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CAN DIGITAL NUDGING GET MORE WOMEN TO PARTICIPATE IN CERVICAL SCREENING?

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I certify that the work presented in this thesis is my own unless referenced.

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Abstract

Cervical screening can radically reduce the incidence of cervical cancer. It is one of the few cancers that can be prevented due to screening. The Cervical Screening Program in Norway, therefore, recommends all women between the ages of 25-69 to participate in screening. Yet, approximately 250,000 women have not done so in the last ten years. This study explores whether digital nudging can get more women to participate in cervical screening. Based on theory from persuasive technology and digital nudging five persuasive messages were designed. These messages were presented to a representative sample for cervical screening through a survey to investigate how they were perceived. A total of 280 responses were solicited. Findings show that digital nudging in the form of persuasive messages can be effective to get more women to participate in cervical screening. However, some messages were more effective than others. The text message with the highest potential to get women to participate in screening, of those who were tested, was a message with a scheduled appointment. 87% of all the respondents answered that it is desirable to receive an invitation to cervical screening through a text message.

Contents

Motivation

The motivation for this thesis was twofold: Previous knowledge and interest in persuasive technology, and a desire to make a small contribution to women's health. Governments and policy-makers have increasingly applied theory from digital nudging to improve the health of the population. It has thus received a lot of attention in the health sector in the last decade. I wanted to use my knowledge in this field to make a small contribution to women's health. Cervical screening is a preventative measure against cervical cancer, which usually affects women between the ages of 25-69. Although research shows that cervical screening can radically reduce the incidence of cervical cancer, there are still too many women who do not participate in cervical screening [1]. Measures to increase attendance are therefore necessary to prevent incidences of cervical cancer and mortality.

Since digital nudging has been successfully implemented in various health interventions, it was relevant to investigate whether this could also be used to get more women to participate in screening. Hopefully, this study can be a contribution to the design of screening invitations.

Chapter 1

Introduction

1.1 Statement of problem

Cervical cancer is a type of cancer that affects women between the ages of 25-69. It is one of the few cancers that can be prevented due to screening [1]. The Cervical Screening Program in Norway, therefore, recommends all women between the ages of 25-69 to regularly attend screening, which includes taking a pap smear [2]. Still, many women choose not to do so. Approximately 250,000 women of screening age have not participated in screening in the last ten years [3]. Half of those who are diagnosed with cervical cancer have not followed the recommendations from the Cervical Screening Program [2].

As preventive measures such as screening exist, The World Health Organization (WHO) issued a goal in 2018 to eliminate cervical cancer worldwide [4]. By 2018, the incidence rate in Norway was 12,8 cancer cases per 100 000 women [2]. WHO´s goal is to reach an incidence rate of less than 4 cases per 100 000 women. It is, therefore, necessary to get more women to participate in screening to avoid incidences of cervical cancer. Currently, all women in screening age receive invitations to participate in cervical screening. These invitations are sent two months before it is time to take a new pap smear. By 2020, approximately 40% of these invitations were sent by mail, and 60% were sent as digital letters (Personal communication, The Norwegian Cervical Screening Program, January 26, 2021).

Researchers have investigated why women do not participate in cervical screening. Results show that the reasons are complex, but forgetting to schedule an appointment [5, 6, 7], having to book an appointment yourself [8, 9], and the current invitation

being too weak [8] is among the reasons. A recent study on non-attendees to the Cervical Screening Program in Norway reported that today's invitation strategy failed to motivate some women to participate in screening [8]. The researchers suggested that changes to the invitation strategy might be effective to increase attendance.

Persuasive technology has been widely used within the field of Human-Computer Interaction (HCI) to change, shape, or influence behavior [10]. Over the past decade, governments and policy-makers have used it to improve the health of the population [11]. A way of influencing behavior is through the use of nudging, which was introduced in 2008 by Thaler and Sunstein [12]. A nudge is defined as "Any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a nudge, the intervention must be easy and cheap to avoid" [12, p. 6]. Several studies have reported that nudging has been effective to influence or change health behaviors [13, 14, 15, 16, 17, 18]. Commonly used nudges in health interventions are persuasive messages sent through a text message (SMS). Persuasive messages change, shape, or influence behavior through text [10].

As parts of the healthcare industry have been digitized over the past decade, letters and phone reminders have increasingly been replaced by text messages [19]. Research show that text messages have been effective in various healthcare interventions, including screening [19, 20, 21, 22]. According to Guy et al. [23] short text message reminders have proven to increase attendance to scheduled appointments in healthcare.

This study used theory from digital nudging and persuasive technology to design digital nudges. The nudges were presented to the target population for cervical screening in the form of persuasive text messages to investigate how they were perceived. According to Jung and Mellers [24] an understanding of how the public perceives nudges are important to successfully implement them. If the public does not accept nudging it may provoke strong reactions and prevent the nudging from being effective [25].

1.2   Aim

The aim of this study was to explore if digital nudging could get more women to participate in screening. As screening is a preventive measure for cervical cancer, this was a step towards improving the health of women in this target population. This

study may be relevant for both research implications and implications for practice. Results can be used by practitioners to get more women to participate in screening. It will also provide valuable insights into how persuasive text messages perform in a health intervention.

1.3   Objectives

The objectives of the study were to apply theory from the field of persuasive technology and digital nudging to design a digital nudge implementation. The nudges were presented to representatives from the target population for cervical screening in the form of persuasive text messages. Data was collected using a method that was capable of capturing how women perceived the various messages.

1.4   Research questions

The problem statement for this master thesis was: Can digital nudging get more women to participate in cervical screening? To address this, four research questions were formulated.

- RQ1: Do women find the following nudges motivating? (Social norms, Default, Affect, Incentives, No nudge)

- RQ2: Do women find it ethically justifiable to receive a message with the following nudge? (Social norms, Default, Affect, Incentives, No nudge)

- RQ3: Do women want to receive an invitation to cervical screening through a text message?

- RQ4: Do different age groups (25-39 years old, 40-54 years old, 55-69 years old) respond differently to the nudges?

These research questions were able to address the problem statement. Previous studies report that the outcome of a nudge is dependent on the context [13, 14, 26]. It was, therefore, relevant to examine different nudges, to see if some performed better

than others. According to Schneider et al. [27] using the most effective nudge may have significant benefits. