. If the behaviour is not being performed, evaluate the different factors and temporarily focus the design on the lacking factor.   |

TABLE 2 - GUIDELINES BEHAVIOUR CHANGE

## 5. PERSUASIVE DESIGN

The findings and guidelines of the background literature and the behaviour change model are now processed in the design of the persuasive technology. This chapter discusses the method used to design the persuasive technology, and defines the initial scope of the technology. The design method is treated first, followed by the targeted behaviour and audience, the barriers that may prevent the behaviour from being performed, and the applied technology channel.

### 5.1 DESIGN METHOD

The method applied to design the persuasive technology is the Eight-Step Design Process by Fogg (2009). This method is aimed to assist design teams in creating a persuasive technology that intends to achieve behaviour change. The basic principle of the design is to start with careful thinking, followed by small, rapid tests which supply valuable information. Once success is achieved the tests can be expanded to more ambitious tests. Literature findings will be tested and evaluated with this design approach to investigate which applied approach is most effective. The total design consists of eight steps, as shown in figure 3, with the first four design steps being treated in this chapter, steps 5 and 6, which are aimed to examples of successful persuasive technologies that are relevant to the technology, in the next chapter ‘Related Work’, and the final two steps being treated in the chapter ‘Design Testing’. Importantly, Fogg (2009) states that true scientific experiment does not begin until the findings have been successfully tested and the design team has gained enough experience with the persuasive technology and the interaction with the audience.

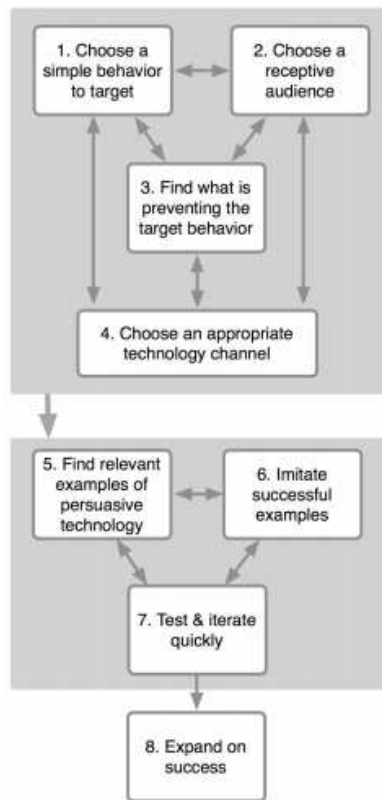


FIGURE 3 – EIGHT-STEP DESIGN PROCESS STAGES (FOGG, 2009B)

## 5.2 TARGET BEHAVIOUR

Key points in choosing an appropriate behaviour to target change are simplicity, and the representation of a good starting point for the intended goal. Simple exercises can bring about large effects as it can lead people to adopt more ambitious goals. As stated before, this research has the ambition of improving the general health of individuals. Initially, the goal will be to improve health conditions for users when they find themselves in stressing moments. Busy and tiring moments are therefore especially valuable to use to investigate the effectiveness of the exercises. The primary focus of the exercises will lie in stretching and breathing exercises, and will be personalized to the users' needs over time. The first exercise that will be applied in the trials is the 20 second stretching experiment used in the research of Fogg (2009), as it has shown to be successful. The duration is carefully chosen to optimize the ability to perform the behaviour, yet retaining its effectiveness. The ability to perform this target behaviour is high, as it can be performed anywhere and it does not require additional tools or specific background knowledge. Also, performing the exercise will not draw any noticeable attention to the performer and thus allowing it to be performed discretely. Any negative influence of the environment can thus be avoided. When the first exercise is performed successfully, different stretching and, or breathing exercises can be used to expand the trials.

## 5.3 TARGET AUDIENCE

As the first seven steps of the design process are aimed to persuade *someone* – not everyone – it is needful to carefully choose the audience based on their characteristics. This step in the design is therefore closely related to target behaviour, step 1, 3 and 4 as those steps represent characteristics that identify the audience. So, the intended user should benefit when performing the behaviour (step 1), does not already perform the behaviour on a regular basis (step 3) and finds him or her to be familiar with the technology used in the intervention (step 4). Additionally, Fogg (2009) states that in order to increase the odds of success it is useful to first focus on people who have experience with exercising in general, enjoy using technology and occasionally try new things. Reflecting all these aspects to the current research implies that the receptive audience for the trials should benefit from stretching and breathing exercises; they do not perform the behaviour regularly; and they should have experience with texting on a mobile phone. The target audience can be expanded to those less receptive to the intervention when success has been achieved with the initial audience.

Before the behaviour change model will be applied to identify additional requirements for the audience, is it first important to notice that these trials are only set in the action stage of the Stages of Change model. The different aspects from the preparation stages, like perceived value, intention and motivation, need to have or acquire a sufficient level before starting with the intended change. However, as no real change can occur in a short period of time, the primary focus will be on users already meeting the preparation stage requirements. Face-to-face contact will be used additionally to inform and remind users of the benefits and threats of the desired behaviour. Returning to the identification of the requirements from the behaviour change model, both intention and motivation are valuable concepts that need to identify the audience. Thus, they need to have the appropriate attitude towards the behaviour and find themselves to have ambition and motivation to improve their health status. Additionally, as the exercises are initially selected to relieve stresses in work and computer related environments, users either working or using the computer often are most valuable to measure. Lastly, the trials will only begin once the users are determined to have met the requirements.

To determine the appropriate language approach towards the users in the trial phase and the actual experiment the social distance needs to be analyzed. The selected audience in the trial phase is closely related to the researcher as the audience consists of family members and friends which implies that the social distance is close. The language approach to the users in the messages will therefore be of informal. The social distance in the actual experiment will be different than from the trial phase as a different audience will be selected. The social distance will be generalized to distant, which implies formal language usage for the interactivity with users. This is in line with the language approach of health educators in general.

#### 5.4 BARRIERS

In order to know what is preventing the behaviour it is needful to understand what is required to successfully perform the behaviour. The guidelines derived from the created behaviour change model give insight in the concepts which must be treated before implementing the behaviour change. Starting with perceived threats and benefits, the program will improve the health condition of users by focussing on problems experienced in daily life activities and work related situations. As these aspects are not often considered harmful to the health situation of users their mindset needs to be reshaped before starting with the program. Table 3 shows the benefits of the programs' stretching and breathing exercises and explains why you should intervene. These benefits are derived from several dedicated websites and are reviewed with an expert in the domain at hand (Education, M. M. F. F. M., & Research, 2009; Heart of Healing, 2008; Scott, 2009; Starks, 2010; Doctors Dunia, 2010). When the user realizes the benefits of performing the behaviour, it will influence the attitude towards the behaviour along with their motivation to perform it. If the user continues to see no use in the behaviour change and the user cannot be cued to action then the research needs to reconsider the appropriateness of the user.

Next aspect derived from the established guidelines is to reduce the barriers to perform the behaviour by minimizing the physical, psychological and financial demands. The physical demands are targeted by keeping the difficulty of the exercises low and thereby increasing the ability to perform the behaviour, and avoiding exercises that may be harmful to the human body when executed correctly. The psychological and financial demands are limited as the behaviour can be performed without drawing (negative) attention from the social environment, and the exercises have no financial demands.

As determined from the Stages of Change model, goal setting is an influential factor in behaviour change. No real change can occur when no goals were set before starting the change. Goal-setting can be used to influence the self-efficacy of users. Self-efficacy, stated as the perceived ability to reach established goals, can be positively influenced by establishing simplistic and short-term goals. The initial goal will therefore be to just perform the behaviour numerous times to get acquainted with performing the behaviour. Once the initial goal is achieved and the effect of the behaviour is valued positively then the difficulty of the goals can be increased to sustain the intention to continue to perform the behaviour and keep the interaction engaging.

| <i>Stretching benefits</i>                                |  |
|---|--|
| <b>Benefits</b>   | <b>Explanation</b>   |
| Increases flexibility and range of motion of the joints   | Muscles tighten as one ages. Regularly stretching can help lengthen the muscles and thereby increase flexibility needed in daily activities.   |
| Better posture  | Tight muscles can lead to poor posture. Stretching the muscles of the lower back, shoulders and chest can help keep the back in better alignment and can improve posture.  |
| Greater circulation of blood to various parts of the body | Stretching improves blood flow to the muscles and joints which can speed recovery after muscle injuries.   |
| Increases energy level                                    | Improved blood circulation increases the energy level as more nutrients are delivered to the cells.  |
| Relaxation and stress relief                              | Stretching, when performed properly, relaxes tense muscles that are often accompanied with stress.   |
| <i>Breath extension benefits</i>                          |  |
| <b>Benefits</b>   | <b>Explanation</b>   |
| Reduces workload for the heart                            | The heart does not have to work as hard to deliver oxygen to the tissues, as more oxygen is inhaled in each breath.  |
| Increased energy level                                    | As the amount of oxygen carried through the bloodstream will increase, the overall energy level will also increase.  |
| Tension release   | Breathing exercises will help release built-up tension in the muscles, especially in neck and shoulder areas.  |
| Increased lung capacity                                   | Training the lungs to inhale more oxygen in every breath will increase the lung capacity.  |
| Relaxation  | Breathing exercises will force one to slow down with the current activities and focus on breathing. This can avoid burnouts and headaches when applied on the right moment. Practiced regularly can make one less reactive to stressful situations, but they will not prevent future stressors from occurring. |

TABLE 3 - BENEFITS OF STRETCHING AND BREATHING EXERCISES

Lastly, intention, representing a construct of the attitude towards performing the behaviour and ones perception of other people’s opinion regarding it, has proven to be a successful behaviour change indicator for years. It will therefore be used to evaluate the readiness of the user to perform the behaviour change. If the attitude of users is measured to be low, intention can be positively influenced by highlighting the social value of performing the behaviour. No action is needed when the attitude is measured to be high. Additionally, as the mindset of the user may change over time, this research will re-evaluate intention throughout the research. When change is measured, the research can anticipate accordingly.

## 5.5 TECHNOLOGY CHANNEL

In choosing an appropriate technology channel, the essential features of the channel have to be discovered first. Taking one step back to the first steps of the design process, four identifying factors can be discovered: (1) the channel has to facilitate the proper transfer of the behaviour; (2) the channel has to be familiar to the target user as training people to use a new channel is difficult and can bring unwanted side-effects; (3) the channel may not form a barrier to perform

the behaviour; and (4) the channel has to be suitable to trigger behaviour. Triggers are an important factor in the Behaviour Model of Fogg (Fogg, 2009c) as they instigate behaviour when they are timed successfully. On the other hand, poorly timed triggers can have a negative effect on the performance of the behaviour. It is well to say that timing is an essential factor in triggering and the triggers should not depend on whether the technology channel is available to the user or not, so the channel should be ubiquitous.

As mentioned before, cell phones are particularly well-suited as they are extremely popular, users take them with them wherever they go, and one cell phone is associated with one individual. Sending text messages is an important standard feature of cell phones, and has proven to provide a successful channel in several health behaviour researches. The chosen target behaviour is simple making it suitable to be transferred through short text messages without losing its value and without sacrificing clarity. Additionally, Fogg (2009d) identified, with the use of his created Behaviour Grid, that mobile phones are well-suited in persuasive solutions that target users to perform existing behaviour or to increase the amount of behaviour multiple times. Mobile phones are therefore evaluated to be well-suited for this solution.

## 6. RELATED WORK

Next step in the design process is to find successful experiments or models of persuasive technology that are relevant to the intervention. Specifically, Fogg (2009) suggests examining nine examples in total: three that achieve a similar behaviour, three that reach a similar audience, and three that use the same technology channel. As finding exact matches to any of those three topics can be difficult, best practices of experts in the behaviour change domain also satisfy the goal. In treating the papers, only attention was paid to aspects that can be of value to this research. Literature findings are treated first, followed by the discussion of these findings and whether they can be adapted into this research.

### 6.1 LITERATURE FINDINGS

To start with related behaviour examples, the research of Sohn and Lee (2007) aims to encourage health behaviour by using an Instant Messaging (IM) system. Several persuasion techniques are applied in the design of the system including persuading through personal awareness, group activity, fun and enjoyable interaction and through unobtrusive and intuitive notification. Although the theory of the techniques can be used for the purpose of this research, it is needful to state that the research uses an interface on a mobile device to approach the user in contrast to this study. The focus of the trials is to test the impact of the messages and the feasibility of the exercises, but the theory concerning the interface will be treated as well as an internet accessible interface will be developed in the actual experiment of this research. Returning to the techniques, *personal awareness* can encourage people to modify their attitude or behaviours. Sohn and Lee (2007) state that persuasive systems should manage that by giving users easy access to their current personal goal, progress and their past performance. Additionally, their performance should be reviewable over different intervals, for example daily, weekly or monthly, and goals should be adjustable based on recommendations. Persuasion through *group activity* implies that when ones performance is compared to the performance of others users can be motivated by either their own progress or the performance of others. This is supported by the fact that competition is recognized to be an effective motivator. Whether the intended behaviour is appropriate to be used for competition usage is doubtful and will be further on. The concept *fun and enjoyable interaction* is comparable to the treated concept of Bickmore and Picard (2005) and implies that a pleasurable interface can positively influence the user to engage in a long-term relationship with the system. The last technique that was applied to the design of Sohn and Lee (2007) is to persuade through *unobtrusive and intuitive notification*. The main point of this concept is that a persuasive technology should be careful in disturbing users since it could have an adverse effect when the timing is wrong. The timing of the triggers is therefore an important factor and should be produced in consultation with the user.

Next related behavioural research is the paper of Consolvo, McDonald and Landay (2009) in which several behavioural science theories and their implications were used to design and build a persuasive technology that encourages users to lead a physically active lifestyle. Two theories that will be discussed here are the Goal-Setting Theory and the Cognitive Dissonance Theory. To start with the *Goal-Setting Theory*, goals tend to motivate users to perform a particular behaviour. A well-established goal should be challenging, but it should not negatively influence the self-efficacy of users by being difficult to achieve. The ability to set goals, either by the user

or in collaboration with an expert, is important and the progress towards the goal should be available for users at any time. Additionally, feedback should also be provided as progress is made and not limited solely to goal achievement (Consolvo et al., 2009). Proceeding with the *Cognitive Dissonance Theory*, the theory states that one will experience discomfort when one realizes his or her attitudes and behaviours are inconsistent. This dissonance will motivate the user to perform the behaviour depending on the importance of his or her beliefs. The implication for persuasive technologies is to support one to remain focused to the commitment by retaining personal awareness throughout the behaviour change process. Apart from the behavioural science theories, Consolvo et al. (2009) also discussed several design strategies for behaviour change technologies. In short, the collected data should be represented in abstract form towards to user, the user should be in control over his or her data, historical data needs to be accessible to the user and related to the goal(s), and other activities that contribute to the desired lifestyle should also be rewarded in the overall progress. The last point can positively influence the user in the early behaviour change stages to continue with the desired change.

The third and last behaviour related research is the research of Rimer and Kreuter (2006). The distinctive aspect of their research is the use of tailoring to create individualized communication. *Tailoring* is used to determine the most appropriate information and, or strategies to meet that person's unique needs in relation to the desired outcome. It can be applied in at least four ways: (1) match content to the individual, (2) ensure that the context is meaningful to the user, (3) design elements to capture attention, and (4) tailor the amount of messages and the used technology channel to the user. Rimer and Kreuter (2006) state that greater perceived relevance and salience increase motivation to process information and enhance message receptivity, information processing, and behaviour change. It is however important to note that tailoring is only effective and efficient for a diverse population and tailoring will only increase the impact of messages; it does not initiate change itself.

Moving on to the three related researches that approach the same audience, the first paper that will be treated is the research of Intille (2004). The goal of the research is to motivate healthy behaviour as people age by presenting just-in-time information at points of decision and behaviour. The challenge however, is to design the technology for people who do not consider themselves to be sick. These people of any age will use the technology only if it improves self-efficacy or well-being without becoming a burden. The research states that the provided information needs to generate high feelings of perceived value and the design must contain elements of fun, humor, creativity, or inspiration to entice users to keep using it.

The next research of Oliveira and Oliver (2008) investigates several methods that can influence the motivation of the audience. The distinctive factors are *personal awareness* and *social pressure*. Personal awareness implies that the user should always have access to his personal performance and goals. The design should also present easy-to-understand recommendations on what to do to improve the performance based on the collected data. Social pressure is stated by the research to be a strong motivational element and can be applied by providing information about the performance of users who are engaged in the same activity. The quantification of the performance of users is required to make users comparable and will also provide a suitable way to display it in an understandable way. When users can easily evaluate their performance and the performance of other, it can offer to be an effective mean to increase ones motivation. As mentioned before however, the appropriateness of the competition factor with the intended is doubtful and will be discussed further on.



Ritterband et al. (2009) paid more attention to the environmental influences on the audience in their research as environmental factors can influence user characteristics by shaping the knowledge or motivation of users. This positive or negative reinforcement can either provide support or serve as a barrier to perform the desired behaviour. It is therefore of importance to measure these influences on the user to determine the impact of the environment of the user. The evaluation of the environmental influences is comparable to the intention concept of the behaviour change model created in this research. When the environment is measured to have a negative influence on the user, the program should actively try to limit the barriers by raising awareness of the threat and the benefits of performing the behaviour. The user should only start performing the behaviour when the intention is measured to be at a sufficient level.

The next three papers have already been discussed earlier in this study, but will now be specifically addressed to the unique aspects on the use of the technology. To start with the feedback of the participants from the research of Anhoj and Moldrup (2004), the participants proposed to use a self-selected time of the day for the messages, different timing for work and social schedule, and to limit the number of messages a day to a minimum as the added value of the extra messages is observed to be low. In essence the user should decide how the system should behave and not the system itself. Next, the Sweet Talk intervention system used in the research of Franklin et al. (2006) used text messaging to enhance the self-efficacy of users and to offer social support. The intervention scheduled the automated delivery of a series of tailored messages, including weekly reminders of goal settings, a daily message providing tips, information or reminders to reinforce the goal. The system has series of messages stored in the database which can be used at any time. These templates will accelerate the process of sending messages for the expert that controls the system. System related the mDiet study discussed in Fogg and Adler (2009) consisted of four components: 1) A web-application to enrol participants and set user preferences; 2) a database to trace the participants' records; 3) an application to determine the appropriate timing and messages to send and to process the messages received; and 4) an SMS message delivery/reception platform. Although not all the components are relevant for this research, each component does give a good view of what an automated text messaging system needs to incorporate. These components are therefore valuable in the design of a backend support system.

## 6.2 LITERATURE IMPLEMENTATION

The different aspects from the nine papers treated in the previous step will now be analyzed further to discover how they can be applied to this research. Aspect that do not contribute to the wellness definition of this research and cannot be implemented in the available timeframe will not be applied to the design of this technology. Additionally, Fogg (2009) states that it is better to first imitate and test features that have already proved themselves, than to start from scratch. Any different unique aspects of this research can be added later. The discovered aspects are grouped into personal awareness, interaction, social and environmental influences and tailoring, all being derived concepts of the stated concepts from the created behaviour change model shown in figure 2.

Personal awareness is closely related to the goal setting theory and the web interface component used in the mDiet study, as users can have easy access to their goals using the web interface. As discussed before, personal awareness and goal setting both encourage en motivate users to change their current behaviour pattern and are therefore of great value to this research.

As the interaction with the user is through text-messages on the mobile phone, it is important to determine the feasibility of goal-setting with the available number of characters in a single message. Goals that are likely to be set in this research, e.g. “perform the behaviour for one week” or “perform two exercises this weekend”, are short of nature and are therefore feasible to be defined in a single message. The implementation of goal setting through text-messages does not require much effort and time and will therefore be added to these trial phases of the experiment. The implementation of a web interface supporting the personal awareness concept on the other hand does require effort and time. The system behind the interface should exist of nearly the same components as the mDiet system used in the research of Fogg and Adler (2009), making it impossible to implement at short notice. It will therefore not be added to the trial phase. Preference is first given to components that are easy to be implemented and tested.

Several interaction elements were identified in the treated papers, starting with unobtrusive and intuitive notifications. Triggers could have an adverse effect when they are found to be disturbing or interrupting, so in line with the participants’ reactions in the research of Anhoj and Moldrup (2004) the service will apply a self-selected time on exercise days. The trigger still can be interrupting though, as interruptions in schedules can occur daily. However, experienced mobile phones users will silent their phone when they do not want to be disturbed. This advantage of mobile phones over other technologies allows texting to be used more discretely. The alignment of the desired time is feasible through text messages as users should discover the appropriate time for themselves and they only have to send the specific time to inform the service. Also, to avoid any unnecessary disturbance the amount of messages will be limited to a minimum as the added value of the additional messages is observed to be low by participants (Anhoj and Moldrup, 2004).

As stated before, a fun and enjoyable interaction can positively influence the user to engage in a long-term relationship with the system. This will be achieved in two ways, starting with the exercises. The exercises are the main focus of the program and will have a determining factor in the decision of the user to continue with the intended lifestyle change. So, in order to keep the user connected to the program the exercises will need to be both entertaining and challenging and still meet the created behavioural requirements. In addition, Intille (2004) states that the provided information needs to generate high feelings of perceived value to entice users to keep using it. These aspects will be coordinated in consultation with an expert. Next to the exercises, the web interface can add value to the interaction by allowing users to access their historical data, both performance and completed goals, in abstract form (Consolvo et al., 2009). The exact functionality of the feature will however be determined after the trial phase.

The social and environmental influences can both have a positive and negative influence on the user at hand. When looking at negative influences, the social environment can negatively reinforce the user when the people in the environment do not have the appropriate attitude towards the behaviour. Users, starting with the behaviour or have just started to perform the behaviour, can be negatively reinforced by their environment which can lead to avoidance of the intended behaviour. To measure these influences this research will ask the user on their view of the attitude to the intended lifestyle of their personal social environment. When the user notes a positive view of the environment, more obtrusive exercises can be used in the program. The program will continue to use unobtrusive and discrete exercises when the view is noted to be negative.

A form of social pressure that can be applied to programs which use exercises where performance can be measured is competition. Competition is recognized to be an effective motivator; however the applicability in wellness programs is questionable as these programs are aimed to improve one's lifestyle on a personal level. Because of this doubtfulness this research chooses to avoid visualization of any activity in group form through messages or a web interface. One form of pressure that can be applied is the cognitive dissonance theory, which implies that one will experience discomfort when one realizes his or her attitudes and behaviours are inconsistent. So, when the user says that he or she wants to perform the behaviour and the behaviour avoided or no replies are send to the program, the theory is appropriate to be applied. As the appliance of the theory is feasible through text messages, it will be implemented in the design of the program.

The last concept of the treated papers, tailoring, is stated to only be effective and efficient for a diverse population. The population of this research will be selected on the requirements set earlier in this research, and are therefore comparable to each other. However, the larger goal of each participant to participate in this research can be totally different and can imply the domain of exercises in the program. The context of the program will be more meaningful when the exercises are tailored to the goal of the user. Additionally, participants can react differently to each exercise, and when no or any negative effect is measured the program will need to react accordingly. These two cases are examples of content tailoring to the properties and preferences of each user. Another type of tailoring that will be applied is the self-selected time of the day which has already been discussed. The tailored time of each message and the other tailoring implementations will increase the impact of each message and will enhance behaviour change (Rimer and Kreuter, 2006). Additionally, tailoring information to avoid repetitiveness is an important aspect in relationship building (Bickmore et al, 2005).

## 7. DESIGN TESTING

In this chapter assumptions and literature findings are tested with a series of non-scientific tests. These small, rapid tests will teach more than one big test and allow the design team become familiar with persuasive technology, gain insight in testing, and experience the reactions of users (Fogg, 2009). As already stated in the previous chapter, the focus will be set to features that can be implemented easily and fast. The design will be expanded systematically once successful behaviour performance is measured by changing one attribute at the time. More difficult behaviour can be used, new audience can be tested, and elements from the treated literature can be applied to evaluate the applicability to this research. Finally, Fogg (2009) states that it is important to keep a low expectation profile as these tests are aimed to gain valuable experience in designing a persuasive technology. The findings of the trials are discussed next.

### 7.1 TRIAL FINDINGS

The first step of testing was to determine whether the design could successfully elicit the target behaviour from the audience. Looking at the first runs, each trigger achieved to elicit the behaviour successfully. To determine the completion of the exercise, the trigger had to include a question that could imply whether the exercise has been performed. Apart from the direct approach, the design also included questions to determine the effect of the exercises. The addition of these question avoided repetition and created additional value for the question, but also implied to completion of the exercise at hand. The effect of the initial exercises, covering arms and fingers, was valued positively with the finger stretching exercise to be particularly well-received. The next exercise in the program - "perform a full stretch for 20 seconds" - was reported to be too long and too obtrusive. Apart from the duration, performing a full stretch will always be obtrusive to the environment. Obtrusive exercises could impose barriers to perform the behaviour, so this exercise is only appropriate to be performed at home or by those whose performance is not influenced by the environment.

No real problems or noteworthy aspects concerning the stretching exercises were discovered in the remainder of the trials. One exercise was reported to be vague, but after a closer examination the explanation appeared to be erroneous. The types of exercises that were valued the most by the users are the neck and wrist aimed exercises. Bad posture of users during work situations, like working behind a personal computer, can be the reason that relieving tension from these muscles has imposed positive effects. Each derived preference influences the upcoming exercises as the program is tailored to the preferences of the users. Continue using failing exercises will negatively influence the perceived credibility of the service that can lead to avoiding the behaviour or the entire service.

As the initial exercises were valued positively, the behaviour could be expanded by adding similar exercises and by making it more difficult for the audience. The difficulty of the behaviour was increased in two ways: extending past behaviour and adding breathing exercises to the program. In the first case an additional movement was added to the behaviour of the day before, and in the second case the user was asked to extend each breath by breathing in through the nose out through the mouth. The technique of the first extension was tested successfully, noting that the user still had a clear image of the exercise from the previous day. The second extension also succeeded, but a side note has to be made here. The wellness expert stated that the user has to be focused for each breath to maximize the effect of the exercise. For that you need

experience in performing these exercises, making these type exercises of a higher difficulty level than regular stretching. Breathing exercises should therefore only be added to the program when the user has successfully performed the stretching exercises.

The behaviour was not only extended in relation to the audience. The audience was also extended to people less experienced in performing exercises, but who importantly are open for change. The effect of the initial exercises is of greater importance in the extended scenario, as the attitude towards performing the behaviour needs to be influenced positively. Reflecting this to the exercises that are valued most, the neck and wrist exercises form the best starting exercises for users receptive and less receptive to the behaviour. Looking at the interaction with the less receptive users, interesting conclusions can be drawn. The users do value the exercises positively and report that the effect of the exercises is important to their health, but they find it difficult to make space in their busy schedules. When the trigger arrives at an inconvenient moment, like for instance a business meeting, the behaviour is avoided and will only be performed if it comes to mind after the meeting what is unlikely in the current stage of the behaviour change. This will be a persistent problem, even for those that are performing the exercises on a regular basis.

One solution to this problem was implemented during the trials. The self-selected time of the day did however not cover the whole problem as the time was generalized to each exercise day. Any interruptions in a day schedule that is rated as more important by the user can invoke a problem in the performance of the exercise scheduled for that day. The other solution to avoid this problem is to have an actualized view of his or her schedule. This however, can impose other problems, like privacy issues, and is too extensive to be treated in this research. Coming back to the expanded audience, each performed exercise represents progress in their started behaviour change process and should be valued as a step forward. When the behaviour is avoided as the trigger is badly timed, users should ideally reschedule the behaviour themselves. This is however difficult to impose to users who have just started with the behaviour change. Looking at the behaviour model, these users located in the preparation and action stage of the model. The duration to travel from one stage to the next is user dependent and may not be pushed (Clarke, 2007). The program will therefore take these badly timed triggers for granted and will only evaluate the exercises when the user is at ease with the behaviour and performs the exercises on a regular basis.

Continuing with the goal-setting implementation, the theory was implemented in two ways representing two different levels: goal-setting with and without the support of triggers. The goal in the first implementation was to perform an exercise each day in the current week, and in the second implementation to perform two exercises the upcoming weekend. The difference in level is represented by the support of triggers to perform these exercises. In contrary to the week-approach, the weekend goal did not assist the user with a daily trigger testing the motivation and self-efficacy of the user as he or she needs to trigger him or herself to perform a self selected exercise, making it more intensively to complete than with the support of triggers. Users have to work more actively on these goals, opposed to waiting for the triggers of the program to tell you to perform a particular exercise on that moment. The resulting data does not provide insight whether the weekly goals, with trigger support, were effective as no users made remarks covering the goals and no experimental scenario was created. A likely problem rises at the accessibility of the goals. The current approach only gives access to the goals via the mobile phone message feature, depending on the easy accessibility of the mobile phone interface. The

implementation of a web-interface can increase the accessibility by providing access to past performance and current goals. Returning to the resulting data, the data does provide insight in the effectiveness of the weekend solution without the support of triggers, as it was evaluated to be only effective for users with an evaluated high motivation concluded from their past performance. The past performance of users that did not achieve their goal showed inconsistency, telling us that these users are located in the early stages of their behavior change and are adherence to the triggers. Also, the self-efficacy to complete the goal can be negatively influenced for experienced, but especially starting users with the difficulty level of the goals and will therefore need to be adjusted to each user. This is in line with the findings of Consolvo et al. (2009). Additionally, no comments were given to users when the goal was not achieved as they have just begun to perform the behaviour and should only be positively reinforced in this phase of the behaviour.

The technology channel was evaluated on the previously indentified factors. The first evaluated aspect was the feasibility of the proper transfer of the behaviour, evaluating the message capacity in relation to the message content. The available number of characters available in a single text message is 160 characters. Messages can have more characters, but providers will charge the cost of a single message for every 160 characters used. Also, messages can become unsuitable for cell phones with small displays, as users have to scroll down to read the entire message. The exact effect of information below the screen border on a mobile phone is however uninvestigated. The message structure was evaluated to be very important in keeping the goal of the message clear and to constrain the length of the message. Two types of send messages were discovered in the trial phase, triggers and replies, and are shown in table 4. The essence of the triggers is that the user interrupts his or her current activity and starts performing the exercise explained in the message. Any additional information in the message can be distracting. Evaluating the content of the triggers, the length could vary dependent of the optional sections that could ultimately remove the essence of the message. Triggering is an essential part of this research and the content will therefore be minimized to focus on a clear essence. The other elements will be transferred to replies and additional messages to ensure that these concepts will add their value to this research.

| <b>Message type</b> | <b>Section</b>                   | <b>Mandatory</b> |
|---------------------|----------------------------------|------------------|
| <i>Trigger</i>      | Salutation                       | Yes              |
|                     | Remember past information        | No, optional     |
|                     | Goal notice                      | No, optional     |
|                     | Awareness notice                 | No, optional     |
|                     | Notice to stop with current work | Yes              |
|                     | Exercise with explanation        | Yes              |
|                     | Duration notice                  | Yes              |
|                     | Greetings                        | Yes              |
| <i>Reply</i>        | Salutation                       | No, optional     |
|                     | Praise                           | No, optional     |
|                     | Empathy                          | No, optional     |
|                     | Reflect on message content       | Yes              |
|                     | Increase self-efficacy           | No, optional     |
|                     | Minimize barrier                 | No, optional     |
|                     | Awareness notice                 | No, optional     |
|                     | Greetings                        | No, optional     |

TABLE 4 - MESSAGE STRUCTURES AS USED IN TRIALS

Next point of evaluation is the match between technology channel and audience. It has already been established that the audience should be familiar to technology channel, implying that the user has experience with texting and uses his or her cell phone on a regular basis. Key for the research is the input of users, in the form of replies, as it gives information on both exercise performance and effect. Additionally, no relationship can be build, or tailoring can be applied, when there is no input from the target user. Evaluating the reply rate of the audience, a few participants were rated not to be suitable after all. The first participant was discovered to be very suitable for the targeted behaviour and to be familiar with texting, but responding to the service constituted a barrier. The users only used his phone textingwise for incoming messages and essential replies. The second was familiar with the use of his phone, but did occasionally not use his phone for an indefinite period like a day. And the last did use her cell on regular bases, but did not find time to put aside her daily work to perform the exercises. It needs to be seen whether these users can be of value when the audience is expanded in the remainder of this study. No problems were detected with the other users, apart from an occasional failing timing of a trigger, which has already been discussed.

The last point of evaluation is the feasibility of measuring the intention concept of the Elder et al. (1999) study. Intention, the attitude of a user towards performing the behaviour and ones perception of other people's opinion regarding it, was tested at the end of the trial phase asking for both attitude and belief in one message. Only one answer was received making it hard to generalize to other users and form conclusions. The derived answer covered two text messages, implying that the formulation of a short and clear response can be difficult and can impose a burden. It however is a key indicator in determining whether the behaviour will occur, so it needful to measure. An alternative to measuring it in two messages is to measure it in two separate messages. The exact impact of this implementation is questionable as the participant from the research of the Anhoj and Moldrup (2004) preferred the minimization of messages each day. The research will evaluate the one message implementation of the intention concept again in the experiment phase to acquire more valuable data.

## 7.2 EXPAND DESIGN

At this point of the design process the research has gained valuable experience in persuasive technology, the interaction with users, and the initiated effect of the performed behaviour. As Fogg (2009) states, by the end of the seventh step of the design process the pilot testing has been completed, and the research team can feel confident about the intervention and can expand to a controlled experiment. Before looking at the design of the experiment, the findings of the trail phase will be summarized and processed into the implementation of the current persuasive design. After that the research will progress to the method of the experiment phase.

The findings are treated in two ways. First, attention will be given to the overall process and its global finding and second, more specific findings which resulted from the trial phase will be summarized and processed in a more accessible manner. Looking at the overall process till so far, the study can be proud what it has achieved already. Of course, there is room for a lot of improvements, but the technology proved to change behaviour even if it was small or simple. These initial stages give insight in the concepts that are of importance in persuasion and behaviour change. The most influential aspects in the research till so far, are the mindset and motivation of the audience, the behaviour that needs to be performed and the timing of the triggers. Starting with the audience, when the targeted user is not open for change the service

will fail to achieve consistent behaviour change even if the design of the service has generated good results with open minded users. These users need to acquire an appropriate mindset first, before they are ready for change, representing the precontemplation and contemplation stages of the Stages of Change model (Clarke, 2007; Denison, 1996). Guiding users to the successful completion of these stages however, is a research of its own and does not lie in the scope of the current research. Next, the effect of the behaviour and the ability to perform the behaviour in the program, and especially of the initial exercises, is of great importance in the determination of users to continue with the program. When the program fails to initiate positive effects, the credibility of the service will diminish until the service will be tossed aside. When the ability to perform the behaviour is low, the user will not perform the behaviour. Even if both audience and behaviour is a match, the timing of the trigger needs to occur at the right moment to initiate the performance of the behaviour. If the timing of the trigger is off, the trigger will most likely fail resulting into avoidance of the behaviour. These findings are in line with the behaviour change mode created by Fogg (2009c) that is adapted in our model.

The findings of the trials are summarized in table 5, along with guidelines for the upcoming experiment phase. Important aspect of this phase is to acquire more detailed picture of the experiences of the users. As not all is suitable to be measured through text messages, the experiment will use a questionnaire to measure the experience of the users on different topics that are hard to derive from the SMS replies. Also, a website will be implemented for both administrators and users to manage data and user progress. A more detailed explanation of the measures and the website will be given in the following chapter.



| Topic             | Behaviour   | Audience   | Triggers   | Messages  | Goal-setting   |
|-------------------|---|--|--|---|--|
| <i>Findings</i>   | <p>The effect of initial exercises is of importance for the course of the program</p> <p>Obtrusive exercises could invoke barriers</p> <p>Effect feedback is needful to tailor the exercise</p> <p>The effect of breathing exercises is more difficult to maximize making it harder to perform</p>                              | <p>The time between sending and reading a message can vary</p> <p>Sending replies can form a barrier to participate</p> <p>Initiating change is more difficult for users who have busy schedules</p> | <p>Information not related to the exercise can be distracting</p> <p>Self-selected time is not accurate each day</p> <p>Triggers occasionally fail for users that have interrupting events</p> <p>Feedback concerning performance is needful to measure progress</p> | <p>Long messages can be inappropriate for small displays</p> <p>Constraining the content to the length of one message can be difficult</p> <p>Avoid unnecessary messages</p> <p>Intention replies can be spacious</p> | <p>The accessibility of goals is low as it is only available in the storage of the phone</p> <p>The evaluation of the effectiveness of goals with triggers is difficult through messaging</p> <p>Goals without triggers are only effective for users that have a high motivation</p> |
| <i>Guidelines</i> | <p>Use neck and wrist aimed exercises first</p> <p>Determine the obtrusiveness of exercises in consultation with expert and start with unobtrusive exercises</p> <p>Ask for the effect of the exercise at hand in triggers</p> <p>Use breathing exercise only when the user has gained experience with stretching exercises</p> | <p>Only use users who use their phone regularly</p> <p>Notice user about the costs and the obligatory of responses</p> <p>Show more patience with busy users in initial stages</p>                   | <p>Avoid unnecessary information in triggers</p> <p>Send tips to increase awareness</p> <p>Accept that users do not reschedule triggers themselves</p> <p>Measure performance with questions related to the performed behaviour</p>                                  | <p>Keep the content of each message within the capacity of one message</p> <p>Do not treat multiple concepts in one message</p> <p>Adjust message structure depending on content and goal of each message</p>         | <p>Improve accessibility by making the current and completed goals accessible on a website</p> <p>Evaluate the effectiveness of week with triggers goals through questions after the study</p> <p>Keep the difficulty of goals without triggers low to improve self-efficacy</p>     |

TABLE 5 - TRIAL FINDINGS AND GUIDELINES

## 8. EXPERIMENT METHOD

The findings and the guidelines were processed into a three week experiment. The goal of the experiment was to gain more knowledge on the new findings and to expand the behaviour and the audience to check its receptiveness. This is in line with the process model of Fogg (2009).

### 8.1 PARTICIPANTS

A total group of 10 participants were selected for the experiment. The group of participants had no comparable background, consisted of 4 female and 6 male participants, and were all native Dutch speakers. Each participant had to meet requirements set from literary findings, behaviour model guidelines, and experience gained from the trials which are shown in table 6. This requirement profile was set to maximize the value of the experiment as these participants could provide valuable feedback required for the current stage of the research. Less receptive participants can be chosen once the study has proven to be successful on a larger scale.

| <b>Profile</b>    |  |
|-------------------|--|
| <b>Topic</b>      | <b>User requirements</b>                                     |
| <i>Behaviour</i>  | Should benefit from performing the behaviour                 |
|                   | Does not perform the behaviour on a regular basis already    |
|                   | Has sufficient perceived value of performing the behaviour   |
|                   | Has sufficient motivation to perform the behaviour           |
|                   | Has an appropriate attitude towards performing the behaviour |
|                   | Is open for change   |
| <i>Technology</i> | Has experience with receiving and sending text messages      |
|                   | Is not limited by budget for sending text messages           |
|                   | Likes to experience with new technical innovations           |

TABLE 6 - USER PROFILE

### 8.2 MATERIALS

Three types of data were sent to the users: exercises, benefits notices, and focus points to maximize the value of each exercise (Shown in table 7). The exercises in the program were created in consultation with an expert of the domain of wellness. All exercises were aimed to be unobtrusive and met the following requirements: (1) the duration is no longer than 20 to 30 seconds, (2) instructions are transferable in one text message, and (3) the exercises can be performed independent from body position. The exact content of the exercises will be dealt with in the 'Program'-section. The benefit list, shown in table 3, remains unchanged from the trials and was used to increase the perceived value of performing the exercises. Focus points were applied in exercise explanations and informational messages and are of importance to maximize the effect of both stretching and breathing exercises. These focus points are derived from the website of the Mayo Foundation for Medical Education and Research (MFMER, 2009).

| <i>Stretching focus points</i>       |  |
|--------------------------------------|--|
| <b>Focus</b>                         | <b>Explanation</b>   |
| Pain free stretching                 | Feeling tension is appropriate when one stretches, but do not overstretch to the point it will hurt.                   |
| Relax and breathe freely             | Relax and continue to breathe freely during stretches as it will avoid unwanted tension.                               |
| Don't bounce                         | Bouncing can result in small tears in the muscle, which tightens the muscles even further.                             |
| Avoid cold stretches                 | Stretching cold muscles can result into hurting them. Stretch when the muscles feel warm and receptive for stretching. |
| <i>Breathing focus points</i>        |  |
| <b>Focus</b>                         | <b>Explanation</b>   |
| Concentrate on the exercise          | When performing the exercise, stop the current activities for a brief moment and focus on the exercise at hand.        |
| Apply when feeling tense or stressed | The breathing exercises are most effective when applied in tense or stressful situations.                              |
| Breathe through the nose             | Hairs at the entrance of the nose trap particles that may injure the lungs.  |

TABLE 7 - FOCUS POINTS

A questionnaire was used to inspect those aspects of the service that are not measurable through SMS messages and which could not be inferred from the retrieved data. The user experience with the service was measured through both open and scaled questions, with the scaled questions being measured on a 5-point Likert scale. Users could express themselves on two different scales for the scaled questions: agree to disagree and positive to negative. The questionnaire consisted of seven parts: (1) general feedback to functionality, (2) personal lifestyle, (3) exercises, (4) messages, (5) goals, (6) website, and (7) Short Message Service. In the first section two questions were presented to determine the features that were valued most and what features are anticipated in a possible new version of the service. In personal lifestyle, users were asked about their attitude towards performing the behaviour, the perception of their environment towards the behaviour, the influence of their environment on the targeted lifestyle change, the perceived threat of avoiding the behaviour before and after the experiment, the perceived benefits before and after the experiment, their current exercise activity, and their motivation to improve their lifestyle. The exercises section only consisted of questions from which the answers could not be derived from the conversation history. The questions were aimed to detect barriers, determine overall ability to perform the exercises in the program and to determine whether the exercises were diverse and challenging enough to each user. In contrary to the trial phase, questions were asked after the experiment to get a more accurate view of the user perception concerning the messages send to him or her, and to determine the effect of applied literary concepts. These questions in the message section concerned the perceived experience on amount of message, language usage, salutation, content clarity, and the timing of the message. After that goal-setting was treated as the trials showed difficulty to determine the effect of goals, especially for goals with additional trigger support. Questions were presented concerning clarity of the goals, self-efficacy to achieve the goals, and the internalization of the stated goals. As the usage of the website was optional and no expectations on the website activity could be made, no extensive research was performed on the usability and features appreciation. The website section only consisted of questions related to progress and

goal management tracking in order to capture the perceived value of the website for these aspects. The last section evaluated concepts derived from the background literature, determining the quality of the service, relationship and interaction, the choice of technology channel, the perceived coercion of the service, and the perceived quality of the tailoring that was applied for both information and exercises. The questionnaire was finally stored at ThesisTools.com as the website for the service was not suitable for storage.

The created behaviour change model revealed the need to be prepared before starting with behaviour changer, so in order to acquire an appropriate mindset and to activate the user for the upcoming change, an invitation was provided by email. The invitation provided information about the aim of the service, the content of the program with an example exercise, benefits of performing the behaviour to influence the initial mindset, duration and unobtrusiveness notices to reduce possible barriers, and a user requirement notice to inform users that replying to messages stated in the service is required. Additionally, users were informed that the service does not charge any additional costs for messages. The invitation contained the logo of Utrecht University to increase the scientific credential of the research. This is an implementation of the power of authority concept derived from Cialdini (2004). The background of the invitation lastly contained a picture of two exercising persons to increase the association to the wellness domain.

In comparison to the mDiet system of Fogg and Adler (2009), the web-application build for this experiment phase consisted of three components: 1) A web-application facilitating the features listed in table 8, 2) a database to store participants, exercises, templates, messages and progress, and 3) a third party website for sending messages. The web-application was accessible for both administrators and participants both having a personalized view. Administrators could manage all the participants in the experiment through the web-application, and users could access their progress and stated goals. The interface was build to improve the accessibility of both progress and goals to users, and the internalization process of performed exercises and goals in a specific exercise week. Completed exercises and goals were marked with a green success notice to increase to positively reinforce the user, and the Utrecht University label was placed at the bottom of the screen to increase scientific credential. On technical ground, the application was built in the Microsoft Visual Studio environment and written in ASP.net C# 2.0. A free template from freewebtemplates.com was used and modified for the design of the website. The website was eventually stored at exoft.net as it was freely available to this research. The second component of the website, the MSSQL database, was used to store the data and to calculate the performance of each participant in the program. The website was accessed through LINQ for ASP.net, and manually managed in the database management application Microsoft Server Management Studio. Third and last, the third party website Mollie.nl was used to facilitate the actual sending of messages to the participants in the program. The available C# API allows easy access to the service to send messages on a self-selected time. Lastly, send messages that were cued by the service, could be viewed and deleted through the administrator interface of Mollie.

| <b>txt4Health web-application features</b>  |  |
|---|--|
| <i>Feature</i>  | <i>Accessibility</i>                       |
| Enrol and manage participants used in the experiment  | Administrators                             |
| Set user preferences like self-selected time of the day and the use of a secondary (work) phone | Administrators                             |
| Change the presented password to own preference   | Users                                      |
| Send messages to users on a selected time and add received messages to the system               | Administrators                             |
| Manage exercises and directly send exercise trigger to user                                     | Administrators                             |
| Manage goals and directly send goal to user   | Administrators                             |
| Create templates that can be search for and applied when messages are sent                      | Administrators                             |
| View and update user progress   | Administrators<br>Participants (view only) |
| View the messages history between the user and the service                                      | Administrators<br>Participants             |

TABLE 8 - WEB-APPLICATION FEATURES

### 8.3 EXERCISE PROGRAM

The program of the experiment consisted of three weeks and the difficulty level of the exercises increased one level each week by increasing the degree of attention needed to perform the exercises successfully. All exercises in the program were created by an expert in the domain of wellness. The exercises in the first week were plain stretching exercises, the exercises in the second week were mindful stretches in which users had to control two movements at the same time, and the third and last week plain stretching exercises were combined with breath control. The exercise basics remained the same over the entire program, but the exercises changed along with the difficulty level of the week. These basic exercises are shown in table 9. Feedback from the users was used to tailor the program to each specific user. When the user did not value the exercise positively, it was avoided in the remainder of the program. In the last case, an exercise similar to positively valued exercises by the user was added to the tailored program. Apart from the triggers that were sent each day of the exercise week, additional messages were sent containing benefits, tips, goals and measures with a maximum of one additional message a day.

| <b>Standard exercises for the first week</b>                                   |                      |
|--|----------------------|
| <i>Exercise</i>  | <i>Duration</i>      |
| Keep your arms next to your body and fully stretch your fingers slowly.        | Repeat 10 times      |
| Slowly stretch your feet and toes from you and towards you.                    | Repeat 10 times      |
| Make two fists and slowly turn the wrists clockwise and then counterclockwise. | Five times each way  |
| Straighten your spine by stretching your head into the air.                    | Two times 10 seconds |
| Stretch your neck by bringing your chin to your chest and then to the air.     | 10 seconds each way  |

TABLE 9 - EXERCISES (COMMUNICATED IN DUTCH)

At the first day of the experiment an initial attitude measurement was applied to evaluate the openness of users towards the behaviour and to create a measurement comparison to evaluate the influence of the program after the three weeks of the program. During the first week, each user was asked to discover the personal most valuable time to perform the exercises which from there on was applied as self-selected time. In the second week, the intention concept was measured along with the adherence to the service. Adherence was measured the same way as in the trial phase, again no trigger was sent to the users and its effect was measured the day after it.

Lastly, on the final day of the third week users were asked to perform their favourite type of exercise and reflect it back to the service. After the experiment ended, users were asked to fill in the questionnaire located at the ThesisTools.com website. The reciprocity rule was applied in the questionnaire trigger to engage users to fill in the questionnaire. The link was finally sent to the email address of the user as it was not suitable to be sent in a single text message. The last message was scheduled a week after the experiment, containing appreciation notice and a final adherence measure.

At the end of the first week, a weekend goal was set to perform the two most valued exercises from the first week of the program. The trigger of the goal also contained the login credentials for the website to access the performed exercises in an easy way. On both exercise days in the weekend, users were not provided with triggers to remind them to perform the specific behaviour in order to check the adherence to the service and to check the motivation to perform the exercises. The achievement of the goal was verified on the first day after the weekend. At the start of the second week, a short-term goal was set to perform an exercise each day of the upcoming week. This goal was supported with trigger to remind the user of to perform an exercise each day. Users were notified of the successful completion of their goal at the end of the week when all exercises were performed successfully.

The social distance to the participants was generalized to distant in contrary to the trials. The language usage was therefore formal, implying politeness and the use of pronouns as the communication language was Dutch. This is in line with the language approach of health educators in general. Additionally, extrovert language was used in triggers as they required highly social presence and introvert in additional messages to invoke a clear social presence. The choice in the degree of social presence is based on the findings of the study of Lee and Nass (2003).

## 8.4 MEASURES

The effects of the different findings which are processed into the current implementation of the program were measured in two ways: measurement through text messages and through the created questionnaire. Starting with the measurements through texting, the task and goal performance was measured by asking questions either about the effect of the exercises and whether it has been completed. The exercise effect was also used in the tailoring of the program to avoid the continuation of exercises that did not have any perceived effect. Next, the initial attitude value was measured before the start of the experiment, and the adherence to the service was measured through the evaluation of the exercise performance when no triggers were used. Lastly, after the experiment ended, a final adherence measurement was performed evaluating the continuation of the targeted behaviour without using the service. Moving on to the questionnaire, both open and scaled questions were used to measure the experience of the user. Open questions measured the perceived value of the features and what was lacking in the eyes of the participants, the attitude of the user towards the lifestyle after the experiment, and the quality grade of the entire service. The scaled questions were divided into six sections: lifestyle, exercises, messages, goals, website, and service. The measured concepts were derived from background literature, the created behaviour model, and trial findings and are shown in table 10. As stated before, all the scaled questions were measured on a 5-point Likert scale.

| <b>Questionnaire measurements</b> |   |   |   |
|-----------------------------------|---|---|---|
| <i>Treated in</i>                 | <b>Background</b>   | <b>Behaviour model</b>  | <b>Trials</b>   |
| <i>Measure</i>                    | System credibility<br>Technology channel match<br>Tailoring effectiveness<br>Quality of interaction<br>Language usage<br>Social support<br>Perceived ethics<br>Relationship value<br>Adherence to service | Self-efficacy exercises<br>Self-efficacy goals<br>Increase perceived threat<br>Increase perceived benefits<br>Perceived barriers<br>Intention<br>Motivation<br>Ability to perform exercises | Unobtrusiveness exercises<br>Effectiveness of goals<br>Perceived timing effect<br>Perceived website value<br>Environmental influences |

TABLE 10 - QUESTIONNAIRE CONCEPTS

### 8.5 PROCEDURE

Before the experiment started, individuals in the social environment of the researchers were evaluated based on the created users profile which is shown in table 6. The selected participants were invited through an invitation flyer that was sent to their personal email address. Participants either confirmed their participation face-to-face or by an email or text message. At the first day of the experiment each participant received a notification that the experiment started that day along with an initial attitude measure. After the initial measure, the three week program started containing exercises that need to be performed on work days and in one weekend. The availability of the website to keep track of progress and goals was communicated at the end of the first week along with the login credentials. On the last day of the program, each participant received a text message trigger to engage users to fill in the questionnaire. The link to the questionnaire was mailed separately to the personal email address to increase accessibility to the link. A week after the experiment, when all questionnaires were filled in successfully, the experiment was ended by thanking each participant for their participation and by measuring the continuation of the exercise performance after the program.

## 9. RESULTS

The structure of the results is as follows: performance analysis will be reported first, followed by the conversation history analysis, and is ended with the questionnaire analysis. No name was associated to the questionnaire results to increase the openness of participants.

### 9.1 PERFORMANCE ANALYSIS

The performance of each user, shown in table 11, was measured for both exercise and goal performance. The overall exercise performance was 83%, with an average performance of 90% in the first week, 85% in the second, and 74% in the third and last week. Two participants successfully completed all the exercises in the program and two did not successfully complete one entire week. The lowest exercise performance is 50%, with a low point reached in the third week when the participant only performed one exercise (20%). The average exercises performance dropped from the first week in five cases, and the performance gained in two cases. The overall goal performance is 50%, with an equal performance of the weekend goal and the week goal. Three participants completed both goals successfully, three participants completed neither of the two goals, and four completed either the weekend or week goal. Two of the participants that have completed both goals also completed all the exercises; the other had an average performance of 85.7% with a peak of 100% in the week of the completed goal. Two of the three participants who did not complete either of the two goals had an overall low performance rate of respectively 50% and 64.3%; the performance of the third participant was closer to the overall average score of 83%, namely 78.6%. The performance of the remaining four participants who completed one of the two goals ranged from 71.4% to 100%.

| Weeks                              | Exercise performance |        |        |        | Goal performance |      |       |
|------------------------------------|----------------------|--------|--------|--------|------------------|------|-------|
|                                    | Week 1               | Week 2 | Week 3 | Total  | Weekend          | Week | Total |
| <i>Performance per participant</i> | 100,0%               | 75,0%  | 80,0%  | 85,7%  | Yes              | No   | 50%   |
|                                    | 80,0%                | 100,0% | 80,0%  | 85,7%  | Yes              | Yes  | 100%  |
|                                    | 100,0%               | 100,0% | 100,0% | 100,0% | Yes              | Yes  | 100%  |
|                                    | 60,0%                | 75,0%  | 20,0%  | 50,0%  | No               | No   | 0%    |
|                                    | 80,0%                | 50,0%  | 60,0%  | 64,3%  | No               | No   | 0%    |
|                                    | 100,0%               | 75,0%  | 40,0%  | 71,4%  | Yes              | No   | 50%   |
|                                    | 100,0%               | 100,0% | 100,0% | 100,0% | Yes              | Yes  | 100%  |
|                                    | 80,0%                | 100,0% | 100,0% | 92,9%  | No               | Yes  | 50%   |
|                                    | 100,0%               | 100,0% | 100,0% | 100,0% | No               | Yes  | 50%   |
|                                    | 100,0%               | 75,0%  | 60,0%  | 78,6%  | No               | No   | 0%    |
| <i>Average</i>                     | 90%                  | 85%    | 74%    | 83%    | 50%              | 50%  | 50%   |

TABLE 11 - PERFORMANCE EXPERIMENT

### 9.2 CONVERSATION HISTORY ANALYSIS

The conversation history delivered a wide spread of information valuable to be analyzed on audience, behaviour, and technology aspects. Other aspects were covered by the questionnaire which will be treated after the conversation analysis. A first global analysis showed a varied conversation length for both the amount of messages and the content of the replied messages. Especially for those participants with lower performance results, the amount of replies and the length of replies are much lower in comparison to high performance participants. A deeper



analysis of each participant showed that the low performance participants both had busy work schedules. Triggers failed to initiate the targeted behaviour as the participants had other priorities that were of greater perceived importance than the scheduled exercise. When the trigger failed, no reschedule was performed resulting in both the avoidance of the behaviour and replies to the service. Participants with a high performance rate either performed similar behaviour on a regular basis, or were evaluated to be highly motivated to work with the service. Other participants found a way to integrate the exercise performance in their daily schedule, apart from occasional slips which can be pointed to failing timing.

Service adherence was tested on two occasions, firstly participants did not receive a trigger to perform the exercises at the fourth day of the second week, and secondly users were asked after the experiment whether they continued the exercise performance. Four participants noticed the absence of the trigger during the day, with only two participants performing relevant exercises on their own. The other participants resulted to be dependent to the service to perform relevant behaviour. Seven participants replied to the after experiment check, with only two participants who continued the behaviour after the experiment and one who performed only one exercise. Participants who did perform daily exercises after the program were evaluated to be the participants that showed high motivation during the experiment phase and performed all the exercises in the program. Again, service adherence resulted to be high for the other individuals who participated in the experiment.

Behaviour effect feedback was instigated through feedback questions at the end of several triggers. These questions were evaluated to generate important information for the tailoring of the exercise program as the difficulty and the exercise effect was valued differently among participants. One exercise that was valued to be difficult among participants was the wrist rotation exercise, as participants had trouble to rotate their hands in the opposite direction. In addition, users who stated their preferences in body parts received program adjustments to more wrist, neck or spinal stretches. Several comments were given on the suitability of the effect communication through text messages as it was perceived to be difficult to state the exact thoughts in a single text message. Apart from the exercise effect questions, the experiment also experimented with the reply format of messages by simply asking participants to reply 'Yes'/'Y' or 'No'/'N' to the question whether they have performed the exercise. The reply format was evaluated to be a success as it generates the correct response and lowers the barrier to reply for participants. Lastly, the self-selected time of the day was evaluated not to be applicable to all days of the week for each participant as the reply rate varied from day to day which was also commented by a user in the questionnaire results.

### 9.3 QUESTIONNAIRE ANALYSIS

Moving on to the questionnaire feature rating, participants reported that any new version of the service should retain the timing of exercises, type of exercises, mobile phone usage and one participant stated that website should be retained to review past performance. Recommended new or improved features were better experiment start, more exercises in weekend, more challenging exercises, exercise illustration through mail or website, varied timing of exercises, and tailored information to the current context of the participant. Participants had the option to give additional feedback about the experiment at the end of the questionnaire, with several participants reporting the missed website trigger as previously treated. Other feedback concerned a missing overview of the exercise structure, difficulty of text messaging in several

cases, contradicting language usage as it was formal but used the first name of participants at the start of the message, and the need for self-selected exercises.

The attitude and intention of participants was measured on different occasions. At the start of the experiment participants were asked for their initial attitude towards the intended lifestyle. All participants reported to be positive and open towards the lifestyle which is in line with the requirements profile of the experiment participants. In the second week of the program the intention was measured in full with success. Participants reported overall positive attitude and environmental beliefs, except for one participant that stated not to continue with the exercises in the program after the experiment. Intention was also measured to be positive in the questionnaire after the experiment. In conclusion, no real changes were found in the overall intention of participants as the program progressed, except for one participant that did not value the type of exercises.

The resulting parts of the questionnaire covered the evaluation of concepts which could not be evaluated from the conversation history. Statements of eight questions were reversed to retain the focus of participants when the questionnaire was filled in, and the scores were reversed again for the upcoming analysis. The first section of the questionnaire covered statements concerning the lifestyle of each participant with its results shown in table 12. The first two statements, attitude and environment belief, cover the intention concept. Average scores were 4.4 with a SD of 0.52 on attitude, and 4.1 with a SD of 0.88 on belief, resulting in a high intention score on a 5 point scale. The environmental influence on the participants was scored 3.5 (SD = 1.08), with three participants having a high positive environmental influence having scored 5 points, and one low negative influencing scoring 2 points. Diverse scores were given on perceived lifestyle activity (Mean = 3.5; SD = 1.27), having three cases with a low activity scoring 2 points, and three cases with a high activity scoring 5 points. Statement 6 (M = 4.4; SD = 0.70) and 8 (M = 3.8; SD = 1.23) show that the participants knew the threats and benefits well which is in line with the profile requirements of the participants. The service contributed to the perceived knowledge in both the case of the benefits (M = 4.4; SD = 0.52) as for threats (M = 4.0; SD = 1.05) having both cases show positively valued reactions. The perceived knowledge gain of

| #  | Measure  | Mean | SD   | Median |
|----|--|------|------|--------|
| 1  | Attitude towards lifestyle   | 4,4  | 0,52 | 4      |
| 2  | Environmental belief towards lifestyle                             | 4,1  | 0,88 | 4      |
| 3  | Environmental influence on performing behaviour                    | 3,5  | 1,08 | 3      |
| 4  | Active lifestyle before experiment                                 | 3,5  | 1,27 | 3,5    |
| 5  | Performed comparable exercises before experiment                   | 3,3  | 1,34 | 3      |
| 6  | Knew the threats of pressure and stress on body                    | 4,4  | 0,70 | 4,5    |
| 7  | Learned the threats of pressure and stress on body through service | 4    | 1,05 | 4      |
| 8  | Knew the benefits of the targeted lifestyle before experiment      | 3,8  | 1,23 | 4      |
| 9  | Learned the benefits of the desired lifestyle through the service  | 4,4  | 0,52 | 4      |
| 10 | Likes working with new technology                                  | 3,9  | 1,10 | 4      |
| 11 | Motivated to perform exercises that can improve my health          | 4,5  | 0,53 | 4,5    |

TABLE 12 - LIFESTYLE (#1-3 5-POINT SCALE: NEGATIVE TO POSITIVE -  
#4-11 5 point scale: Disagree to Agree)

the threats of pressure and stress on the human body was only negatively valued once (Score = 2). In line with the established profile for the selected participants, the average score on motivation, question #11, was 4.5 (SD = 0.53). Lastly, the degree of liking to work with new technology was reflected on positively (M = 3.9; SD = 1.1) which can also be seen as a form of motivation.

The exercise section of the questionnaire covered the experience from the performed exercises and aspects that could not be determined from the received messages (Table 13). The overall effect of the exercises was valued positively (M = 4.0; SD = 0.67) in line with the analysis of the conversation history. No barriers hold participants back in performing the targeted behaviour as the duration formed no barrier (M = 4.3; SD = 0.48), the exercises could be performed unobtrusively (M = 3.9; SD = 1.10), the exercises suited the participants (M = 4.2; SD = 0.79), and as they were easy to be performed implying a high efficacy (M = 4.6; SD = 0.52). Additionally, the exercise explanation was valued to be clear (M = 3.9; SD = 0.57) all indicating a high ability to perform the behaviour. The programs variation was perceived above average (M = 3.8; SD = 1.03), having only one low perceived variation score (Score = 2). The challenge in the exercises was evaluated to be diverse with scores ranging from 2 to 5, but leaning to the negative side (M = 2.6; SD = 1.17) indicating a lack of challenge. Finally, no increase of difficulty was noticed in the structure of the program (M = 2.6; SD = 0.84). The median score of 2 is represented by six low scores of 2.

| # | Measure  | Mean | SD   | Median |
|---|--|------|------|--------|
| 1 | Positive effect from exercise                      | 4    | 0,67 | 4      |
| 2 | Duration of exercises formed no barrier            | 4,3  | 0,48 | 4      |
| 3 | Exercise explanation was clear                     | 3,9  | 0,57 | 4      |
| 4 | Exercises could be performed unobtrusive           | 3,9  | 1,10 | 4      |
| 5 | Type of exercises suited me                        | 4,2  | 0,79 | 4      |
| 6 | Program contained varied exercises                 | 3,8  | 1,03 | 4      |
| 7 | Exercises were easy to perform                     | 4,6  | 0,52 | 5      |
| 8 | Exercises were challenging                         | 2,6  | 1,17 | 2,5    |
| 9 | The increase of difficulty in weeks was noticeable | 2,6  | 0,84 | 2      |

TABLE 13 - EXERCISES (5-POINT SCALE: DISAGREE TO AGREE)

The trials lacked feedback concerning the language usage in the messages. This feedback is however evaluated in the experiment phase with the applied questionnaire, containing questions concerning language usage, timing effect, and the amount of messages which are shown in table 14. Starting with the language usage, statements 1 to 4 all covered the language usage as experienced through the messages. These statements were valued diversely, especially the statements 1 (SD = 1.45) and 3 (SD = 1.23). The result set of statement 1 is skewed to the right, having a median of 4.5 representing many positive values. When looking at the reported values of each participant, two participants rated the language usage negatively (Scores = 1; 2) explaining the high standard deviation. The same applies to the result set of statement 3 which also contained a low negative score (Score = 1). Both negative scores were given by the same participant. Evaluating the other language usage statements, both content clarity and salutation variation were valued positively, respectively mean 4.0 (SD = 0.47) and mean 3.5 (SD = 3.5) implying appropriate language usage in the messages send to the users. Moving on to the timing effect of the exercises, participants did not perceive the timing to increase or reduce exercise effect (M = 3.2; SD = 1.08). The avoidance of increase implies a lack of value for the self-selected

time of the day. Lastly, two participants evaluated the amount of messages to pose a barrier, both scoring the concept 2 out of 5. Other participant however did not perceive the amount of messages to form a barrier (M = 3.8; SD = 1.14)

| # | Measure  | Mean | SD   | Median |
|---|--|------|------|--------|
| 1 | The language usage fitted the service                      | 3,9  | 1,45 | 4,5    |
| 2 | Content of messages was clear                              | 4    | 0,47 | 4      |
| 3 | Salutation in messages was appealing                       | 3,8  | 1,23 | 4      |
| 4 | Salutation was varied                                      | 3,5  | 1,08 | 3,5    |
| 5 | Time of exercises gave the exercises more effect           | 3,2  | 1,23 | 3      |
| 6 | Directly performed the exercises after reading the message | 3,7  | 0,95 | 4      |
| 7 | Number of messages formed no barrier                       | 3,8  | 1,14 | 4      |

TABLE 14 - MESSAGES (5-POINT SCALE: DISAGREE TO AGREE)

Table 15 shows the statements that were used to evaluate the impact and participant experience related to goal-setting. The stated goals in the experiment were both perceived to be clear (M = 3.6; SD = 1.07) and achievable (M = 3.9; SD = 0.74) with the second to imply a good self-efficacy and not to pose a barrier. Participant reported low on both the active performance of the week (M = 3.1; SD = 1.2) and weekend goals (M = 2.7; SD = 1.25) which is in line with the results from the performance analysis. The proposed goals had little perceived effect on the performance of the exercises (M = 3.3; SD = 1.06) resulting in a low effectiveness of the stated goals. Participants reported diverse on the last statement in the section, having four scores below 3 and four scores above 3 eventually leading to a mean of 2.9 with a standard deviation of 1.37. The mixed scores are in line with the diverse performance of the weekend goal.

| # | Measure  | Mean | SD   | Median |
|---|--|------|------|--------|
| 1 | Stated goals were clear                            | 3,6  | 1,07 | 4      |
| 2 | Stated goals were achievable                       | 3,9  | 0,74 | 4      |
| 3 | Actively performed the week goal                   | 3,1  | 1,20 | 3      |
| 4 | Actively performed the weekend goal                | 2,7  | 1,25 | 2      |
| 5 | Proposed goal contributed to perform the exercises | 3,3  | 1,06 | 3      |
| 6 | Needed a trigger to achieve the weekend goal       | 2,9  | 1,37 | 3      |

TABLE 15 - GOAL-SETTING (5-POINT SCALE: DISAGREE TO AGREE)

Before looking at the results of the website evaluation shown in table 16, it has to be stated that only four participants logged in with their personal login credentials at the website that was send to them at the end of the first week. Even those users did not use the website on a regular basis, leaving it open to debate whether the results of the questionnaire are valuable. The open ended questions and input revealed that several participants did not know of the existence of the website until it came up at the questionnaire, implying the failure of the trigger to visit the website. The value from the results of the website statements and the effectiveness of the website trigger will however be discussed later on. First the feedback will be evaluated, immediately showing the lack of perceived website value in statements 1, 4 and 5. Statement 2 and 3 did not cover the website, but also showed very low results showing the lack of goal tacking (M = 2.1; SD = 1.29) and progress tracking of (M = 2.3; SD = 1.42). Participants reactions were diverse on the last statement (M = 3.5; SD = 1.43), with three participants scoring 5 point and one scoring only 1 point. This statement is however only valuable aimed at users that have actually used the website actively during the experiment.

| # | Measure  | Mean | SD   | Median |
|---|--|------|------|--------|
| 1 | Website was of value to service  | 3,2  | 1,14 | 3      |
| 2 | Kept track of stated goals   | 2,1  | 1,29 | 2      |
| 3 | Kept track of progress and performed exercises                             | 2,3  | 1,42 | 2      |
| 4 | Website was of value for keeping track of stated goals                     | 2,6  | 1,07 | 3      |
| 5 | Website was of value for keeping track of progress and performed exercises | 2,6  | 1,07 | 3      |
| 6 | Website can be of value to the service on a longer run                     | 3,5  | 1,43 | 3      |

TABLE 16 - WEBSITE QUESTIONS (5-POINT SCALE: DISAGREE TO AGREE)

The last section of the questionnaire covered statements concerning the service and is shown in table 17. Starting with the technology match, the use of the mobile phone was valued positively by all users ( $M = 4.6$ ;  $SD = 0.52$ ). Added to the positive score on “working with a new technology” showed a match in technology usage which is in line with the created user profile requirements. No real perceived effect was found in the tailoring of information ( $M = 3.3$ ;  $SD = 0.82$ ) and exercises ( $M = 3.0$ ;  $SD = 0.82$ ), resulting in low tailoring effectiveness. The relationship value between the service and the participant was positively valued on interaction aspect ( $M = 3.8$ ;  $SD = 0.92$ ), credibility and thereby quality (average of 7.35 out of 10), and language usage which has been treated before, but failed to provide social support ( $M = 2.7$ ;  $STD = 1.25$ ). Four participants scored the social support of the service under 3 points and only two above implying a failed social support implementation. The service did not use coercion to perform the exercises in the program ( $M = 2.6$ ;  $SD = 1.35$ ), but was perceived to push the user into performing the behaviour in four cases (Score = 4). In contrary to the adherence scoring resulted from the performance of the weekend goal, the exercise day without trigger support measurement and the post experiment performance, users did not perceive themselves to be adherence to the service to change their lifestyle ( $M = 2.2$ ;  $SD = 1.03$ ). No results could be drawn from the post experiment performance as participants did not have a clear view whether they wanted to continue with the started lifestyle change ( $M = 3.0$ ;  $SD = 0.67$ ) making it hard to draw any conclusions. In addition to the previously treated relationship value, users generally wanted to continue using the service ( $M = 3.7$ ;  $SD = 1.25$ ) with only one user that did not wanted to continue using the service (Score = 1). The same participants also scored low on the continuance of the performance of the exercises after the experiment (Score = 2), in contrary to the overall results ( $M = 3.7$ ;  $SD = 0.82$ ).

| #  | Measure  | Mean | STD  | Median |
|----|--|------|------|--------|
| 1  | Use of mobile phone was appealing                      | 4,6  | 0,52 | 5      |
| 2  | Information was tailored                               | 3,3  | 0,82 | 3,5    |
| 3  | Exercises were tailored                                | 3    | 0,82 | 3      |
| 4  | Service forced the performance of exercises            | 2,6  | 1,35 | 2,5    |
| 5  | Service offered social support in the lifestyle change | 2,7  | 1,25 | 3      |
| 6  | Dependent to service to change lifestyle               | 2,2  | 1,03 | 2      |
| 7  | Interaction with service was pleasant                  | 3,8  | 0,92 | 3,5    |
| 8  | Would like to continue using the service               | 3,7  | 1,25 | 4      |
| 9  | Continue to change the lifestyle after experiment      | 3    | 0,67 | 3      |
| 10 | Continue to perform the exercise after experiment      | 3,7  | 0,82 | 4      |

TABLE 17 - GENERAL (5-POINT SCALE: DISAGREE TO AGREE)

## 10. DISCUSSION

Before starting with the analysis of the findings of the research, focus will be placed upon the general achievements of the service till now. The service managed to persuade 10 participants to perform exercises that were sent to them through short text messages. Not all messages containing exercises successfully inferred the behaviour performance at the participants, but with a total average of 83% the service greatly performed at only the second development test run. As in the trials, experience gained from the experiment provides valuable information that can be used to improve the service to the next level. Findings of the experiment and study are analyzed next in the following order: user analysis, service analysis, improvements gained from trials to experiment, roundup of the research and its achievements, improvements that can be applied in further research, and a reflection on the contribution to the different research areas of the study.

### 10.1 USER ANALYSIS

Starting with the user analysis, all participants in the experiment matched the created profile shown in table 6 as questionnaire answers and message replies indicated participants to have a high motivation to perform the behaviour, an appropriate attitude towards the behaviour, to match the technology chosen in the study, and to be open for change. The profile was created to only include individuals in the experiment who were ready to begin with the intended behavior change. Reflecting the profile to the created behaviour change model, participants matching the profile could be considered to be located at the preparation stage of the model. One participant commented the experiment to have begun with a false start, implying the invitation to have missed its goal to influence the current mindset of participants with content features and the procedure of the study. An initial conversation between service and participants can resolve failing starts in the future by determining the specific mindset issues which are of importance before using the service.

As stated before, the overall average exercise performance of users was 83%. When looking at the average performance rates of each experiment week, the average performance dropped in all three weeks. The service failed to maintain the behaviour performance over the three week period in several cases which can be explained by a failing relationship building. Two aspects of creating a relationship stated by Bickmore and Picard (2005), providing social support and keeping the interaction engaging, were not achieved by the service. Questionnaire results showed low scores on the perceived degree of challenge in the exercise, the increase of difficulty each week, and the provided social support to perform the exercises. These findings address the downward trend in exercise performance, and need to be resolved in a next version of the service. This will however be analyzed from a service perspective further on.

Reflecting the performance drops and the performance of each participant to the stages of the behaviour model, participants were located in different stages of the behaviour change model during the course of the experiment. Before analyzing the performance rates, intention was measured to be positive during the experiment for all participants, with the exception of one who did not value the exercises positively which however did not affect his performance rate. The intention concept will therefore be left aside in this analysis. Participants with a 100% performance rate of both exercises and goals were evaluated to be highly motivated and at ease with performing the behaviour and its effect. Service adherence tests during and after the

research additionally showed that they were not dependent to the service to perform the behaviour. These participants are therefore concluded to be in the maintenance stage of the behaviour change model. The low performance participants were evaluated to linger in the preparation stage of the model, as the participants showed many slips during the experiment and the adherence to the service was evaluated to be high as no exercises were performed when the participants did not receive a message. Busy work schedules were reported to be one of the reasons of the low exercise performance, as the timing of the triggers could fall within important work-related activities giving the participants no room to either read the message or perform the behaviour. The wrongly time triggers did not infer the behaviour and have therefore failed in their intention. These findings are in line with the behaviour model findings of Fogg (2009c), who also state that wrongly timed triggers will not infer behaviour on a regular basis. However, motivation was also evaluated to be low as no initiative was taken outside working hours and message replies and message lengths were minimal. Both motivation and trigger timing need to be increased to improve the exercise performance in the future. Motivation can be improved by raising awareness, highlighting the social value of performing the behaviour, and by making the exercises more challenging to perform. Other participants in the experiment program were evaluated to be in the action stage of the model. The behaviour was performed numerous times, but contained slips over the total period. Next step in their lifestyle change is to perform the behaviour over a period of time without slips and relapses. User commitment has to be increased and social support has to be given to assist the participants to the next stage.

As was shortly mentioned before, wrongly timed triggers are bound to lead to avoidance of the desired behaviour. Failing triggers represent triggers where participants have to reschedule the content of the trigger, as their current activity disallows the behaviour to be performed. Behaviour in this experiment that was aimed for with triggers was the performance of exercises or goals, or to navigate to the website to experience its value. When analyzing the failing triggers from a user perspective, the change that items are rescheduled depend on the degree of internalization of the participant and his or her adherence to the service. Illustrating the degree of internalization, as no additional triggers were sent to retrigger the behaviour, the performance solely depends on the participant at hand. If the participant internalizes the content of the trigger so that he or she will remember it later on, the behaviour might be performed. Otherwise the trigger is likely to be forgotten and the behaviour will not be performed. This avoidance should not be judged negatively, but accepted and the service needs to anticipate this fact in the future. As the experiment already contained self-selected timing for triggers, the solution has to be more advanced. One solution was proposed by a participant to apply a chosen time on each day of the week and not a generalized time. This however puts more load on the participants and is not quickly applicable at the start of the behaviour change. Another solution is to connect the service to the personal agenda of the participant, but this can impose barriers to participants as it concerns the sharing of private information. A totally different solution will be proposed after the analysis in the improvements section. The website trigger failure will be analyzed from the service perspective as it was already treated from the user perspective in the result section.

The last part of the user analysis concerns the continuation of the lifestyle change and exercises after the experiment. Participants were neutral in the questionnaire results in whether they would continue the lifestyle change after the experiment, and were on average positive on continuing the exercises after the experiment. The positive results on the exercise continuation contradict with the last adherence test, evaluating the exercise performance after the

experiment. From the seven replies, only two participants reported to have performed daily exercises after the experiment. These two participants were the same two participants who were evaluated to be in the maintenance stage of the behaviour change model and continued their daily exercises successfully. One participant reported to have performed the behaviour numerous times, but as in the experiment no steady performance was achieved. The last participant who replied to have performed the behaviour after the experiment, only performed one exercise indicating a failing continuation of the lifestyle change. This participant and the other participants who did not continued to lifestyle change at all were, as evaluated, dependent to the service to perform daily exercises and have not maintained the lifestyle change after the experiment. Interestingly, one participant with a 100% performance rate during the experiment reported to have thought about the behaviour after the experiment, but did not continued the promising start of the lifestyle change at all after the experiment. It is unclear what the barriers were to continue with the performance as the participant did thought about it on his own and no barriers were detected during the program. Additional feedback is needed to clarify this aspect, but is not available as the experiment was already completed when the problem was identified.

## 10.2 SERVICE ANALYSIS

Starting with the analysis from a service perspective, the content delivered to the participants and the language approach used by the service was positively valued by the targeted audience. The service therefore matched with the target audience in its basic form, delivering health exercises to individuals who want to change their lifestyle. One remark was given about the contradicting language usage as participants were approached formally, but the service used the first name of the individual at hand. Full formality indeed does not include first name salutation, but full formal form is unusable in text messages as the amount of space to salute an individual would take too much space and all message would exceed the one text message limit with all the disadvantages that entails. An intermediate solution is therefore the only approach that comes close to the social distance that is desirable in health solutions, or the service should entail an informal approach. However, as the feedback was positive on the intermediate approach, the service can continue using it until further remarks.

The delivered exercises in the program were overall valued positively and met the requirements set in consultation with the domain expert. Exercise explanations were clear and unobtrusive, the effect was valued positively, the exercise type suited the audience, and there were no barriers to perform the behaviour. The exercises however failed in two aspects, being challenging and having a clear difficulty structure along the program. Both aspects were intentionally minimized by the study to keep the ability to perform the behaviour high and to positively influence the self-efficacy of each individual in the program. However, participants scored low on both aspects implying a lack of difficulty and difficulty increase during the course of the experiment. In further runs, the difficulty should be aligned to the level of the participant to increase interaction engagement and perceived information individualization. Also, tailoring will increase the impact of the sent information, and can entice individuals to keep using the service. Participants were neutral towards the perceived tailoring effectiveness of information and exercises of the current implementation although the service did apply the tailoring of exercises. However, no explicit statements were made on the use of tailoring after the invitation and the tailoring only covered the content of exercises and not the difficulty level of exercises. To increase the impact of information and messages, the service needs to emphasize the use of tailoring and apply information and difficulty tailoring in future implementations. It has to be



investigated if the notice is effectively transferrable through text messaging or that it should be stated on for example the website of the service.

Apart from the tailoring perspective, the lack of interaction engagements also negatively influenced the relationship building process between service and user. Providing an engaging interaction is one of the factors to entice users to keep using the service. Other factors of creating a relationship, providing social support and tailoring, have also failed to be successful. Providing social support through text messages is experienced to be difficult in the experiment period as participants want to receive a minimal amount of messages a day. With the scheduled exercises and informational messages not much room is available to provide adequate support on exercise days. This can be solved by providing social support through a different technology channel to retain the impact of triggers and keep the number of text messages low. More information is needed however on whether the use of multiple communications channels can be effective in this persuasive design.

Last aspect that will be treated before advancing to the trial guideline evaluation is the ethical aspect of the persuasive design and its perceived force or coercion. Although participants did state to be physical active in any way before the experiment, daily triggers with exercises can be a major change in their daily schedules and can become pushy over time. This can be the reason that four out of 10 participants perceived the service to force the performance of exercises. A more gradual start can be the solution to lower the perceived coercion for individuals who are not used to daily exercises. Other participants however reported not to perceive any force in the choice to perform the exercises making the service overall ethically justified.

### 10.3 TRIAL GUIDELINE EVALUATION

The remaining aspects of the experiment, message structure and goal-setting, will be analyzed and evaluated against the created trial guidelines shown in table 5. Starting with the structure of the messages sent to the participants, guidelines prescribed to avoid unnecessary information in triggers, and to avoid multiple concepts in one single message and to adjust the message structure depending on the content and goal of each message. In comparison to the message structures as used in the trials, shown in table 4, the salutation and greetings sections for triggers were adjusted to optional fields to increase the focus to the other sections and minimize the length of each message. The adjustments were successful and no exercise trigger in the entire program exceeded the character limit of 160. The omission of salutations and greetings also increased the variation and perceived variation in messages, and was reported to be appealing. The changed structure also had its effect on benefits notices and the added performance focus points as they were not sent in triggers, but in separate messages. Although the content of the messages was valued positively in the experiment, the separate messages can seem pointless when no context is given and can therefore be difficult to process. To increase context, the notices can be added to reply messages with the downside that the message can become spacious. The website can also be used to transfer the message by displaying related notices on progress and exercise pages, increasing the perceived value of the website to the program. The exact implementation of this needs to be explored in future research.

Goal-setting guidelines included effectiveness evaluation, and improving accessibility to the completed and outstanding goals with the use of a website. Apart from the performance rate of the stated goals, effectiveness was also evaluated with specific questions after the experiment in the questionnaire. Goals were reported to be clear and achievable, but were not performed

actively along the program. Participants additionally stated not to keep track of their goals or their progress. The website was intended to increase the connectedness to the service by showing users their progress and goals on their personalized page. However, as stated in the results, the trigger to lure each participant to the website failed and only lured four participants to the website. The failure can be caused by different reasons: the environment did not provide access to the website, its value could have been removed by the stated goal at the start of the trigger, or users did not perceive the website to be of any value at that point of the experiment. Illustrating the first reason, if the participant was not near a computer when he or she read the trigger, the website could not be accessed at that time. In line with the failing exercise triggers, participants did not reschedule the trigger to later in the day. The website usage is however negligible due to the low number of participants who accessed the website and the low website activity. One participant who did use the website responded positive on to the availability of the website and stated to keep the feature in any new version of the service. The website was experienced to be very helpful and usable from an administrator point of view in monitoring each participant and sending daily messages. Only criticisms are the manual input of received messages and its features, the lack of sending group messages, and the unavailability to cancel sent messages within for example one minute after pressing the send-button. Separate usability should however be performed with end-users to evaluate the website from a user perspective.

#### 10.4 RESEARCH ROUNDUP

The goal of this research was to investigate the dimensions of health behaviour change and to create a short message service to persuade people to take health exercises into their daily lives. Before evaluating whether the goal has been achieved, an evaluation will be performed concerning the performed step and achievements of this study. The study started with investigating the different dimensions of health behaviour change, and created a tailored health behaviour change model for persuasive technologies. This tailored model was combined with the eight-step design process created by Fogg (2009) to create a short message service aiming to persuade individuals to change their inactive lifestyle by adding short stretching exercises to their daily lives. The scope of the behaviour change model was chosen to only contain behaviour change stages for individuals who are perceived to be ready for the intended lifestyle change as the duration of the study is too short for full behaviour change. Tests of the persuasive design were performed in two periods of three weeks and showed to successfully infer behaviour performance at the selected audience, but failed to achieve lasting behaviour and lifestyle changes in the three week period on a large scale. Achieving lasting change is difficult however, as the duration to travel between behaviour change stages can differ for each individual and change can fail when the duration period is tried to be pushed. Although results proved to be successful, the service failed to achieve steady exercise performance during the testing periods for busy users and to create a relationship with users. Improvements to the current design can be made in the effectiveness of triggers, the degree of social support, and by making the interaction and exercises more challenging. Returning to the goal of the research, this study has successfully created a health behaviour change model aimed for persuasive designs, and a short message service that is evaluated to generate short term successes in changing the lifestyle of individuals, but failed to achieve overall lasting change in the experiment period. Moving on to the research question whether individuals can be persuaded to change their lifestyle with timed SMS triggers containing simple but effective exercises, this study concludes that it can be achieved. The current persuasive design already managed to persuade individuals in short-term change, and with improvements to several concepts the design should also be able to invoke

long-term lifestyle changes on a large scale. In line with the Behaviour Model of Fogg (2009c), the timing of triggers is evaluated to be very important in generating change as poorly timed triggers most often result into failure. Also, the exercises in the program need to generate fast effect, need to be performable unobtrusively, and need to have a fine balance between challenge and difficulty.

## 10.5 FUTURE RESEARCH

Now that the first tests have been performed and the findings have been processed, focus can be placed upon the next version of the persuasion design. Recommendations to improve the current design are based on the findings from the trials and the experiment and the experience gained along the study. These improvements are aimed on both the behaviour model and the current version of the implementation. Starting with the behaviour model, the current model only covers the preparation, action and maintenance stages of the model and needs to be extended to cover the entire scope of behaviour change and to reach a wider audience. In line with the current stages of the model, additional stages need to be aimed at health behaviour change and persuasive designs. Also, special attention needs to be given to the continuation factor of the lifestyle change as the current version failed to achieve successful results on a large scale.

Improvements to the current version of the implementation can and need to be made on several dimensions. For starters, multiple technology channels need to be applied to increase the transferability of information like awareness notices, benefits of the intended lifestyle, and focus points to increase the effect of the exercises in the program. Sending these items through for instance email also increases the *impact* of the triggers in the program as triggers will then be the only messages sent from the service to the mobile phone of each user. Additionally, the number of messages a week can be decreased as email messages can contain more information and transfer it in a more user friendly approach. Additional literature has to be found however to evaluate and confirm these assumptions. Looking at the findings from both trials and experiment, improvements are suggested on self-selected exercises, self-selected timing, exercise difficulty, social support, and perceived website value. All these aspects have been treated one way or another, but the main improvement that needs to be made is to decrease the rate of failing triggers. Apart from extending the current self-selected timing feature, a solution has to be found that allows users to 'snooze' their exercise and retrigger the behaviour after the current activity. Postponing the exercise through text messages can for instance be achieved by replying a number of minutes to snooze or a new time on that day, but can be difficult to implement due to format issues. Another solution that can be applied has a big impact on the overall design, but has the potential to resolve several issues and is stated by Sarasohn-Kahn (2010) to be the new form of wireless health care and wellness delivery. This solution implies the use of a smartphone application to interact with the user instead of using text messages. Smartphones usage is increasing fast and Sarasohn-Kahn (2010) reports that 42 percent of the Americans owned smartphones as of December 2009. Additionally, Thompson (2010) has estimated the global smartphone usage to account for 26 percent of all handsets in four years time. Smartphones are valued for the ability to run applications, which can be downloaded by any smartphone user in the application store of their mobile operating system, and their easy internet access. The number of mobile Internet users increased with 74 percent between 2007 and 2009, and allows users to access the Internet and receive and sent data at all time. Exercise triggers can be sent through the internet to the mobile application or directly invoked from the

application, and users can choose to 'snooze', deny or complete the delivered exercise trigger from the interface. When the user completes the exercise with one press of a button, the application can ask the user to rate the exercise by selecting a number of stars, and allow them to add feedback concerning the exercise at hand. Information is gathered fast and enjoyable, and all the information given by the user will be replied to the service. Apart from increasing the interaction engagement, the use of a graphical interface also decreases the amount of manual input making the service less demanding for users. The interface can also provide access to current and completed goals, exercises and explanations, progress, and social support elements to improve the relationship between the service and the user. By making goals and user progress available in the mobile interface, the website will become obsolete for users. The web application will remain to have its value for administrators as they can monitor each participant from there. More research has to be done on the exact implementation, but with the increase in smartphone and mobile internet usage, and the list of features that can be implemented in the mobile application the change of technology channel can prove to be valuable.

## 10.6 RESEARCH CONTRIBUTIONS

Overall, this study has gained valuable findings for several disciplines. Firstly, in relation to information science, the study applied an experimental approach by using a fairly new iterative, user-centered method to generate much feedback and fast results in order to keep the users involved and connected to the project. The eight-step design process method of Fogg (2009) proved to successfully create an initial version of a persuasive technology, and to generate many small and large findings that were valuable in the development of the current implementation and are valuable for future development. Secondly, the study contributes to the field of psychology as it has created a behaviour change model aimed to change the lifestyle of physically inactive individuals with the use of persuasive technology. The model needs to be improved on maintaining change, but has proved to successfully infer behaviour change in the three week periods of the test runs. Lastly, participants reported positively on the use of the mobile phone in line with related researches of Anhoj and Moldrup (2004), Rodgers et al. (2005), and Franklin et al. (2006). The findings of these studies can have great impact on the field of health care as all studies report potential in wireless health care delivery. Health care services can extend their reach in comparison to traditional service in cost, access and convenience, and the service is perceived to be less demanding and insistent by users. Also, the created exercises are aimed to generate fast effect to relieve individuals of tension in stressing moments, and can be applied or used in future health programs.

## 11. CONCLUSION

This study was aimed to investigate how the lifestyle of inactive individuals can gradually be change into more physical active lifestyles as inactivity of individuals is problematic and expensive to current society. In order to achieve the change, the study created a tailored behaviour change model and combined it with a new persuasive short message service that was created using the eight-step design process of Fogg (2009). Behaviour was invoked by applying timed triggers containing simple stretching or breathing exercises. Two three-week runs were performed to test the effect of different findings and to retrieve valuable feedback from the chosen participants. The first test, referred to as trial phase, was aimed to perform short tests to evaluate specific findings and to get experience with applying persuasive technology. The processed findings and guidelines were then evaluated in a three-week experiment.

The service was concluded to successfully infer simple and small behaviour change in the trial phase. Insights were gained in the concepts that are of importance in successful change, and the mindset and motivation of the audience, the behaviour that needs to be performed and the timing of triggers were evaluated to be most influential. More detailed findings were acquired from the experiment phase which showed an average performance rate of 83% in the total group of 10 participants. The service, with the implemented guidelines from the trial phase, was evaluated to be successful in generating short-term change, providing easily performable exercises that generate positive effect, and to effectively inform participants about the benefits of the desired lifestyle. It failed in providing social support and challenging exercises, and could not infer lasting change for participants who were not evaluated to be highly motivated. Achieving lasting change in a short period is difficult however, as the duration to travel between behaviour change stages differs for each individual and should not be pushed. The timing of triggers was evaluated to very important as poorly timed triggers, especially for starting users, most often result into failure. This is in line with the Behaviour Model of Fogg (2009c).

Reflecting the findings on the goal of the research, it can be concluded that the study has successfully created a health behaviour change model aimed for persuasive designs, and a short message service that is evaluated to generate short-term successes in changing the lifestyle of individuals, but failed to achieve overall lasting change in the three-week experiment period. The study also concludes that the research question that was set up at the start of the research, whether individuals can be persuaded to change their lifestyle with timed SMS triggers containing simple but effective exercises, is achievable. The current persuasive design already achieved short-term lifestyle changes, and with improvements to the failing concepts the service should also be able to invoke overall long-term lifestyle changes.

For future research, improvements are suggested on exercise difficulty, trigger timing, and providing social support. Also, the use of an additional technology channel, like email, to transfer information that is not easily transferrable through text messages can lower the amount of messages to the mobile phone and thereby increase the impact of triggers. The biggest challenge will be to minimize the amount of failing triggers due to bad timing. An experimental solution is proposed to investigate the effect of using a smartphone application to interact with the user. Sarasohn-Kahn (2010) stated smartphones to be the new form of wireless health care and wellness delivery. The application can simulate trigger messages, give access to goals and progress, and provide more information on each exercise. Additionally, the use of a graphical interface decreases the amount of manual input making the service less demanding for users.

## REFERENCES

1. Adler, R. (2007). Health care unplugged: The evolving role of wireless technology. *California HealthCare Foundation*.
2. Anhoj, J., & Moldrup, C. (2004). Feasibility of collecting diary data from asthma patients through mobile phones and SMS (short message service): response rate analysis and focus group evaluation from a pilot study. *Journal of Medical Internet Research*, 6(4).
3. Berdichevsky, D., & Neuenschwander, E. (1999). Toward an ethics of persuasive technology. *Commun. ACM*, 42(5), 51–58.
4. Berscheid, E., & Walster, E. H. (1983). *Interpersonal attraction*. Random House.
5. Bickmore, T., Giorgino, T., & Picard, R. (2006). Guest editorial: special issue on dialog systems for health communication. *Journal of Biomedical Informatics Elsevier*, 39, 465–467.
6. Bickmore, T. W., Caruso, L., Clough-Gorr, K., & Heeren, T. (2005). "It's just like you talk to a friend" Relational agents for older adults. *Interacting with Computers*, 17(6), 711–735.
7. Bickmore, T. W., & Picard, R. W. (2005). Establishing and maintaining long-term human-computer relationships. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 12(2), 327.
8. Chatterjee, S., & Price, A. (2009). Healthy living with persuasive technologies: Framework, Issues, and Challenges. *Journal of the American Medical Informatics Association*, 16(2), 171.
9. Cialdini, R. B. (2004). The science of persuasion. *Scientific American Mind*, 14(1), 70–77.
10. Clarke, B. Models of Behavior Change. *Rural Health Institute*. Retrieved from [http://srdc.msstate.edu/02health/pdfs/clarke\\_models.pdf](http://srdc.msstate.edu/02health/pdfs/clarke_models.pdf)
11. Consolvo, S., McDonald, D. W., & Landay, J. A. (2009). Theory-driven design strategies for technologies that support behavior change in everyday life. In *Proceedings of the 27th international conference on Human factors in computing systems* (pp. 405–414).
12. Denison, J. (1996). Behavior change—A summary of four major theories. *Arkington: Family Health International/AIDSCAP*. Retrieved from <http://www.fhi.org/en/aids/aidschap/aidspubs/behres/bcr4theo.html>
13. Dunia, D. (2010). Breathing Exercise Benefits. Retrieved from <http://doctorsdunia.in/breathing-exercises-benefits/>
14. Education, M. M. F. F. M., & Research. (2009). Stretching: Focus on flexibility. Retrieved from <http://www.mayoclinic.com/health/stretching/HQ01447>
15. Elder, J. P., Ayala, G. X., & Harris, S. (1999). Theories and intervention approaches to health-behavior change in primary care. *American Journal of Preventive Medicine*, 17(4), 275–284.
16. Etzioni, A. (2000). Social norms: Internalization, persuasion, and history. *Law & Soc'y Rev.*, 34, 157–178.

17. Feng, J., Lazar, J., & Preece, J. (2004). Empathy and online interpersonal trust: A fragile relationship. *Behaviour and information technology*, 23(2), 97–106.
18. Fogg, B. J. (2002). Persuasive technology: using computers to change what we think and do. *Ubiquity*, 3(44).
19. Fogg, B. J. (2009a). Creating persuasive technologies: an eight-step design process. In *Persuasive '09: Proceedings of the 4th International Conference on Persuasive Technology* (Vol. 350, pp. 1–6). New York, NY, USA: ACM.
20. Fogg, B. J. (2009b). The Behavior Grid: 35 ways behavior can change. In *Persuasive '09: Proceedings of the 4th International Conference on Persuasive Technology* (Vol. 350, pp. 1–5). New York, NY, USA: ACM.
21. Fogg, B. J. (2009c). A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology*. New York, NY, USA: ACM.
22. Fogg, B. J. (2009d). The new rules of persuasion. *RSA Journal*, Summer 2009.
23. Fogg, B. J., & Adler, R. (2009). *Texting 4 Health: A simple powerful way to change lives*. Stanford, CA: Captology media.
24. Fogg, B. J., & Allen, E. (2009). 10 uses of texting to improve health. In *Persuasive '09: Proceedings of the 4th International Conference on Persuasive Technology* (Vol. 350, pp. 1–6). New York, NY, USA: ACM.
25. Fogg, B. J., & Nass, C. (1997). Silicon sycophants: the effects of computers that flatter. *International Journal of Human-Computers Studies*, 46(5), 551–561.
26. Fox, K. R. (2007). The influence of physical activity on mental well-being. *Public Health Nutrition*, 2(3a), 411–418.
27. Franklin, V. L., Waller, A., Pagliari, C., & Greene, S. A. (2006). A randomized controlled trial of Sweet Talk, a text-messaging system to support young people with diabetes. *Diabetic Medicine*, 23(12), 1332–1338.
28. Gasser, R., Brodbeck, D., Degen, M., Luthiger, J., Wyss, R., & Reichlin, S. (2006). Persuasiveness of a mobile lifestyle coaching application using social facilitation. *Lecture notes in computer science*, 3962, 27.
29. Ham, J., Midden, C., & Beute, F. (2009). Unconscious Persuasion by Ambient Persuasive Technology: Evidence for the Effectivity of Subliminal Feedback. In *Proceedings of the Persuasive Technology and Digital Behaviour Intervention Symposium*.
30. Healing, H. O. (2008). Benefits of Stretching. Retrieved from <http://heartofhealing.net/relaxation-wellness/stretching/benefits-of-stretching/>
31. IJsselsteijn, W., de Kort, Y., Midden, C., Eggen, B., & van den Hoven, E. (2006). Persuasive technology for human well-being: setting the scene. *Lecture Notes in Computer Science*, 3962, 1–5.

32. Intille, S. S. (2004). A new research challenge: persuasive technology to motivate healthy aging. *IEEE Transactions on information technology in Biomedicine*, 8(3), 235–237.
33. Kelly, C. (1987). "To Persuade without Convincing": The Language of Rousseau's Legislator. *American Journal of Political Science*, 31(2), 321–335.
34. Kleiboer, A., Sorbi, M., Mérelle, S., Passchier, J., & van Doornen, L. (2009). Utility and Preliminary Effects of Online Digital Assistance (ODA) for Behavioral Attack Prevention in Migraine. *Journal of Telemedicine and e-Health*, (0), 1–9.
35. Lacroix, J., Saini, P., & Goris, A. (2009). Understanding user cognitions to guide the tailoring of persuasive technology-based physical activity interventions. In *Proceedings of the 4th International Conference on Persuasive Technology* (pp. 1–8).
36. Lee, K. M., & Nass, C. (2003). Designing social presence of social actors in human computer interaction. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 289–296). New York, NY, USA: ACM.
37. Lockton, D., Harrison, D., & Stanton, N. (2008). Design with intent: Persuasive technology in a wider context. *Lecture Notes in Computer Science*, 5033, 274.
38. Nass, C., & Moon, Y. (2000). Machines and mindlessness: Social responses to computers. *Journal of Social Issues*, 56(1), 81–103.
39. de Oliveira, R., & Oliver, N. (2008). TripleBeat: enhancing exercise performance with persuasion. In *Proceedings of the 10th international conference on Human computer interaction with mobile devices and services* (pp. 255–264).
40. Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, 18(2), 189.
41. Rimer, B. K., & Kreuter, M. W. (2006). Advancing tailored health communication: A persuasion and message effects perspective. *Journal of Communication*, 56(s1), S184–S201.
42. Ritterband, L. M., Thorndike, F. P., Cox, D. J., Kovatchev, B. P., & Gonder-Frederick, L. A. (2009). A behavior change model for Internet interventions. *Annals of Behavioral Medicine*, 1–10.
43. Rodgers, A., Corbett, T., Bramley, D., Riddell, T., Wills, M., Lin, R. B., & Jones, M. (2005). Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *British Medical Journal*, 14(4), 255.
44. Sarasohn-Kahn, J. (2010). Changing Health Care for Consumers and Providers.
45. Scott, E. (2009). Breathing Exercises for Stress Relief. Retrieved from [http://stress.about.com/od/tensioamers/a/Breathing\\_Ex.htm](http://stress.about.com/od/tensioamers/a/Breathing_Ex.htm)
46. Sohn, M., & Lee, J. (2007). UP health: Ubiquitously persuasive health promotion with an instant messaging system. In *CHI'07 extended abstracts on Human factors in computing systems* (pp. 2663–2668). New York, NY, USA: ACM.



