A Quasi-Experimental Exploration of the Effects of the Mobile-App “Heia meg” on Motivation to Change Exercise Behavior and Dietary Intake

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Abstract:

Background: This thesis explored the effects of a lifestyle-change mobile application developed by Helsedirektoratet named "Heia meg". The app targets five different behaviors for lifestyle improvement. This study explored the effect on improved dietary intake and increased exercise. The app delivered messages and suggestions intended to encourage and motivate the user.

Participants: The participants were recruited by offering them to participate immediately after they had downloaded the app (independently) by receiving a link in the app. They were informed that they would be contacted again and asked to undergo the survey again after 30 days. There was a total of 256 submissions, of these were 208 submissions for the first round and 48 submissions for the second round. There was a total of 15 participant for the baseline and posttest for exercise and 13 participants for healthy eating. These were the participants that completed the same survey at two times with a 30 day interval.

Design: The study consisted of a pretest posttest quasi-experimental design with a baseline survey, and a posttest survey after the participants had received the intervention for 30 days. The survey attempted to map the participants level of motivation to change a health-related behavior using the transtheoretical model of change questionnaire. The participants were scored on the stages of readiness to change. There was an even distribution between the target behaviors.

Results: An independent *t*-test yielded statistically significant differences for the action stage for the dietary intake group. A paired *t*-test yielded statistically significant differences for the action stage for dietary intake.

Conclusion: The results implies that the "Heia Meg"-app may have had an effect in increasing motivation to improve dietary intake over a course of 30 days. This study adds to the field of mHealth and the promising possibilities of this field.

*This theses has followed the guidelines of the APA 7th manual.

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Introduction

As we enter a new decade, it is important to reflect upon the known issues that our society will battle within the foreseeable future. Lifestyle and habits have become an increasingly important variable for predicting health, and there are many forms of behaviors that come into play (Forouzanfar et al., 2016). Lifestyle choices such as diet, exercise, alcohol and cigarette use have enormous effect on health and quality of life, and they are all seemingly behaviors that individuals chose whether or not to engage in (Forouzanfar et al., 2016).

Since the 1960s, the obesity epidemic has steadily grown and has become the cause of an enormous amount of health issues all around the world. In later years, data is showing that the obesity epidemic is affecting developing countries, and the consequences are dire (Popkin & Doak, 1998). According to the World Health Organization 41 million people die every year due to noncommunicable diseases. This is equivalent to 71 % of all deaths around the world and at least 2.8 millions of these deaths are a result of overweight and obesity (WHO, 2018).

Diet and exercise both affect obesity, and individuals and societies alike are struggling to meet the recommended requirements to uphold a healthy lifestyle (Jebb & Moore, 1999; Young & Nestle, 2002).

So how should we attempt to tackle these challenges in this modern and technology-infested era? Perhaps part of the answer is to "get on the wave" and work with, and through, the technological advancements. This thesis will explore the role of health interventions through mobile-apps, a field called mHealth, and attempt to explain how mHealth can be a part of a solution for the challenges our society is facing. Even though mHealth is a broad term that entails many forms of health-behaviors, this thesis will be narrowed down to focus on diet and exercise, as these was the variables in the experiment.

The thesis has used several well established health models including the theory of planned behavior and the health action process approach, and it will include Prochaska and DiClemente's stages of change-questionnaire from the transtheoretical model and the stages of change to give scores and categorize the participants (Ajzen, 1991; Prochaska et al., 1992; Schwarzer & Luszczynska, 2008). This project could provide a useful contribution regarding the development of successful behavior change-apps, and particularly those targeting different stages of motivation. Given that we find differences between the groups, it may shed light on how these interventions should be designed to have the broadest impact.

This study has attempted to measure a possible motivational change through the use of an mHealth application called "Heia meg" developed by Helsedirektoratet.

The "Heia Meg" Application

The application for this research project, "Heia Meg", was developed by Helsedirektoratet in collaboration with the TRY company, and the app has a background from the UKs similar web-based intervention called "One you" (2019). The foundation of the project is based on the assumption that motivation influence behavior change, and the intervention is designed in a manner that intends to be supportive in a non-direct way (Opinion, 2019: unpublished). Helsedirektoratet has additionally internally conducted both qualitative and quantitative research prior to the development of the "Heia meg" app (Opinion, 2019: unpublished). The qualitative interviews were conducted to try to shed light upon what the participants felt was the most important aspects of behavior-change, and the barriers most important to overcome. The quantitative research was conducted through surveys to establish the common obstacles and needs. A find in the research was that approximately half of the participant reported that they wished to succeed on their own regarding behavior change, and that 17 % reported that support from family and friends were important (Opinion, 2019: unpublished).

Figure 1

Screenshot from app

The target for the intervention is thus to encourage the participant to focus on intrinsic motivation for behavior change, and provide tools to overcome barriers in the form of information by being directed to Helsenorges webpages.

Once the app "Heia meg" has been downloaded one is asked to agree to the terms of use, followed up by being asked to choose one or two out of five behaviors to focus on. The behaviors to choose from are exercise, dietary intake, smoking, alcohol consumption, and mental health. After the participants make their decision, they are regularly receiving messages from the app. The participants will receive a message on their phone saying "you have a new message from Heia meg/Du har fått en ny melding fra Heia Meg". The messages consist of useful tips, encouraging messages, and facts regarding the target behavior. The messages are in Norwegian, and follow Norwegian grammar rules. Except from the first welcoming message, the messages usually consist of one to three

sentences that has a total of less than 50 words. They do not include smiles, emoji's, or textese (example, BRB, LOL, TBH).

The participant would only be included if they chose exercise or dietary intake as one of their target behaviors within the app. This was decided after carefully considering all the five target behaviors in the app. After considerations it was concluded that mental health is a complex and covert behavior that requires a different form of measurement than how the other behaviors would be measured. It also varies greatly to dietary intake and exercise regarding measuring motivation. Alcohol consumption and smoking are behaviors that are often considered more sensitive information, and poses ethical issues when asking participant to answer questions regarding how they feel about their drinking and smoking behavior. While these question are also relevant for the remaining behaviors, it is probable that excluding them will be experienced as less intrusive for the participants.

Figure 2.

Screenshot from app

The ethical considerations for this research project are mostly concerned with the acquiring of personal data. Since the experiment will compare the subjects baseline their own posttest, an identification number was necessary to acquire. The identification number was the participant own phone number, but this information was to be anonymised during data analysis. Therefor the participants would not be anonymous, but the data will be protected, anonymized and stored for 5 years, and then deleted.

Another ethical consideration was informed consent, and the participant was informed of the purpose of the study, the storing of their data, and that they may withdraw their consent at any time. They must have read the informed consent-file, and sign that they have read and understood the purpose of the project, and how their participation will be used.

Helsedirektoratet owns the project and are interested in developing new knowledge on the topic, as well as receiving an indication of the effectiveness of their app. This study was not a direct form of effect-evaluation, but may give insights regarding the appropriate target population.

mHealth

mHealth, or mobile health, is a relatively new field with broad possibilities for a positive impact that additionally has the ability to reach a large number of people in a cost-effective way. mHealth is traditionally used on smartphones, and during the last decade there has been developed an enormous amount of applications for smartphones that targets a variety of different types of life-style change. There are several studies that has found promising results of the effect of smartphone interventions (Gordon et al., 2017; Norman et al., 2013; Partridge et al., 2017). Most of the apps developed to aid lifestyle change are targeting a change in behavior, like a reduction in smoking or increased intake of fruit and vegetables.

The value of such apps can be connected to the reduction of risk factors such as smoking or obesity, and these have a long-term impact on the cost to the health system (Aitken et al., 2017). This project has narrowed the focus to mobile health specifically, and investigate one specific mobile app. However, the literature on mHealth interventions was still limited due to the new nature of this format, and thus some other digital interventions have been included in the literary review. Digital health-interventions as a whole has become a big marked, and there are a variety of platforms such as web-based, phone-based and mobile-based. eHealth interventions are electronic, and often computer based. This is a similar format as they both take place digitally and include limited-to-none human interaction.

There are a large variety of apps available, and within mHealth they can generally be categorized into two sectors. There first sector is called "wellness management", which was the focus of this research project, and these apps facilitate tracking and modification of fitness behaviors, stress, lifestyle and diet. Tracking devises have gained a wide popularity, with devises like "fitbits" being collaborated with the wellness apps. The development of sensors such as these fitness trackers, heart rate-monitors et cetera gives the user data to monitor their progress and gives specific behavior-oriented feedback (Aitken et al., 2017).

The other category within mHealth is commonly referred to as "health condition management", and these types of apps supply information on disease and specific medical conditions, and may enable access to care and treatment protocols such as medication reminders (Aitken et al., 2017). In the early development of mHealth apps there were a majority of "wellness management" apps. However, there has been an increase in "health condition management" in the later years. According to Aitken et al. (2017) report, mental health is usually categorized within the health condition management sector, and it is also the most common focus for disease-specific apps, often being treated with augmentative and alternative communication (AAC). These apps usually address problems such as depression,

anxiety and ADHD. This was an interesting find considering "mental health" has been included in the "Heia meg"-app, despite the fact that the remaining behaviors in the app would traditionally fall into the "wellness management" group. However, that should not be interpreted as to overlook the potential for mHealth app that focus on mental health specifically. Suicide prevention interventions are an incredibly important need, as suicide-rates continue to increase in the USA (Dickter et al., 2019). mHealth can be a valuable part of treatment options. An example of this can be seen in one study attempting to map the effect of an internet based depression prevention intervention called CATCH-I with promising results. The participants consisted of young people ranging between the ages of 14-21. They found that suicide contemplation decreased during the intervention with a moderate effect for full completion of the program (Dickter et al., 2019).

As previously mentioned, there has already been conducted a fair amount of experimental studies evaluating the effects of both wellness management apps and health condition management targeting the same behaviors as the "Heia meg" app. It is perhaps especially interesting to investigate how app-interventions compare to traditional face-to-face interventions. In a systematic review of digital interventions for increasing exercise in adolescents it was found that digital interventions could produce small but significant increases in exercise, and that they were most effective when combined with face-to-face contact (Rose et al., 2017). Goal setting and self-monitoring were common components of digital interventions, and the two elements appeared to be most effective when paired. The review additionally found some evidence that website interventions can affect diet and exercise behavior-change among adolescents. However, these changes are often not sustained in the medium or long term. This may be partially due to the variability in engagement with interventions (Rose et al., 2017). The authors concluded that there is a lack of evidence for other digital approaches to behavior change, including text messages, email, smartphones, and social media. Despite these gaps, this review showed that particular intervention features, mainly health education, goal setting, self-monitoring, and when targeting to specific populations, can lead to improved diet and exercise behaviors in adolescents (Rose et al., 2017).

Podina and Fodor (2018) argue that a multicomponent behavioral intervention with two or three behavior change-techniques is a gold standard. They evaluated 5 e-health meta analyses on weight management that indicated that they were adequate for weight management. They concluded that it was important to separate weight loss, weight

maintenance and weight gain prevention, which they argued was a flaw with some of the previous meta-analyses (Podina & Fodor, 2018).

Dowd et al. (2018) created a prototype app to assist in self-management of the dietary regulated celiac disease. They received feedback that the app should include healthy gluten free recipes, price information, and lists of recommended foods. The app should also be easy to use, and have a function to track symptoms and cooking tips. This is applicable to general mHealth regarding dietary change. Using mHealth apps for assisting self-management of dietary behavior is desirable to the participants, and "Heia meg" includes many of the described items (Dowd et al., 2018).

In a study looking at college student's preferences in health and lifestyle apps, it was found that 40 % of the participants already used at least one of these apps. The authors additionally concluded that the participant preferred health and lifestyle apps that used statements, emoticons, single explanation marks, and capitalization. In other words, following basic grammatical rules were preferred. The messages should be non-directive, positive not include textese and have length (Heron et al., 2019).

Gianluca et al. (2014) argues there are five components that must be considered to achieve quality technological weight-loss interventions. Those are self-monitoring, consular feedback and communication regarding goals, progress and results, and social support by creating a community in the app, structured programs with incorporated behavior change principles, and individually tailored programs. Technological weight-loss interventions that incorporate these strategies are traditionally more successful.

One of the benefits of using app-interventions is that it is easily available. Ebert et al. (2018) concluded that low treatment rates are not a result of treatment not being available, but simply that the treatment and medication offered is simply not being used. Thus, app-interventions can be effective when people do not have easy access to face-to-face treatment or are not able to attend opening hours, and additionally when people prefer to avoid face-to-face interactions (Ebert et al., 2018). The authors also concluded that both face-to-face cognitive behavior therapy (CBT) paired with digital cognitive behavioral therapy together gives better results than both interventions alone. A possible explanation for why digital interventions shows such promising results may be the trend of a stronger emphasis on self-empowerment. The apps often focus on the user increasing their self-management competencies. However, digital interventions should be seen less as a substitute for conventional psychotherapeutic interventions, and rather be seen as a supplement to the treatment spectrum (Ebert et al., 2018).

The availability of technological devices has increased enormously. While deceives such as cell phones were previously associated with people of high income, now 95 % of the Norwegian population has a smartphone according to SSB (2019). However, even though smartphones are accessible to most, it is still important to question whether mHealth interventions are applicable to most. One study noted that low-income and minorities has had little involvement in the development of mHealth apps. An app was developed specifically for a test-group in Harlem, a traditionally low-income community in the United States (Vangeepuram et al., 2018). They created an app to attempt to help the participants to improve their health. They found that those that had graduated high school were seven times as likely to use a mHealth app than those whom had not. They concluded that health apps are desired in low-income communities, and that they should be specifically tailored to their needs (Vangeepuram et al., 2018).

One of the great advantages of mHealth is that it is cost effective and can reach a lot of people. In a study by Materia et al. (2018) they redeveloped the “strong healthy woman”-intervention (SHW) into a smartphone app that delivered a supplement of the intervention. The SHW intervention was developed for women that were preconceptional with obesity. The areas of focus were exercise, dietary intake , stress and weight management. They conducted focus group interviews and found that the women preferred an app, text or mobile websites for communications, educational materials and surveys. The authors concluded that mHealth apps can be a valuable to incorporate to face-to-face intervention (Materia et al., 2018).

However, even though there are studies that show us that it’s entirely possible to developed lifestyle changing apps that are empirically evaluated and show effect, one must also consider if this is the actual representation of the marked. In a study by Paige et al. (2018) they examined how the transtheoretical models processes of change and mHealth literacy strategies were employed in mobile smoking cessation apps. With a sample of 100 apps available on iTunes they found that over half of the apps included seven (78 %) processes of change. Fewer included self-liberation (36 %) and reinforcement management (34 %). They additionally found that it was common with plain language and that few apps had usability and interactive strategies.

Paige et al. (2018) proposed to include plain language, usability principles and interactive features in the apps to increase likelihood of usage and behavior change. The authors proposed that apps should not limit interaction with other users. Despite this user ratings may not have been influenced by the theoretical basis or usability of apps. Paige et al. (2018) additionally, found that users were less likely to download apps that required payment.

Interactive apps help users overcome boredom and frustration that have detrimental effects of technology-based learning.

There have been conducted a fair amount of studies on the quality of smoking cessation apps, and the results are consistent in that to the larger degree an app follows empirically tested methods for behavior change such as ACT and other clinical practice guidelines, the more successful the users were in achieving smoking cessation (Abroms et al., 2013; Abroms et al., 2011; Bricker et al., 2014; Zeng et al., 2016).

The advantages with smoking cessation apps were found to be availability, having a visually-engaging design, video and audio capacities, unrestricted text capabilities, access without cellular or internet connection, immediate access to intervention content, optimized to smartphone screen size, content shareable via social media, tracking progress anywhere and anytime (Bricker et al., 2014).

While these are finds specific for smoking cessation apps, there seem to be the same tendencies for exercise wellness apps as well (Voth et al., 2016). There is a strong tendency for wellness apps to not be based on empiric research. The apps that did include effective behavior change techniques were associated with having a payment fee (Voth et al., 2016).

Theoretical background.

When studying behavior change one need to base it on theoretical models. As this thesis explores behavior change for groups of people theoretical models from social psychology and health psychology have been implemented to developed the method of the experiment. The theoretical foundation of this thesis was based on the principles from the transtheoretical model, the theory of planned behavior and the health action process approach (Ajzen, 1991; Prochaska et al., 1992; Schwarzer & Luszczynska, 2008).

There are some fundamental assumptions that separate these theories regarding behavior change. Theory of planned behavior (TPB) considers behavior change as a continuum while the transtheoretical model considers behavior change as something that evolves through stages. The health action process approach model can be considered as a hybrid between a continuum model and a stage model as it views behavior change both as a continuum and as something that goes through stages (Schwarzer & Luszczynska, 2008).

To determine which model one should use as a theoretical foundation for a study there are several factors to consider. Core questions to ask are which model can potentially best explain the variance in the dataset? – and which model could give the most insight to the causal mechanisms behind the behavior? – and will the model that forms the most specific predictions be the best model to develop an intervention (Schwarzer & Luszczynska, 2008)?

An important point that Schwarzer and Luszczynska (2008) argues is that all these health models and theories of behavior-change are built on construct that are created to attempt to establish an overview, and allow us to attempt to understand these very complex phenomena. Different theories may be well equipped to form models of explanation, but which model or theory that is the most efficient to use will be determined by the intentions of a study or intervention, as well as the research question. In other words, it may not be expedient to attempt to prove that either continuum models or stage models are all together the better choice, as these models are all created to provide tools to better understand behavior (Schwarzer & Luszczynska, 2008).

As Glanz et al. (2008) discuss, there does not exist one solitary single theory that can sufficiently explain the entirety of behavior change. It is simply a too complex phenomenon, and to obtain the most comprehensive understanding one should consider and utilize a mixture of the established theories. Behavior change is additionally a phenomenon that occurs over time and across different stages that entails both stability and changeability. It is also a fact that that a major part of the at-risk population is not ready for action, and action-oriented interventions will thus not be appropriate or effective for all (Glanz et al., 2008).

Considering all this, we will continue by looking at the approach and reasoning behind the methods of this study. There will be presented some general information about the transtheoretical model, the health action process approach, the theory of planned behavior, and how this experiment was developed using the principles of these theories.

This research project will attempt to explore to which degree the app "Heia meg" is suited to increase the users' motivation to change a behavior, and whether it is better equipped to do so for users in an earlier stage of changing a health-promoting behavior. Thus, it is advantageous to consider behavior change as something that occurs in stages to best be able to distinguish the participants into categories (Marcus et al., 1992).

The Transtheoretical Model

Some of the research from the early 90s had a tendency to look at the determinants of exercise with a two stage-model - inactive to active. This understanding led the researchers to try to facilitate change through a single determinant. Stage theory suggests that behavior change proceeds through multiple stages that are influence by different determinants and requires different interventions strategies (Glanz et al., 2008).

The transtheoretical model of change (TTM) was developed by the Rhode Island-group in the 80s. As previously mentioned, it is a stage-model and views behavior-change as

something that moves through stages. According to TTM, there are five different stages that an individual goes through during a change process (Prochaska et al., 1994).

The first stage is called precontemplation and consists of the individual not being aware or not caring about the negative consequences of their behavior. The individual does not intent to change their behavior within the following six months (Prochaska et al., 1992). The second stage is called contemplation, and during this stage the individual is reconsidering the behavior. The individual is aware that they have a problematic behavior or addiction, but there has not yet been made a commitment to change. It is common to stay in this stage for longer periods of time. An important part of this stage is weighing the positives and negatives of their problem-behavior. An individual would be placed in the contemplation stage if the person intends to change their behavior within the next 6 months (Prochaska et al., 1992). The third stage is called preparation. Preparation is a stage where there is both a behavior and intention criteria. The individual has decided to change and is planning strategies to achieve it. It is usually defined as planning to change within a month. It is common to have one failed attempt at changing in the past during this stage. Action is when the individual is overcoming their problem-behavior by altering their behavior, experiences or environment. This stage requires much time and energy from the individual (Prochaska et al., 1992). The fifth and final stage is maintenance, and the individual moves into this stage after being in the action-stage for approximately six months. This is a continuous stage that requires effort, but less so than action. There has also been proposed a sixth stage, termination, but this has been mainly empirically discredited and is very little used (Glanz et al., 2008; Prochaska et al., 1994). However, it is important to note that for some types of behaviors, termination is a useful term, for example if the behavior “putting on a seatbelt” has become a default action that its effortless, the term termination could be applicable. However, for other behaviors, such as for a recovering alcoholic there may always be a possibility to relapse thus there would rarely be achieved absolutely zero temptation to drink.

The transtheoretical models focus on intention as the core of behavior change and focus on the processes that leads up to a decision. The model considers emotions, cognitions and behavior, and there are three factors that influence which stage an individual is at in the TTM stage model. The first factor is called the Processes of Change, and according to TTM there are nine fundamental processes for change. There are some additional processes for certain types of behaviors such as for medication use. However, these were not applicable in this study. Which processes that are the most influential varies depending on which stage one is in (Prochaska & DiClemente, 1982).

The next factor is decisional balance, and that initials that the individual considers the advantages and disadvantages of changing their behavior. This balance will change across the different stages. A smoker in the precontemplation stage will likely experience more disadvantages for quitting than advantages. However, if that individual moves through he stages over to the action stage they would probably experience a majority of advantages by quitting.

The final factor that determines which stage an individual will be in is self-efficacy. The definition of self-efficacy originates from Bandura’s social-cognitive theory and is defined as “the self-confidence in one’s own capability to initiate and maintain a new behavior even if obstacles emerge” (Bandura, 1997).This factor can further be divided into different kinds of self-efficacy depending on whether it involves quitting or beginning a behavior, maintaining a new behavior, or start up again after a setback. According to Ochsner et al. (2013) one can assume that phase-specific self-efficacy demonstrates its relevance in other phases of behavior change where the specific type of self-efficacy would be ineffective. Likewise, Scholz et al., (2005) found that individuals that had already started a behavior, and was thus in a maintenance-stage, had a bigger advantage by obtaining volitional self-efficacy than those that had not yet begun the behavior change.

The aim of the TTM is to be able to map which stage an individual is at, and then use the processes of change to create interventions that are specific to that stage. Theoretically each stage has specific processes that to a higher degree should influence the individual to move to a later stage. This is of course theoretically very advantageous to reduce drop outs, as this creates a customization to each participant, as opposed to treating everyone the same (Glanz et al., 2008).

The titles, definitions and representative interventions of the processes of change are as following:

- Consciousness raising: increasing information about self and the problem behavior through observations, confrontations, interpretation, biotherapy.
- Self-reevaluation: assessing how one feels and thinks about oneself with respect to a problem by using value clarification, imagery corrective emotional experience.
- Self-liberation: choosing and commitment to act or believe in one’s ability to change through decision making therapy, resolutions, Logotherapy techniques.
- Counterconditioning: substituting alternatives for problem behaviors with relaxation, desensitization, assertion, positive self-statements.

- Stimulus control: avoiding or countering stimuli that elicits problem behaviors by restructuring one's environment, avoiding high-risk cues, fading techniques.
- Reinforcement management: rewarding one's self or being rewarded by others for making changes through contingency contracts, overt and covers reinforcement, self-rewards.
- Helping relationships: being open and trusting about problems with someone who cares using therapeutic alliance, social support, self-help groups.
- Dramatic relief: experiencing and expressing feelings about one's problems and solutions by using psychodrama, grieving losses, role playing.
- Environmental reevaluation: assessing how one's problem affects physical environment through empathy training, documentaries.
- Social liberation: increasing alternatives for non-problem behaviors available in society by advocating for rights of repressed, empowering, policy interventions.

(Prochaska et al., 1992)

As previously mentioned, the processes of change impact is based on the stage one is in, and is the foundation of the tailored interventions. To encourage an individual to go from the precontemplation stage to the contemplation stage, one should utilize consciousness raising, dramatic relief, and environmental reevaluation. To go from the contemplation stage to the preparation stage one should use self-reevaluation. And to go from the preparation stage to the action stage, self-liberation is effective. And finally to go from the action to the maintenance stage one should use reinforcement management, helping relationships, counterconditioning, and stimulus control (Prochaska et al., 1992)

According to Glanz et al. (2008) TTM interventions are well equipped to minimize drops outs due to the fact that they take into consideration that not everyone is ready for change. If properly implemented, it adapts the intervention to fit the individual at every stage.

This is however not always as easily implemented as it is theory. In a literary review on the effectiveness of health interventions based on the principles of TTM, Bridle et al. (2005) concluded that the methodical quality of the studies were mixed, and there were limitations regarding randomization, blinding, and data analysis. The same conclusion was drawn in another review by Spencer et al. (2007). Additionally, these articles found there was only limited evidence for the effectiveness of interventions based on TTM (Bridle et al., 2005; Spencer et al., 2007). There was little evidence to support stage progression compared to other interventions, as well as to no interventions or usual care. However, out of the 20

studies, five favored TTM whilst non favored the other direction. That result is statistically unlikely to be by chance if we assume that TTM is not effective. However, this result may be a byproduct of the intervention intensity compared to control interventions. Yet, some of the interventions may not be fully incorporating all the elements of TTM such as decisional balance and self-efficacy (Bridle et al., 2005).

It has been proposed that TTM is better suited for some types of behavior change. Specifically smoking cessation has been considered an advantageous behavior as opposed to behaviors such as dietary change (Bridle et al., 2005). However, according to one review article there was no evidence to support the claim that TTM interventions effectiveness is influenced by the behavior that is targeted. There was not one specific behavior that had better effect (Bridle et al., 2005).

In a review study of interventions on dietary behavior based on TTM principles, the authors concluded that there was still a need for more reliable and valid assessment tools to measure the effectiveness of the interventions (Spencer et al., 2007). The evidence supported the validity of TTM to describe and categorize populations and to form the interventions. However, the evidence for the interventions based on TTM were inconclusive thus calling for better measuring equipment. These authors also voice their concern regarding the quality of the TTM interventions considering there was a lack in evidence for the actual interventions. This concern has been raised by several authors where there is often little to some evidence for the TTM based intervention, but that the results are inconclusive due to differences in application of the TTM principles (Spencer et al., 2007; Bridle et al., 2005). As Brindle et al., (2005) puts it,

> It is necessary first to accurately identify an individual's readiness to change so that interventions, based on stage-specific processes of change, can be fully tailored to not only stage, but all theoretical variables that the TTM conceptualizes as necessary to facilitate stage progression. Stages of change and the other theoretical variables need to be reassessed frequently, and the intervention should reflect changes in the individual's readiness to change. (p. 297)

As the quote explains it is an elaborate process to properly implement an intervention based on TTM principles. Another concern is regarding the actual efficiency of the interventions, seeing as the favorable outcomes for the TTM could simply be a result of the increased intensity of the TTM interventions compared to the control interventions (Spencer et al., 2007).

In a literature review it was found that TTM had been applied to increase fruit and vegetable intake or decrease dietary fat intake (Norman et al., 2013). There were very few

other studies that focused on other food groups or nutrients. This is somewhat unfortunate considering improving one's dietary intake involves more than adding more fruit and vegetable or decreasing fat intake in real life. This is however a suitable form of measurement for research purposes and consistency was more obtainable by limiting the studies to simple food groups. The success of classifying the subjects in this review was very consistent seeing many used the food frequency questionnaire (FFQ) (Norman et al., 2013).

Behavior change is often viewed as a singular or independent event. This is also a common way to describe the events by using phrases such as "quitting smoking" or "starting to exercise". This view is closer to the continuum models. A very simplified explanation of continuum models would be to say that behavior change occurs and either persists or does not (Conner & Norman, 2015). In a stage model the assumption is that change evolves as a phenomenon over time and does not necessary happen linearly. It is very possible to go back to previous stages. One typical critique of stage models is that some people skip stages. Most people can recall examples of people that seemingly make a big change overnight and stuck to it. The TTM model would not say that any stages were skipped, but rather that the individual moved through them in an unusual fast fashion. According to Sheeran (2002) the stage movements may be interpreted as simply a reflection of a change in ones intention to change, and thus reflects the challenges people face when attempting to translate intention into behavior. One could argue against Sheeran (2002) by pointing out that TTM does have behavioral targets that are part of the descriptions. Additionally, the earlier stages are comparable to the motivational stages in health action process approach, and the later stages to the volition stage.

However, Armitage et al. (2003) argues that there has been found a linear increase in the social cognitive variables such as self-efficacy, which they claim can be an indication that the stages of change are in fact a pseudo-stages model.

In another article Armitage et al. (2004) claim it is unclear which variables predict progression or regression between the TTM stages. Despite there being many examples of successful TTM cross-sectional studies, the authors only found one study that provided reliable tests on predicting longitudinal changes of stages. Additionally Armitage et al. (2004) argues that there have only been conducted longitudinal studies on smoking and exercises behaviors.

The precaution adaption process model.

There is another commonly used stage model called the precaution adoption process model. This model was developed by Weinstein and Sandman (1992). This model entails

seven discrete stages in the process of precaution adoption. The stages are described as “unaware of issue”, “unengaged by issue, “deciding about acting”, “decided not to act” or “decided to act”, “acting”, and “maintenance”. This model differs from the TTM in several ways, the most obvious being the additional stages. Opposed to the TTM model, the stages are not in any way defined by time periods, and could thus arguably be better at reflecting actual stages individuals go through (Conner & Norman, 2015). There are many similarities to TTM, stage one and two can be summarized within TTMs precontemplation-stage. The two stages regarding deciding to act hold many similarities to the contemplation version in TTM, and deciding to act is comparable to preparation. This model is less suitable for this study considering people in stage one and two are highly unlikely to be part of this study at all. The target population consist of people that has downloaded a behavior change app, and are hence probably within the contemplation stage or higher.

Additionally, the questionnaire that has been used in this study does entail sixth stage, that sub-categorize the participants within precontemplation. These sub-categories are the non-believe precontemplation stage and the believe precontemplation stage (*Exercise: Stages of Change (Continuous Measure) | Cancer Prevention Research Center*, n.d.).

As there was more available research on the topic of this project with the TTM model, it became the preferred choice for a stage model. Additionally the questionnaire that was available on exercise fit the needs for the project. Therefore it seems probable that the precaution adoption process model would not add anything to improve this project it will not be further included.

Theory of Planned Behavior

Theory of planned behavior (TPB) is a commonly used continuum model within health psychology (Ajzen, 1991). The theory of reasoned action, which is the precursor of TPB, proposed that behavioral intentions would occur immediately before the behavior, and that intention is a representation of the likelihood of that preforming a certain behavior would lead to a specific outcome. Such beliefs antecedents would further be divided into normative and behavioral (Madden et al., 1992). However, there has been established that there is a gap between intention and behavior, thus intention is not proficient to explain all the variance (Gollwitzer, 1993).

Further, there are three fundamental conditions that are part of determining the magnitude of the relationship between the intention and the behavior. The first one being to which degree does the amount of intentions and the behavioral criterion match according to their levels of specificity. Secondly, how stable is the intention over time and up to the

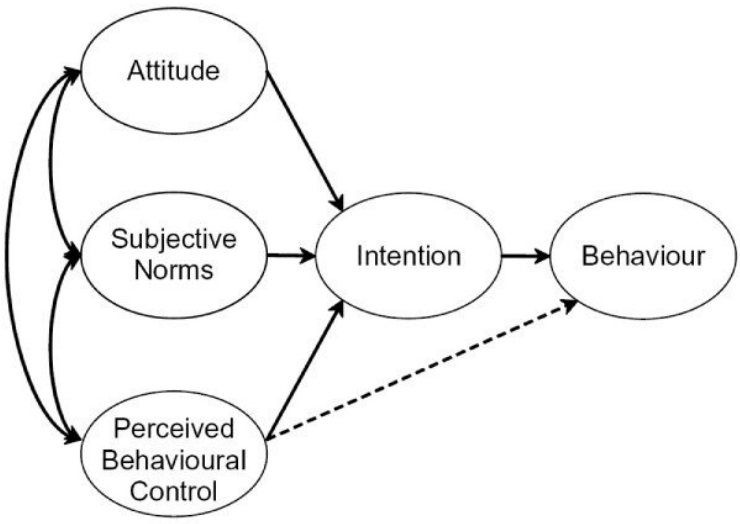
moment of the behavior being put into action. And the final condition is to which extent the individual is able to perform the behavior they are intending (Madden et al., 1992).

However, the theory of planned behavior consists of three additional fundamental elements. Attitude, subjective norm, and perceived behavioral control. These factors influence behaviors in different ways, and combined explain more of the variance between intention and behavior than the theory of reasoned action model. In a study by Madden et al. (1992) theory of planned behavior was deemed an extension of theory of reasoned action, and that the inclusion of perceived behavioral control significantly improved the prediction of both intentions and target behavior. The claim that perceived behavioral control affect the prediction of target behavior varied according to the actual behavioral control. Additionally, the target barriers violated the assumption of volitional control and the conclusion was that the theory of planned behavior is superior. It also on average explained more variation in behavioral intentions regardless of control (Madden et al., 1992).

Attitude consists of an individual's perception of a behavior. Subjective norms consist of how the individual perceived societies expectations and attitudes regarding a behavior. Perceived behavioral control consists of both an internal and external aspect. Perceived internal behavioral-control entails an individual's belief in ones' own ability to control behavior. External perceived behavioral-control entails an individual's interpretations of how the environments control their own behavior (Ajzen, 1991). This relationship is demonstrated in figure 3.

Figure 3.

Visual demonstration of TPB



(Ajzen, 1991)

TBP has effectively predicted a number of health related behaviors such as smoking and drinking. In a study by Godin and Kok (1996) a meta-analysis on TPBs effect on health behaviors was conducted. They found that 66.2 % of the explained variance could be attributed to intention, making the author conclude that "in general, health-related behaviors remain largely within one's personal motivation" (p. 93, Godin & Kok, 1996).

In one study by Courneya et al. (2001) they conducted a digital intervention through interview over the phone where they attempted to predict stage transition using the theory of planned behavior regarding exercise behavior. They used different social cognitive construct such as intention, attitude and social norms. The results showed that intention, attitude and subjective norms predicted progression from precontemplation. Intention, perceived behavior control, social support and attitude predicted progression or regression from contemplation. Intention and attitude predicted progression or regression from preparation, and regression from action and maintenance was also predicted by intention, attitude and social support. Thus, here is an example of the theory of planned behavior and the transtheoretical model being combined with good results. The article concluded that exercise behavior occurs in stages and TPB is useful for predicting transitions between stages (Courneya et al., 2001).

However, there are some limitations to TPB and especially continuum models. According to Schwarzer (2008) a general weakness of continuum models is that they account for intention variance better than for behavior variance. They do not include a post intentional phase in which goals are translated into action. The segment between intentions and behaviors is a black box that is often called the intention-behavior gap.

In a study by Armitage (2005) the ability of TPB to predict the participation and maintenance of exercise was explored. The study found that perceived behavioral control was a significant predictor of intention and behavior, and further discussed some interesting limitations regarding TPB. Firstly, there has been a lack of research regarding TPB ability to predict the maintenance of behaviors. The second potential limitation discussed was regarding the finds that indicate that past behaviors is the biggest predictor of future behavior, controlling for the effect of the variables of TPB. The third limitation was that according to Armitage (2005), much of the early research of TPB (from before 1997) does not contain behavioral measures. The final limitation regards the measurement of exercise behavior which has mainly been relying on self-report.

Health Action Process Approach

Health action process approach (HAPA) is a more recently developed model within health psychology and it has rapidly grown in popularity and reconnection. HAPA is, as

previously mentioned, a hybrid between a continuum model and a stage model (Schwarzer & Luszczynska, 2008). In a continuum model the individual is placed on a scale that is supposed to reflect the likelihood of a specific action to occur. It is thus assumed that the behavior is determined by the individual's intention. Intention is as previously discussed an important predicter of behavior, with specific cognitive concepts such as self-efficacy and attitudes that affect the forming of intention (Ajzen, 1991).

HAPA suggests that adaption, initiation and maintenance of health behavior must be considered as a process consisting of both a motivation phase and a volition phase. The volition phase can further be divided into a planning phase, and action phase, and a maintenance phase. HAPA propose that perceived behavior control is a central factor within all phases. Risk-perception is the most important for the contemplation phase, which occurs early in the motivation development, but is less vital at the later stages (Schwarzer & Luszczynska, 2008).

Similarly, outcome-expectancies is more relevant during the stage where the individual balance the advantages and disadvantages of the consequences of their behavior, but it loses its power as soon as a decision had been made. Self-efficacy is important both for the individuals perceived ability to execute an action, as well as ones perceived ability to maintain it (Schwarzer & Luszczynska, 2008).

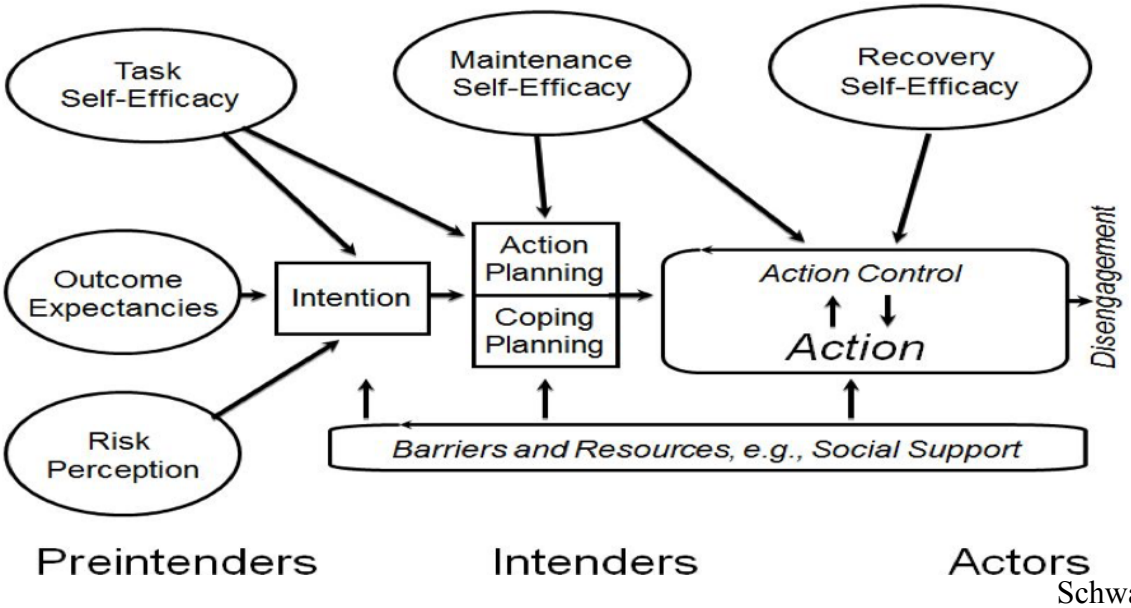
The difference between motivational self-efficacy and volition self-efficacy is that motivational self-efficacy serves as a prediction of intention-formation, while volition self-efficacy is relevant for the actual behavior change. In a study by Ochsner et al. (2013), the ability of behavioral-intentions to moderate the association between violation self-efficacy and behavior was examined. A factor analysis confirmed the phase specific separation of self-efficacy. Motivational self-efficacy emerged as a predictor for behavior intentions over all other HAPA variables after six months. However, volition efficacy did not emerge as a predictor. Volition self-efficacy interacted with intention as a prediction of behavior, and indicated that violation self-efficacy is only beneficial for individuals with high levels of intentions. The authors concluded that it is beneficial to distinguish between motivational and volition self-efficacy when developing interventions of dietary change (Ochsner et al., 2013).

In the motivational phase, risk awareness, outcome expectancies, and self-efficacy are predictors of intention. The volitional phase follows intention formation, in which intention, action control, planning, and self-efficacy are specified as predictors of behavior. Motivation self-efficacy refers to one's own confidence in ability to perform a new behavior. Volition

self-efficacy refers to own perceived ability to maintain the behavior over time and when obstacles emerge (Ochsner et al., 2013).

Figure 4.

Visual demonstration of HAPA



Schwarzer, 2014

As seen in figure 2, there are three distinct phases consisting of preintenders, intenders and actors. Similarly, to the processes of change in TTM, there are different variables that influence the phases, and the individuals ability to progress to a later stage. This distinguishing gives the means to create powerful interventions for behavior change.

In one study Milne et al. (2002) compared a motivational intervention based on protection motivation theory (PMT) with the same motivational interventions augmented by a volitional intervention based on implementation intentions (Gollwitzer, 1993). The results of the study were that the motivational intervention significantly increased "threat and coping appraisal" as well as intentions to engage in exercise behavior. The comparison intervention had a dramatic effect on subsequent exercise behavior. This volitional intervention did not influence behavioral intention or any other motivational variables. The authors concluded that supplementing PMT with implementation intentions strengthens the ability of the model to explain behavior. This has implications for health education programs, which should aim to increase both participants' motivation and their volition (Milne et al., 2002).

Research question

The research question was to what degree does the mobile-app "Heia meg" affect level of motivation using the stages of change model regarding one out of two health-promoting behaviors. The first hypothesis was that the participants that related the most to the contemplation-stage or the preparation-stage at the first round would be more likely to have progressed to a later stage than the participants that started off in other stages. The second hypothesis was that there would be a correlation between which stage the participant would relate to the most in the posttest with a higher reported use of the application.

The transtheoretical model was considered and used to categorized level of motivation in this project. As discussed previously in this thesis, the empirical evidence for using this model to design interventions for behavior-change has been inconclusive and has showed varying effect, but the research has shown it still remains a good method to categorize the stages of motivation (Marcus et al., 1992).

Methods

Participants

The study recruited participants through the mobile-app "Heia meg". A message within the app read "Vil du hjelpe oss gjøre appen bedre? Hvis du svarer på noen enkle spørsmål kan vi finne ut om appen er god motivasjonshjelp!" (In English: "Would you like to help us improve the app? If you answer a few simple questions we can evaluate if this app helps increase motivation").

The message was followed by a link to the survey. The survey begun after the participants read and signed the informed consent form. They consented to being over the age of 18, agreeing to be asked to participate again after 30 days, and that their data would be kept, but de-identified for up to five years for publications purposes.

Figure 5.

Screenshot from the app

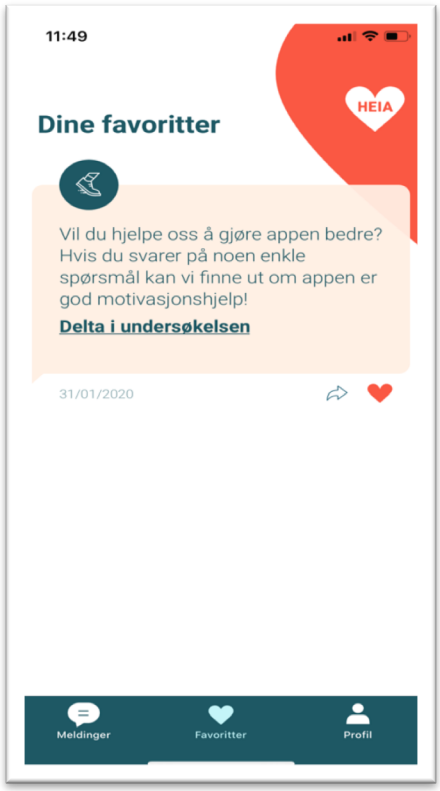


Figure 6.

Screenshot taken of the message

The participants were asked to submit their mobile numbers for identification. This was necessary to compare their baseline to the posttest survey as well as a mean of contacting them for the posttest. The participants were also asked to submit their age (in the form of age groups), gender, and level of education.

After a 30 to 40-day period, the participants would receive a text message on their phone from "Heia meg" (sent by Helsedirektoratet) asking them to participate in the study again. (Hei, du har hatt Heia meg-appen i noen uker. Kan vi be deg svare på noen spørsmål igjen så vi kan finne ut om appen gir deg motivasjonshjelp?)

The raw number of participant (answered surveys) were 261, but 5 were eliminated for not agreeing to the consent-form. 81.2 % (N = 208) answered the questionnaire for the first round and 18.8 % (N = 48) responded for a second round. Out of the second round-group 37.5 % responded that they had used the "Heia Meg" app six to seven times a week for the previous 30 days, 35.4 % reported having used it three to five times a week, 12.5 % reported having used the app one to two times a week, 10.4 % reported having used it a total of one to four times during the last month and 4.2 % reported not having used the app since downloading it.

The participant were evenly distributed between the two behaviors with 52.3 % choosing exercise and 47.7 % choosing dietary intake. A majority of the participant had a higher education with 57.2 % and 38.0 % having finished upper secondary education in the form of "videregående" or "yrkesfag" and only 4.8 % having finished primary school (grade 1-10th).

There was a magnitude of participant in the age group 41-60 years of age (44.7 %). The following of age groups were 30-40 years old (24.5 %), 18-29 years old (17.8 %), and the smallest group, 61 years old or older (13.0 %). There was a vast majority of females among the participant with 85.4 % female and 14.2 % male (one missing data point).

Materials

The questionnaire that was used had been retrieved from the official website of the university of Rhode Island (*Exercise: Stages of Change (Continuous Measure) | Cancer*

Prevention Research Center, n.d.). Prochaska was a current faculty member and was still doing research on the transtheoretical model (The University of Rhode Island, n.d.). The questionnaire was designed to categories the participants within the stage model (Marcus et al., 1992). The questionnaire used was targeted specifically for exercise and was translated to Norwegian. (See appendix for original questionnaire and translated questionnaire). An equivalent questionnaire was thus created for dietary intake as this was not available. There was a questionnaire available regarding weight loss, but this was deemed unsuitable for this study due to fact that not all those who are interested in improving their dietary intake are attempting to lose weight and are overweight which were assumed in the weight-loss questionnaire. The questionnaire for dietary intake in this study was created by using the exact same phrasing and questions as for exercise, but substituting it with "improve dietary intake" or "eat healthier".

The questionnaire was constructed of statements that the participants respond to within the scale of "strongly disagree, disagree, uncertain, agree, strongly agree". The statements were created to reflect the different stages of change, and thus the participant got a total score on each stage, reflecting which stage they reported that they related to the most (Reed, 1995). The stages of change-factors were made up by four questions each, and Table 1 represent the distribution of questions to the stages. A full list of questions are available in the appendix.

Table 1.

Stages of change distribution of questions

Stages of change	Question-numbers
Precontemplation (non-believers in exercise) items	1, 3, 6, 9
Precontemplation (believers in exercise) items	11, 19, 21, 24
Contemplation items	7, 13, 16, 22
Preparation items	14, 17, 20, 23
Action items	4, 8, 10, 12
Maintenance items	2, 5, 15, 18

Note. ("Exercise: Stages of Change (Continuous Measure) | Cancer Prevention Research Center")

To increase the validity of the questionnaire an independent helper translated the Norwegian questionnaire for exercise back to English to evaluate if the true meaning of the original questionnaire was kept. All questions held the same meaning as the original (see appendix for questionnaire or table 4 and 6).

This approach does not exclude other theoretical interpretations than TTM offers, but is the optimal design to best answer the research questions. The questionnaire was web-based, and completed through the site "nettskjema.no" which is affiliated with the University of Oslo. The participants would use their private phones for answering.

Design

The study was pretest-posttest quasi-experimental, since there was no opportunity to have a control group with random assignment or a reversal of the intervention (White & Sabarwal, 2014). It is also worth noting that the sample consisted of participants that had downloaded the application on their own initiative, and thus the sample may not be generalizable to the general population. However, one could argue that it is a representative sample for the target population. There was also used a single-subject design with several participants (AB-design) for those participants that answered twice where each subject was compared to their own baseline. This design hold similarities to a study conducted by Di Noia et al. (2008) in which a computer based intervention was given tailed on TTM stages and processes of change. The design was a pretest-posttest quasi-experimental design, but additionally consisted of a control group that had not been randomly assigned (Di Noia et al., 2008).

The study was not be able to control for other external influencing factors during the 30-day intervention period, so the results may have be influenced by confounding variables.

Procedure

The data-collection had been approved by Norsk senter for forskningsdata (NSD). The data gathering was conducted by having a message sent within the app to new users. When the app "Heia meg" was downloaded the users were asked to choose one or two out of five target behaviors to focus on. These consist of exercise, dietary intake, mental health, smoking, and alcohol consumption. Those whom chose exercise or dietary intake were sent a message asking to participate within a few days after download.

The "Heia meg" app had been available for free download prior to the data-gathering in this project, and thus already had a large base of existing users. The intention was to send out the invitation to participate in the study to exclusively new users within the first days after download. However, when the survey was first sent out there was a technical error that sent the invitation to all the existing users that had chosen exercise or dietary intake independent of how long they had had the app. The answers retrieved from these participants compromise the integrity in this study as the research question asks whether receiving the app increased motivation within the first 30 days after download. Unfortunately, it is impossible knowing which of the participants received the invitation directly following the download. The survey

entailed a question asking if "this was the first time they answer the survey (recently downloaded "Heia Meg")" or if "it was the second time they are answering the survey (downloaded "Heia meg" at least 30 days ago)". This could be a contradicting question for those whom answered the questionnaire for the first time but had downloaded the app for over 30 days prior. Seeing as these participants may have been confused about which option to choose, the validity of the data is somewhat compromised. After that technical glitch the message was continuously sent out to every new user that qualified by choosing exercise or dietary intake.

Table 2.

Descriptive statistics for number of responses

Number of participants	Exercise	Dietary intake
"First time"	105	103
"Second time"	29	19
Both	22	19

Results

Data Analysis

The data analysis was conducted in the SPSS version 26. The variables given a numeric value from 1-5 (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree). The next step was to conduct a factor analysis of both target behaviors.

A factor analysis for both target behaviors were especially interesting to compare to the original factors. As the questionnaire was based on the existing stages of change questionnaire, there were preestablished factors to extract from the dataset. See table 1 for overview of question-distribution that creates the factors.

Exercise.

The factor analysis for exercise had a KMO of .783 with a significance level of ($p = .000$). With the eigenvalue criteria being > 1 seven components were extracted from the dataset that explained a total of 69.3 % of the variance in the dataset (Field, 2018). According to the scree plot there was a clear visual break after the third factor, and a less prominent break after the seventh factor. A parallel analysis was conducted that opted to keep five factors.

Table 3.

Component initial eigenvalues for exercise

	Total	% of variance	Cumulative %
1	6.399	26.6	26.6
2	3.100	12.9	39.5
3	1.874	7.8	47.3
4	1.544	6.4	53.8
5	1.424	5.9	59.7
6	1.221	5.0	64.8
7	1.058	4.4	69.2

A rotated varimax component matrix was ordered to examine the factors that were extracted. The first extracted factor was made up by five variables that held similarities to the believe precontemplation stage and the contemplation stage. The next factor consisted of five variables and were similar to the action and maintenance stage. The next factor also consisted of five factors and were similar to the preparation stage. The next factor had four variables, including one negatively correlated variable (-.750) that were similar to the maintenance stage. Two variables made up a factor similar to the non-believe precontemplation stage, and another two variables formed a "social factor". Finally, a single variable made up the seventh factor. The inner reliability for these factors were measured by Cronbach's alpha and is displayed in table 7 (Field, 2018).

Table 4.

Factor Loadings for Exercise Extracted based on Eigenvalues

Stages of change variables	*Factor loading*						
	1	2	3	4	5	6	7
1. Jeg mener at regelmessig trening er bra, men jeg har ikke tid til å prioritere det nå.	.826						
2. Jeg er klar over hvor viktig det er å trene regelmessig, men jeg kan ikke nå for tiden.	.792						
3. Jeg vet at fysisk aktivitet er viktig, men jeg har ikke tid det nå fremover.	.716						
4. Jeg har ikke tid eller krefter til å trene regelmessig nå.	.688						
5. Jeg kan trene regelmessig, men jeg har ingen planer om å gjøre det.	.485						
6. Jeg har endelig begynt å trene regelmessig.		.878					
7. I det siste har jeg begynt å trene jevnlig.		.807					
8. Jeg har begynt å trene, og det har jeg tenkt å fortsette med.		.617					
9. Jeg har fått til å trene jevnlig, og det ønsker jeg å fortsette med.		.626					

10. Jeg begynte å trene regelmessig i løpet av de siste 6 månedene.	.594					
11. Jeg syns virkelig at jeg burde komme i gang med å trene jevnlig i løpet av de neste 6 månedene.		.774				
12. Jeg forbereder meg på å begynne å trene i løpet av de neste ukene.		.750				
13. Jeg har tenkt på at jeg kanskje burde begynne å trene regelmessig.		.644				
14. Jeg har begynt å vurdere om jeg vil være i stand til å trene regelmessig.		.603				
15. Jeg har satt opp tidspunkt og dag for når jeg skal begynne å trene i løpet av de nærmeste ukene.		.493				
16. Jeg har tenkt på at jeg kanskje ønsker å begynne å bli mer fysisk aktiv.			-.750			
17. Jeg har fullført 6 måneder med jevnlig trening.			.746			
18. Jeg har trent regelmessig en god stund og planlegger å fortette med det.			.666			
19. Jeg har klart å opprettholde treningen min i løpet av de siste 6 månedene.			.578			
20. Jeg er ikke fysisk aktiv nå for tiden, og det bryr meg ikke.				.826		
21. Slik jeg ser det trenger jeg ikke å trene jevnlig.				.769		
22. Jeg har prøvd å finne en venn å begynne å trene med.					.865	
23. Jeg har avtalt med en venn å begynne å trene i løpet av de neste ukene.					.828	
24. Jeg er fornøyd med å være en stillesittende person.						.885

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Dietary intake.

The factor analysis for dietary intake had a KMO of .822 with a significance of (p=.000). With the criteria for eigenvalues set to > 1 six factors were extracted that explained 65 % of the total variance in the dataset (Field, 2018). According to the scree plot there was a big break after the third factor, and a small even slope following the break.

Table 5.

Component initial eigenvalues for dietary intake

	Total	% of Variance	Cumulative %
1	7.120	29.666	29.666
2	3.132	13.048	42.714
3	1.567	6.529	49.243
4	1.466	6.107	55.350
5	1.273	5.306	60.656
6	1.095	4.563	65.219

A rotated varimax component matrix was ordered which showed that the first factor consisted of six factors with the first four being similar to the believe precontemplation stage, and the following two having negative correlations with variables originally belonging to the maintenance and preparation stage. The following factor had six variables consisting of

variables from preparation and contemplation, as well as negative correlation with variables originally from maintenance. The next factor consisted of six variables, all being from action and maintenance. The fourth factor had two variables that focused on the social aspect of the target behavior. The fifth factor consisted of two variables from non-believe precontemplation. And lastly the sixth factor were the same single variables from non-believe precontemplation. The inner reliability within the factors were measured and the Cronbach alpha are displayed in table 7 (Field, 2018).

Table 6.

Factor Loadings for dietary intake extracted based on Eigenvalues

Stages of change-variables	*Factor loading*					
	1	*2*	*3*	*4*	*5*	*6*
1. Jeg vet at et sunt kosthold er viktig, men jeg har ikke tid det nå fremover.	.778					
2. Jeg mener at det er bra å ha et sunt kosthold, men jeg har ikke mulighet til å prioritere det nå.	.708					
3. Jeg har ikke tid eller krefter til å forbedre kostholdet mitt nå.	.642					
4. Jeg er klar over hvor viktig det er å ha et sunt kosthold, men jeg klarer det ikke.	.638					
5. Jeg har spist sunnere lenge, og tenker å fortette med det.	-.578					
6. Jeg har satt opp en plan for hvordan jeg skal forbedre kostholdet mitt som jeg skal begynne med i løpet av de neste ukene.	-.454					
7. Jeg syns virkelig at jeg burde komme i gang med å spise sunnere i løpet av de neste 6 månedene.		.857				
8. Jeg forbereder meg på å begynne å forbedre kostholdet mitt i løpet av de neste ukene.		.800				
9. Jeg tenkt på at jeg kanskje burde begynne å spise sunnere.		.745				
10. Jeg har tenkt på at jeg kanskje ønsker å begynne å forbedre kostholdet mitt.		.690				
11. Jeg har fullført 6 måneder hvor jeg har spist sunnere.		-.576				
12. Jeg har begynt å vurdere om jeg vil være i stand til å spise sunt.		.434				
13. I det siste har jeg begynt å spise sunnere.			.831			
14. Jeg har endelig begynt å spise sunnere.			.825			
15. Jeg har begynt å spise sunnere i løpet av de siste 6 månedene.			.704			
16. Jeg har klart å forbedre kostholdet mitt, og det ønsker jeg å fortsette med.			.622			
17. Jeg har begynt å spise sunnere, og det har jeg tenkt å fortsette med.			.654			
18. Jeg har klart å spise sunnere i løpet av de siste 6 månedene.			.623			
19. Jeg har prøvd å finne noen jeg kan lage mat, dele oppskrifter eller diskutere kosthold med.				.788		
20. Jeg har avtalt med en venn å begynne å spise sunnere i løpet av de neste ukene.				.754		
21. Jeg kan spise sunt, men jeg har ingen planer om å gjøre det.					.647	
22. Slik jeg ser det, trenger jeg ikke å spise sunt.					.590	
23. Jeg er fornøyd med å være en person med et usunt kosthold.						.805
24. Jeg spiser usunt nå for tiden, og det bryr meg ikke.						.552

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

If a comparison is made between table 5 and 6 to the original factors from table 1, the factors extracted by eigenvalues and composed based on the rotated correlation matrix they do not match with the operationalization of the factors from the stages of change-questionnaire.

As this project was based on using the TTM stages of change, it was sensible to keep the already operationalized factors to be able to compare to previous research using the TTM stages of change (Marcus et al., 1992). The next step was to measure the inner reliability from the original stages of change-factors.

Table 7.

Reliability within scales from factors extracted from component matrix.

Factor	Exercise	Dietary intake
	Cronbach α	Cronbach α
1	.823	.193
2	.840	.446
3	.688	.889
4	.493	.530
5	.698	.262
6	.619	.361
7	n/a	

Note. seventh factor n/a due to being one variables.

A comparison can be made of the inner reliability between the factors extracted from the rotated component matrixes in table 7 and the original factors in table 8.

Table 8.

Reliability within scales from Original factors.

Factor/scale	Exercise	Dietary intake
	Cronbach α	Cronbach α
Non-believe Precontemplation	.667	.285

Believe precontemplation	.837	.783
Contemplation	.655	.723
Preparation	.515	.523
Action	.796	.818
Maintenance	.858	.827

Note. The factors were composed by the distribution in table 1.

The inner reliability varied across the factors and target behaviors. It is common to use .70 to .80 as a cutoff point for acceptable inner reliability. However as Field (2018) points out, this is not necessarily realistic when dealing with psychological constructs such as stages of changes. This is because of the diversity within the construct being measured. According to Field (2018) early research suggested that values as low as .50 could be accepted. As for questionaries' such as the one in question, the alpha should not be higher then .90 as this can indicate that the variables are too similar. The number of items on a scale affects the size of the alpha, and each factor consists of four items each. This is relatively low amount of items, and may affect the Cronbach's alphas (Field, 2018).

Seeing as one factor had a very poor inner reliability ($\alpha = .285$) steps were taken to attempt optimize the scale. For the preparation-factor for exercise and the non-believe precontemplation-factor for dietary intake both had a borderline alpha at best ($\alpha = .515$, $\alpha = .524$ respectively). Deleting one or two items would not increase the alpha for neither of the three factors. A decision was made to reduce the non-believe precontemplation-factor for dietary intake to a single variable and leave to two other factors as they were.

As the Cronbach's alpha in the pre-operationalized factors were for the most part acceptable, and that the factors were much more theoretically meaningful, the standardized stages were used to continue the analysis. As well as having the same amount of factors for both scales, it was also problematic to use the factors from the component matrix due to the fact that the factors were composed of variables from contradicting and separate stages, and exercise had seven factors extracted whilst dietary intake had six.

Thus six new factors were created for both target behaviors reflection their score on the stages of change-factors. The next step was to explore if there were differences between the participant from round one and round two. This was done by conducting an independent *t*-test across both target behaviors, with the variables first or second round defining the groups.

Independent *t*-tests for exercise

Table 9.

Descriptive statistics for exercise

	Maintenance	Action	Preparation	Contemplation	Believe precontemplation	Non-believe precontemplation
N	127	128	127	128	127	128
Std. Error of Mean	.361	.331	.267	.274	.320	.205
Std. Deviation	4.15	3.80	3.09	3.16	3.68	2.37
Mean	12.41	13.41	11.36	15.47	8.99	6.57

Table 10.

Results of t-test across factors basted on first or seconds round for exercise

Round	*1*		*2*		*t*	*Sig. (2-tailed)*	*Mean difference*
	M	*SD*	*M*	*SD*			
Non-believe Precontemplation	6.78	2.51	6	1.75	1.517	.132	.782
Believe precontemplation	9.24	3.76	8.22	3.41	1.280	.203	1.02
Contemplation	15.51	3.22	15.33	3.06	.263	.793	.181
Preparation	11.21	2.99	12.14	3.48	-1.385	.168	-.930
Action	13.13	3.77	14.33	3.36	-1.493	.138	-1.19
Maintenance	12.01	4.23	13.51	3.79	-1.667	.098	-1.49

Note. t = equal variance assumed. N= 101 for first round and N=27 for second round.

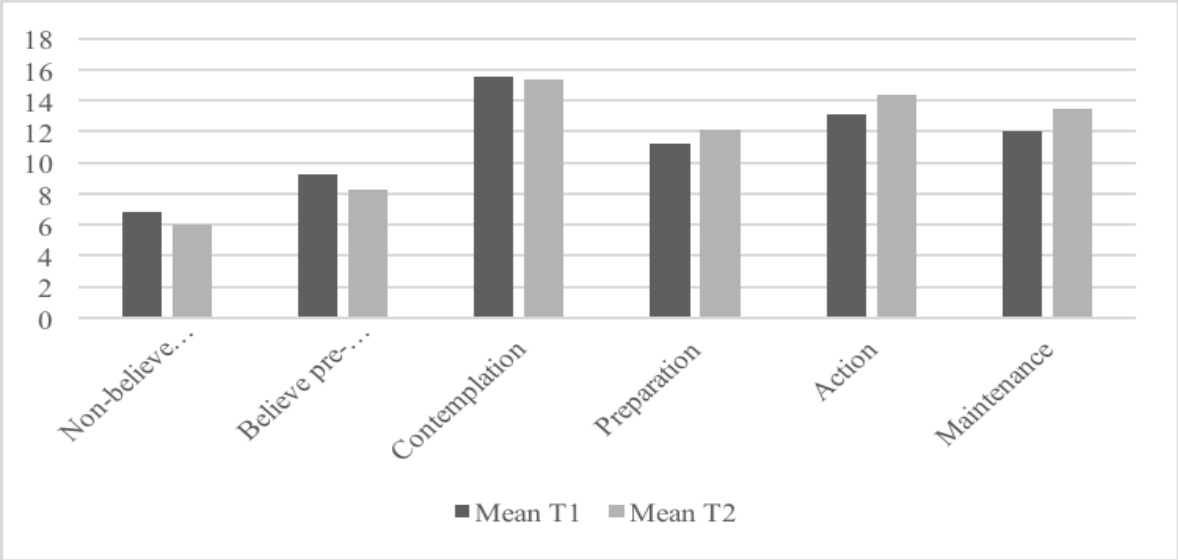
Seeing as the sample was small, it was more statistically meaningful to ignore Levine's test, and look directly to the two-tailed significance test, as here the *t*-statistic and degrees of freedom has been used to calculate a significance level that takes into account the probable imbalance in group variance (Field, 2018).

Table 8 displays that for exercise there were no significant differences ($p < .05$). Therefore these data do not give us very strong evidence to reject the null hypotheses that

there are no differences between the groups. However, there are encouraging results in the average means across the factors.

Figure 7.

The average mean for participant in the exercise-group across the stages of change



The highest mean for the first round is for contemplation (M = 15.51) with the lowest for non-believe precontemplation (M = 6.78). For round two the highest mean is still contemplation (M = 15.33) but preparation, action and maintenance has all increased while believe precontemplation and non-believe precontemplation had been reduced. This is very visually clear in figure 7, where it can be seen that round one (T1) having a higher mean than in round two (T2) and preparation, action, and maintenance all having a higher mean in round two (T2) than in round one (T1). That gives an indication that the mobile-app may be highly suitable for people that relate the most to contemplation change in behavior.

Independent *t*-tests for dietary intake

Table 11.

Descriptive statistics for dietary intake

	Maintenance	Action	Preparation	Contemplation	Believe precontemplation	Non-believe precontemplation
N	108	111	109	110	110	110
Std. Error of Mean	.339	.324	.302	.308	.308	.168
Std. Deviation	3.66	3.55	3.28	3.36	3.36	1.83

Mean	13.25	14.37	12.05	15.42	8.71	6.15

Table 12.

Results of t-test across factors basted on first or seconds round for dietary intake

Round	*1*		*2*		*t*	*Sig. (2-tailed)*	*Mean Difference*
	M	*SD*	*M*	*SD*			
Non-believe Precontemplation	1.47/5.88	.796	1.62/6.48	1.02	-.673	.502	-.151
Believe precontemplation	9.01	3.38	7.37	3.13	1.807	.074	1.36
Contemplation	15.58	3.51	14.37	3.51	1.300	.196	1.21
Preparation	11.78	3.18	12.62	3.51	-.956	.341	-.835
Action	13.94	3.62	16.31	2.57	-2.502	**.014***	-2.36
Maintenance	12.96	3.71	14.81	3.14	-1.873	.064	-1.84

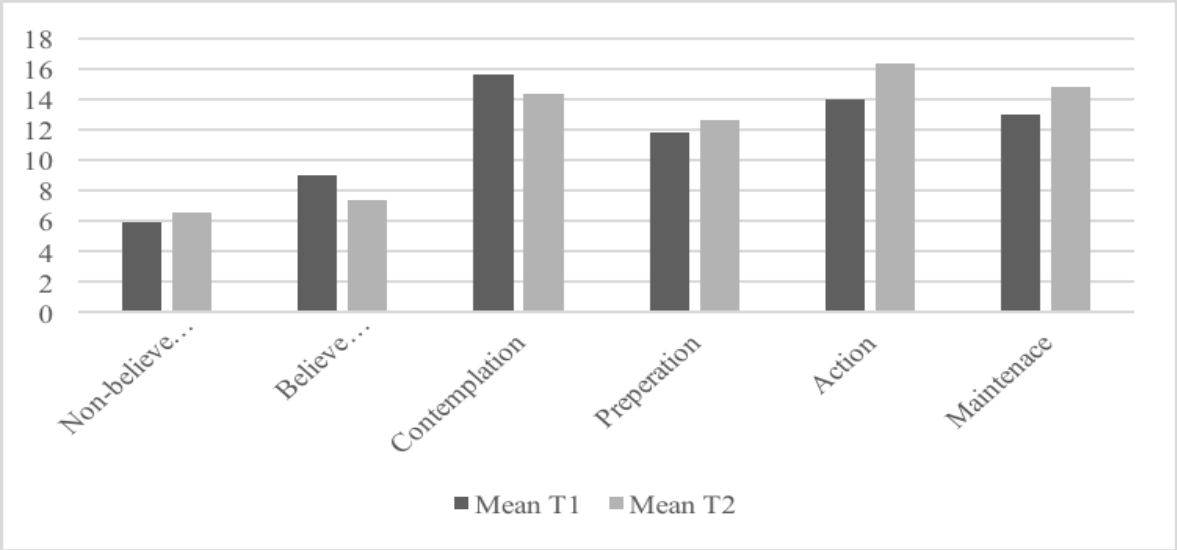
Note. t = equal variance assumed. Non-believe precontemplation had been reduced to one variable due to poor Cronbach a. N= 95 for first round and N= 16 for second round.

First and foremost, one must address the change in the non-believe precontemplation factor. It had been reduced to one variable, as opposed to the other factors consisting of four variables each. To make it equal to the other factors in this analysis it was logical to increase the value by multiplying it by four (T1:1.47 x 4 = 5.88, T2: 1.62 x 4 =6.48).

Table 12 displays that the action-factor does have a statistically significant difference between round one and two (p = .014). Additionally, it can be seen that the highest mean was for round one was contemplation (M= 15.58) and the lowest for non-believe precontemplation (M = 5.88). For the second round action then held the highest mean (M = 16.31) whilst non-believe precontemplation still held the lowest (M = 6.48). This can indicate that the mobile-app is highly suitable for people that are contemplating a change in dietary intake, and that by using the app for 30 days may contribute to moving into taking action.

Figure 8.

The average mean for participant in the dietary intake group across the stages of change



Paired Sample *t*-test for exercise

Table 13.

Results of paired sample t-test with baseline and post-intervention for exercise N=15

	Paired differences			*t*	*df*	*Sig. (2-tailed)*
	Mean difference	*SD*	*Std.error mean*			
Non-believe Precontemplation	.333	2.12	.549	.607	14	.554
Believe precontemplation	-1.00	2.17	.560	-1.784	14	.096
Contemplation	-.200	2.73	.705	-.284	14	.781
Preparation	1.20	3.85	.996	1.205	14	.248
Action	1.53	2.85	.735	2.084	14	.056
Maintenance	-.133	2.09	.542	-.246	14	.809

Note. the mean has been subtracted from T1 to T2, so there is an increase in action and maintenance and a decrease in prep, con and the contemplations.

A paired sampled *t*-test was conducted by pairing the participants that answered twice with at least a 30 day interval. The analysis compared the participants baseline and post-intervention scores on the stages of change-factors. As we can see in table 10, there were no statistically significant differences ($p < .05$) from baseline to posttest for the exercise group. As the SPSS program always subtracts the mean from the from the first group, and thus one must read the negative means as having increased that amount from baseline to posttest (Field, 2018). That means that there has been an increased score in the believe precontemplation factor, the contemplation factor and the maintenance factor. There has additionally been a decrease in the score of non-believe precontemplation, preparation and action factor.

Correlation for exercise.

To analyze the correlation between having used the mobile-app and the score on the stages of change-factors for exercise, a bivariate correlation analysis was conducted using Pearson *r* (N = 12). For non-believe precontemplation $r = -.181$, $p = .573$, believe precontemplation $r = -.188$, $p = .581$, contemplation $r = -.087$, $p = .787$, preparation $r = -.499$, $p = .099$, action $r = -.353$ $p = .261$ and maintenance $r = .0330$, $p = .322$. There were no statistically significant correlation between the scores on the factors and how often the participant reported having used the mobile-app since download. There were no statistically significant correlation between the scores on the factors and how often the participant reported having used the app since download. However, preparation and action had correlations larger than .3 which are considered a medium effect (Field, 2018). As the sample was small (N = 12) the strength of the correlation may be considered more valuable. It is unlikely to achelike statistically significant differences with a small sample, so the effects size is more interesting (Field, 2018).

Paired Sample *t*-test for dietary intake

Table 14.

Results of paired sample t-test with baseline and post-intervention for dietary intake N=13

Baseline – post-intervention	*Paired differences*			*t*	*df*	*Sig. (2-tailed)*
	Mean difference	*SD*	*Std.error mean*			

Non-believe Precontemplation	.461	2.18	.605	.762	12	.461
Believe precontemplation	1.15	2.03	.564	2.044	12	.063
Contemplation	-.307	3.61	1.00	-.307	12	.764
Preparation	.153	3.36	.932	.165	12	.872
Action	-2.23	3.00	.833	-2.677	12	.020*
Maintenance	-.692	2.71	.754	-.918	12	.377

Note. the mean has been subtracted from T1 to T2, so there is an increase in action and maintenance and a decrease in prep, con and the contemplations.

The paired *t*-test for dietary intake can be seen in table 11. The mean differences between baseline and posttest for the action stage was statistically significant (p = .020). The remaining mean differences tell us that there has been a decrease in the mean score for the non-believe precontemplation factor, the believe precontemplation factor and the preparation factor, and there has been an increase in the mean of the contemplation factor, the action factor and the maintenance factor.

Correlation for dietary intake.

To analyze the correlation between having used the app and the score on the stages of change-factors, a bivariate correlation analysis was conducted using Pearson *r* (N = 11). For non-believe precontemplation *r* = -.447, p = .168, believe precontemplation *r* = -.549, p = .080, contemplation *r* = -.621, p = .055, preparation *r* = -.485, p = .130, action *r* = .006 p = .986 and maintenance *r* = .036, p = .922. There were no statistically significant correlation between the scores on the factors and how often the participant reported having used the mobile-app since download. However, as preparation, believe precontemplation, contemplation and non-believe precontemplation all had correlations greater than .4 which are considered medium to large effect (Field, 2018). As the sample was small (N = 11) the strength of the correlation may be considered more valuable. It is unlikely to achelike statistically significant differences with a small sample, so the effects size is more interesting (Field, 2018).

Discussion

Sample

To start off we shall begin by discussing the pool of participants in this study. There were two very notable majorities within the sample. The first one being the vast majority of female participants (85.4%). This should be made note of, and would make an interesting topic for further investigation. Are females generally more interested in improving their health, or is it the format that makes it more appealing to females? Are there steps that could be made to make these mobile-apps more desirable for men?

The second surprising find was the majority of the age group 41-60 years of age (44.7 %). The surprise aspect was however completely rooted in a bias assumption that younger people are more inclined to use mobile-apps. Additionally, in the study by Heron et al. (2019) they found that 40 % of the college student, whom the majority of was relatively young, in their sample already had a health promoting app on their phone.

This is also a problem regarding generalizability. It is unknown if the high proportion of females and people in the age range 41-60 years reflect the actual distribution of the users of the app, or if these users had a higher response rate than other users.

Independent *t*-test

Setting aside these overrepresentations in the sample, the data-analysis resulted in some interesting finds. For the independent *t*-test there was a significant difference. Even though the differences were just significant for action in dietary intake, the remaining factors were headed "in the right direction". For both target behaviors, when comparing round one to round two there had been an increase of the mean of maintenance, action and preparation and a decrease of the mean of contemplation, believe precontemplation and non-believe precontemplation. This suggest that there had been a development of motivation to change behavior before and after having had the "Heia Meg" app. It is important to note that in this *t*-test the grouping variable were the participants reply to if it was the first time they answer the survey (and that they had newly downloaded the "Heia meg" app) or the second time they had answered the survey (that they had downloaded "Heia meg" app 30 days prior). This was thus not the participant's being compared to themselves, but the group being compared to each other.

Paired *t*-test

One note must be made about the participants of the paired *t*-test. There were only a small proportion of the participant that answered twice and correctly. For exercise the participants were (N = 15) and for dietary intake (N = 13). There were five missing

participant from these analysis, probably from manually changing the answer from baseline to posttest based on the timestamps of the submissions. These were traditionally much too small samples, and thus these findings should be interpreted with caution (Field, 2018).

When analyzing small samples the statistical significance is less interesting than the effect sizes (Field, 2018). In the instance for the paired sample *t*-tests, the mean differences are more telling than the level of significance. The paired *t*-test for exercise yielded very surprising finds that did not support the hypothesis. The mean differences were not logically systematic, and there had been an increase in the mean of both the precontemplation factors as well a decrease in the preparation and action factors in the posttest. It seems appropriate to accept the null hypothesis that states there would be no differences between the group before and after having had access to the "Heia Meg" app. But it should be kept in mind that there was an increase in mean from the independent *t*-test, and it would be interesting to conduct more research with bigger samples.

However, the paired *t*-test for dietary intake did yield results more in line with the expectations. There had been a decrease in the mean of the earlier stages of motivation represented by the precontemplation factors, but also for preparation. There was also an increase of the mean for contemplation and maintenance and a statistically significant increase for action. From these result it appears appropriate to dismiss the null hypothesis for dietary intake, as the mean differences implies an increase in motivation after having had access to the "Heia Meg" app.

As for the correlation analysis for the participants that had used the app for 30 days and how often they had used it, there were no statistically significant correlations, but this is likely influenced by the small sample. There were medium effects for two correlations for exercise and medium to large effects for four correlation for dietary intake. This makes it appropriate to neither accept or reject the second null hypothesis claiming that having a higher use of the app will not correlate with having used the app frequently.

Theoretical interpretation

One of the most striking finds was the vast difference between the factor analysis and the original factors from TTMs stages of change. This begs the question, does the fault lie within the methodology of this project, or is this an example that should initiate some doubt questioning the validity of the transtheoretical models stages of change?

The factor analysis created factors that entailed overlapping stages, and for both behaviors it created entirely new factors that focused exclusively on the variables that included a social aspect. Additionally, the factors did not match for dietary intake and

exercise. One could definitely argue that this projects methodology lies at fault, but it seems unlikely that this is the sole cause due to the fact that the questionnaire for exercise was directly translated, and had the inner validity tested by an independent helper. As dietary intake was the questionnaire that was created for this project it would seem more likely that this would be the factor analysis with least similarities with the original factors. But as previously overviewed, dietary intake was the one with six factors extracted, not exercise. Furthermore, both questionnaires were equally mismatched with the original stages of change-factors.

Another interesting find was in the scree plots. For both target behaviors the scree plots opted to keep three factors. This could be an indicator that perhaps another theoretical interpretation of the data would have been a more beneficial fit to explain the variance. As previously discussed HAPA suggests three phases in the form of nonintender, intender and actor. If one examines the explained variance for both target behaviors as can be seen in table 3 and 5, the first factor explained 29.6 % variance for dietary intake and 26.6 % variance for exercise, while the second ones explained 13.0 % and 12.9 % respectively. For dietary intake the remaining explained variance for the following four factors started at 6.5 % and decreased to 5.5 % .This created a total of 65.2 %, but as we have examined the explained variance, the majority of the variance is explained in the first two factors composed of 42 %. For exercise the third factor explained 7.8 % and decreased to 4.4 % for the seventh. This created a total of 69.2 % of explained variance, with the two first factors holding 39.5 % of the variance being explained and the remained variance being quite evenly being spread out across the remining factors. Considering this I argue that this is not a strong indicator that a total of three factors would be a better fit at interpreting the data. For both behaviors, keeping two factors would explain approximately 40 %, with the following factors adding evenly more explained variance. If anything, an interpretation that only keeps two factors may be interesting to explore.

If one tries to understand these findings from the perspective of TPB one must first realize the difficulties understanding data based on stages in the light of a continuum model. In a continuum model the individual is placed on a scale that is supposed to reflect the likelihood of a specific action to occur based on self-efficacy, social norms and perceived behavioral control (Ajzen,1991). These constructs does have similarities to the processes of change, decisional balance and self-efficacy from TTM. However, since the two latter constructs were not measured in this project, this comparison was made difficult. But as discussed earlier there have been successful attempts at combing TPB and TTM for changing

behavior, and this may be the most important takeaway (Courneya et al., 2001). Collaboration between models may yield a greater understanding when appropriate to implement. However, for this study one can argue that TTM and HAPA are more sensitive at distinguishing the difference in phases of behavior change, especially in regard to maintaining new behaviors as discussed by Armitage (2005).

Health models and mobile-apps

In the theoretical background of the project there was done a comprehensive review of health models and mHealth. These theories have had had a lot of research focusing on the target behaviors in this study. However, the most interesting aspect of this project may be considered the adaption of health models to the technological field. This was of course not the first project to study this fusion, but as noted in the review of mHealth, the research here is limited due to its new format.

The real desire of this project was to contribute to the continued investigation of possibilities of digital health interventions thought mobile apps. As can be seen from these findings, the app itself was highly used with approximately 72 % of the second round-group reporting that they used the app between seven to three times during the week. That can indicate that the participants of this study found the app useful. Did they find the reminders efficient, and the messages pleasant, encouraging and hopefully even motivational? This begs the question, was this app efficiently designed for its intended user base?

As earlier discussed the review studies had made some conclusions regarding what should be included for a health promoting app to be efficient and well received. As a general format, the "Heia meg" app follows the guideline to most of the research agree with, as being grammatically correct, not using smiley's, emojis' and textees (Rose et al., 2017).

However there were some fundamental elements the application had not incorporated that has been deemed necessary by Podina and Fodor (2018) and Dowd et al. (2018) such as having an online community and giving specific feedback to the user. This was found particularly interesting because these types of tools may have been too intrusive if in fact the target population of the "Heia meg" app are in a contemplation stage. As both TTM and HAPA says, you cannot expect an intervention that is targeted for a person ready to take action to work for a person that is contemplating a change (Prochaska et al., 1992; Schwarzer & Luszczynska, 2008). However, with the processes of change advocating for encouraging an individual to go from the precontemplation stage to the contemplation stage, one should utilize consciousness raising, dramatic relief, and environmental reevaluation. To go from the contemplation stage to the preparation stage one should use self-reevaluation strategies.

As previously discussed. the Heia meg-app does include many of these strategies, combined with encouragement of specific activities like "how about going for a walk for 15 minutes today".

Another very interesting aspect was how the independent *t*-test and the paired sample *t*-test both yielded better results for the dietary intake -group. This was surprising because the questionnaire for exercise had been validated by others and the dietary intake questionnaire had not. This begs the question of why. Did the app accommodate the dietary intake-users better than the exercise-group?

Critique

It became apparent during the analysis that the survey had issues damaging the validity and reliability of the data. There were several participants that switched the target behavior between the first and second round, and thus could not be used for comparison in the paired *t*-test. There were also instances where the participants answered the questionnaire for the second time less than 30 days after the first time, thus invalidating the comparison. There were additionally participants that answered that it was the first time they answered for both rounds, even when there had been a 30 days interval between the submissions. For future research it could benefit to remind the participant of which behavior they had chosen, perhaps additionally remined them when they last took the survey.

The sample size for the baseline and posttest analysis was as aforementioned much too small. With samples of this size it is unwise to generalize the findings regardless (Field, 2018). With the analysis conducted on the whole group, the statistical power was higher, but the validity and reliability was damaged due to the technical errors with sending out the survey. Despite these issues there were some valuable insight to be gathered from the data.

The research question: Do we have an answer?

Due to the issues arising during the data-gathering the original research questions became challenging to explore. The research questions were based on the assumption that we would have more success in gathering the baseline and posttest data for the participants. However with a total of 15 participant for exercise and 13 for dietary intake that met the criteria, it can be argued that it may be beneficial to also focus on the independent *t*-test of round one and two even though this was not part of the original hypothesis. In this tests it was not possible to answer if participants that started off in the contemplation-stage to a higher degree progressed to a later stage. However, it was discovered that the contemplation stage had the highest mean for both target behaviors for round one. This can be an indicator of the target population of the mobile app. The majority of those that download the mobile app

resonate the most with the statement entailing contemplation to change their behavior. This changed in the second round, when the participant reported having had the app for over 30 days, where the statements the majority of dietary intake users resonated the most with action. For exercise contemplation was still the stage with the highest mean, but preparation, action and maintenance had increased. However those changes were not statistically significant, but the changes in the dataset were systematic.

Conclusion

This project has attempted to use the theoretical foundations of the TTM, HAPA and TPB to investigate the lifestyle-change app “Heia meg” developed by Helsedirektoratet. Whilst there were some challenges that come along with the methodology and execution, there has been collected valuable data that lead to some interesting insight.

With these results it seems reasonable to dismiss the null hypothesis for dietary intake, and conclude that “Heia meg” has had an effect in increasing motivation. The results for exercise were less conclusive. An obvious takeaway is the need for more research with a bigger sample, and better technological execution. However it does seem appropriate to conclude that mHealth is a very promising field that can be a part of a solution for the obesity epidemic. From the researching reviews and the data-gathering there definitely seem to be a want for these types of apps, and “Heia Meg” app is an excellent example of an app that can aid in lifestyle change.

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Appendix

Original questionnaire for exercise

1. As far as I'm concerned, I don't need to exercise regularly.
2. I have been exercising regularly for a long time and I plan to continue.
3. I don't exercise and right now I don't care.
4. I am finally exercising regularly.
5. I have been successful at exercising regularly and I plan to continue.
6. I am satisfied with being a sedentary person.
7. I have been thinking that I might want to start exercising regularly.
8. I have started exercising regularly within the last 6 months.
9. I could exercise regularly, but I don't plan to.
10. Recently, I have started to exercise regularly.
11. I don't have the time or energy to exercise regularly right now.
12. I have started to exercise regularly, and I plan to continue.
13. I have been thinking about whether I will be able to exercise regularly.
14. I have set up a day and a time to start exercising regularly within the next few weeks.
15. I have managed to keep exercising regularly through the last 6 months.
16. I have been thinking that I may want to begin exercising regularly.
17. I have lined up with a friend to start exercising regularly within the next few weeks.
18. I have completed 6 months of regular exercise.
19. I know that regular exercise is worthwhile, but I don't have time for it in the near future.
20. I have been calling friends to find someone to start exercising with in the next few weeks.
21. I think regular exercise is good, but I can't figure it into my schedule right now.
22. I really think I should work on getting started with a regular exercise program in the next 6 months.
23. I am preparing to start a regular exercise group in the next few weeks.
24. I am aware of the importance of regular exercise but I can't do it right now.

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