47. Sorbi, M. J. (2009). User acceptance of an internet training for migraine self-management. *Journal of Telemedicine and Telecare, in press.*
48. Sorbi, M. J., Mak, S. B., Houtveen, J. H., Kleiboer, A. M., & van Doornen, L. J. (2007). Mobile Web-based monitoring and coaching: feasibility in chronic migraine. *Journal of Medical Internet Research, 9*(5).
49. Spencer-Oatey, H. (1996). Reconsidering power and distance. *Journal of Pragmatics, 26*(1), 1-24.
50. Starks, E. (2010). Breathing Exercise Benefits. Retrieved from [http://www.ehow.com/about\\_5207953\\_breathing-exercise-benefits.html](http://www.ehow.com/about_5207953_breathing-exercise-benefits.html)
51. Thompson, J. (2010). Smartphone usage set to rocket to 1.7 billion by 2014. Retrieved from <http://www.independent.co.uk/news/business/news/smartphone-usage-set-to-rocket-to-17-billion-by-2014-1955258.html>
52. Tryhorn, C. (2009). Mobile phone use passes milestone as UN report reveals global growth. Retrieved from <http://www.guardian.co.uk/technology/2009/mar/03/mobile-phones1>
53. Tseng, S., & Fogg, B. J. (1999). Credibility and computing technology. *Communications of the ACM, 42*(5), 44.

## APPENDIX

### 1. EXPERIMENT INVITATION



#### Wat is dit voor een onderzoek?

Het onderzoek heeft de ambitie om mensen te helpen *gezonder* te leven. Vaak zijn we zo druk met van alles en nog wat dat we ons zelf daarbij vergeten. Dit kan leiden tot allerlei ongezonde spanningen en stress. Het is daarom van belang om geregeld de tijd te nemen om even tot jezelf te komen en *nieuwe energie op te doen*.

#### Wat houdt het in?

Voor drie weken krijgt u elke dag een bericht toegestuurd op uw telefoon met daarin een korte rekoefening. De bedoeling is dat je deze oefening, welke rond de *20 seconden* in beslag neemt, uitvoert en uw bevindingen terugstuurt via SMS.

*De oefeningen worden op uw persoonlijke situatie toespitst!*

**Voorbeeld oefening:** *Houd uw armen langs uw lichaam en rek uw vingers 10 keer volledig maar rustig.*



Universiteit Utrecht

#### Waarom zou u meedoen?

De oefeningen

- ontspannen de spieren en verminderen daarmee opgebouwde stress
- verlengen de spieren wat leidt tot een verhoogde flexibiliteit.
- verhogen het energiepeil door een verbeterde bloedcirculatie

#### Wat moet u weten?

De oefeningen zijn *eenvoudig* en kunnen *onopvallend* uitgevoerd worden.

Het contact zal via *SMS* plaatsvinden en daarom is *ervaring* met SMS en het *terugsturen* van een dagelijks bericht *vereist!*

Het onderzoek brengt *geen extra kosten* met zich mee, naast de standaard kosten voor het versturen van een SMS.

Wilt u meedoen? **Stuur dan een SMS naar**

Name and phone number

## 2. EXPERIMENT PROGRAM STRUCTURE

| Week 1               | <i>Perform the behaviour each day</i>  |   |  |   |   |  |
|----------------------|--|---|--|---|---|--|
|                      | <b>Monday</b>  | <b>Tuesday</b>  | <b>Wednesday</b>   | <b>Thursday</b>   | <b>Friday</b>   | <b>Weekend</b>   |
| <i>Exercise</i>      | Finger stretch   | Neck glides   | Neck twist   | Wrist circles   | Wrist flexion   | Exercises of the week each day   |
| <i>Illustration</i>  | Rest your arm along next to your body and stretch your fingers fully but slow.                     | Glide your head back as far as it will go keeping head and ears level.  | Turn head to one side slowly then to the other side.   | Make slow circles with a light fist while resting your forearm on your thigh. | Bend your wrist with your other hand having your arms stretched until you feel a stretch in your wrist. | Perform one exercise each day of the exercises that are performed this week. |
| <i>Goal</i>          | Introduction exercise for fingers  | Regular exercise for neck   | Regular exercise for neck.   | Regular exercise for wrist  | Regular exercise for wrist  | Continue behaviour in weekend and set goal for the weekend                   |
| <i>Extra message</i> | What is your view on a lifestyle where you take moment for yourself to reduce stress and pressure? | The exercises in the program are simplistic, do not take much of your time and have been reviewed by an expert. | As you have had one exercise in the morning and one in the afternoon, the goal of today will be to find an appropriate time to perform your exercises. | Perform the stretching exercises slowly and in a smooth motion.               |   |  |
| <i>Goal</i>          | Initial attitude measurement   | Influence self-efficacy<br><br>Authority notice   | Discover appropriate time  | Recommendation on the execution of the exercises                              |   |  |

| Week 2               | <i>Extend behaviour with breathing focus</i>                         |   |  |  |  |         |
|----------------------|--|---|--|--|--|---------|
|                      | Monday   | Tuesday   | Wednesday  | Thursday   | Friday   | Weekend |
| <i>Exercise</i>      | Finger stretch with breathing  | Neck glides with breathing  | Neck twist with breathing  | <i>No message or exercise</i>                              | Wrist flexion with breathing   |         |
| <i>Illustration</i>  | Perform the finger stretch exercise and focus yourself on breathing. | Perform the neck glide exercise and focus yourself on breathing.              | Perform the neck twist exercise and focus yourself on breathing.                                   | -  | This exercise will complete this week's goal. Perform the wrist flexion exercise and focus your breathing. |         |
| <i>Goal</i>          | Extend behaviour with breathing                                      | Extend behaviour with breathing   | Extend behaviour with breathing  | Remind user of own responsibility to perform the behaviour | Extend behaviour with breathing<br><br>Remind user of goal and achievement                                 |         |
| <i>Extra message</i> | Our goal is to perform the behaviour the entire week.                | What is your and your environments attitude towards performing the behaviour? | Stretching, when performed properly, relaxes tense muscles that are often accompanied with stress. |  | Have you performed the behaviour yesterday without regular message?  |         |
| <i>Goal</i>          | Set goal for the week  | Measure intention   | Increase awareness   |  | Cue to action  |         |

| Week 3               | <i>Extend behaviour with body awareness</i>   |   |  |  |  |   |
|----------------------|---|---|--|--|--|---|
|                      | Monday  | Tuesday   | Wednesday  | Thursday   | Friday   | Weekend   |
| <i>Exercise</i>      | Finger stretch with body awareness pt.1   | Finger stretch with body awareness pt.2   | Neck glides with body awareness  | Neck twist with body awareness   | Perform favourite exercise   |   |
| <i>Illustration</i>  | In addition to the finger stretch exercise, stretch one hand alternately more than the other. | Stretch your finger and one for one move your fingers towards each other.                   | Relax your shoulders and perform the neck glide exercise. Stretch a bit further after each repetition. | Relax your shoulders and perform the neck twist exercise. Stretch a bit further after each repetition. | Perform your favourite exercise and reply which one it is.                       |   |
| <i>Goal</i>          | Extend behaviour with body awareness  | Extend behaviour with body awareness  | Extend behaviour with body awareness   | Extend behaviour with body awareness   | Discover favourite exercise  |   |
| <i>Extra message</i> |   | Try to get the most out of each exercise, only then will the total program have its effect. |  |  | A healthy lifestyle is anticipated by many, so be proud of your accomplishments. | As you have participated in this research I would like to ask you to fill in the questionnaire. |
| <i>Goal</i>          |   | Increase attention to each exercise   |  |  | Praise the user for the performed behaviour                                      | Collect experiment data   |

### 3. QUESTIONNAIRE

*Opmerking: De antwoordtypes Positief/Negatief en Eens/Oneens zijn op een 5 punt Likert-schaal.*

| <b>Algemene vragen</b>  |                      |
|---|----------------------|
| <i>Vraag</i>  | <i>Antwoord type</i> |
| Als de SMS-dienst vernieuwd zou worden, wat moet er dan behouden blijven in de nieuwe versie?   | Open                 |
| Als de SMS-dienst vernieuwd zou worden, wat zou er dan verbeterd kunnen worden?   | Open                 |
| <b>Persoonlijk/Levensstijl</b>  |                      |
| <i>Vraag</i>  | <i>Antwoord type</i> |
| Hoe staat u direct na het onderzoek tegenover een levensstijl waarbij u momenten voor uzelf neemt om druk en stress te reduceren?               | Open                 |
| Hoe zal dat uitgedrukt zijn op de aangegeven schaal?  | Positief/Negatief    |
| Hoe staat uw omgeving tegenover deze levensstijl?   | Positief/Negatief    |
| Welke invloed had uw omgeving op u tijdens het onderzoek?   | Positief/Negatief    |
| Voorafgaand aan het onderzoek had ik al een fysiek actieve levensstijl  | Eens/Oneens          |
| Voorafgaand aan het onderzoek voerde ik al soortgelijke oefeningen uit  | Eens/Oneens          |
| Ik was voor het onderzoek op de hoogte van de gevaren van druk en stress op mijn lichaam  | Eens/Oneens          |
| Ik ben na het onderzoek op de hoogte van de gevaren van druk en stress op mijn lichaam  | Eens/Oneens          |
| Ik was voor het onderzoek op de hoogte van de voordelen van een levensstijl waarbij ik momenten voor mezelf neem om druk en stress te reduceren | Eens/Oneens          |
| Ik ben na het onderzoek op de hoogte van de voordelen van een levensstijl waarbij ik momenten voor mezelf neem om druk en stress te reduceren   | Eens/Oneens          |
| Ik probeer graag nieuwe technologie uit   | Eens/Oneens          |
| Ik ben gemotiveerd om oefeningen uit te voeren die lichamelijke gezondheid kunnen verbeteren  | Eens/Oneens          |
| <b>Oefeningen</b>   |                      |
| <i>Vraag</i>  | <i>Antwoord type</i> |
| Het effect van de oefeningen was positief   | Eens/Oneens          |
| De duur van de oefeningen stond mij tegen bij het uitvoeren van de oefening   | Eens/Oneens          |
| De oefeningen waren onduidelijk uitgelegd (reverse)   | Eens/Oneens          |

|   |                      |
|---|----------------------|
| De oefeningen waren onopvallend uit te voeren                     | Eens/Oneens          |
| Het type oefeningen paste niet bij mij (reverse)                  | Eens/Oneens          |
| De oefeningen waren eentonig (reverse)                            | Eens/Oneens          |
| De oefeningen waren eenvoudig uit te voeren                       | Eens/Oneens          |
| De oefeningen boden geen uitdaging (reverse)                      | Eens/Oneens          |
| De wekelijkse opbouw in de aard van de oefening was merkbaar      | Eens/Oneens          |
|   |                      |
| <b>Berichten</b>  |                      |
| <i>Vraag</i>  | <i>Antwoord type</i> |
| De aanspreekvorm in de berichten was gepast                       | Eens/Oneens          |
| De inhoud van de berichten was duidelijk                          | Eens/Oneens          |
| De begroeting in de berichten sprak mij aan                       | Eens/Oneens          |
| Ik vond de begroeting in de berichten statisch (reverse)          | Eens/Oneens          |
| Het tijdstip van de berichten gaf de oefening meer effect         | Eens/Oneens          |
| Ik voerde de oefening direct uit na het lezen van het bericht     | Eens/Oneens          |
| Het aantal berichten per dag stond mij tegen (reverse)            | Eens/Oneens          |
|   |                      |
| <b>Doelen</b>   |                      |
| <i>Vraag</i>  | <i>Antwoord type</i> |
| De opgestelde doelen waren voor mij duidelijk                     | Eens/Oneens          |
| Ik vond de opgestelde doelen haalbaar (niveau/ uitvoerbaarheid)   | Eens/Oneens          |
| Ik was actief met mijn weekdoelen bezig                           | Eens/Oneens          |
| Ik was actief met mijn weekenddoel bezig                          | Eens/Oneens          |
| Het opgezette doel zette mij ertoe om oefeningen uit te voeren    | Eens/Oneens          |
| Ik miste een bericht om een oefening uit te voeren in het weekend | Eens/Oneens          |
|   |                      |
| <b>Website</b>  |                      |
| <i>Vraag</i>  | <i>Antwoord type</i> |
| Ik vond de website van toegevoegde waarde voor de service         | Eens/Oneens          |
| Ik hield de opgestelde doelen bij                                 | Eens/Oneens          |

|  |                      |
|--|----------------------|
| Ik hield mijn progressie en uitgevoerde oefeningen bij   | Eens/Oneens          |
| De website van de dienst had een toegevoegde waarde voor het bijhouden van mijn opgestelde doelen                    | Eens/Oneens          |
| De website van de dienst had een toegevoegde waarde voor het bijhouden van mijn progressie en uitgevoerde oefeningen | Eens/Oneens          |
| De website kan op langere termijn meerwaarde kunnen bieden voor de dienst  | Eens/Oneens          |
|  |                      |
| <b>Dienst</b>  |                      |
| <i>Vraag</i>   | <i>Antwoord type</i> |
| Het gebruik van de mobiele telefoon sprak mij aan in dit onderzoek   | Eens/Oneens          |
| De informatie in de dienst was op mijn persoonlijke situatie afgestemd   | Eens/Oneens          |
| De oefeningen in de dienst waren op mijn persoonlijke situatie afgestemd   | Eens/Oneens          |
| Ik voelde mij niet door de dienst gedwongen oefeningen uit te voeren (reverse)                                       | Eens/Oneens          |
| De dienst bood mij sociale ondersteuning bij het veranderen van mijn levensstijl                                     | Eens/Oneens          |
| Ik voel mezelf niet afhankelijk van de dienst om door te gaan met het veranderen van mijn levensstijl (reverse)      | Eens/Oneens          |
| Ik vond de interactie met de dienst prettig  | Eens/Oneens          |
| Ik zou de dienst willen blijven gebruiken  | Eens/Oneens          |
| Ik ga de verandering in levensstijl doorvoeren na dit onderzoek  | Eens/Oneens          |
| Ik blijf de oefeningen uitvoeren na het onderzoek  | Eens/Oneens          |
| Als ik de kwaliteit van de dienst een cijfer mocht geven was het een   | 1-10                 |
| Overige opmerkingen over de dienst   | Open                 |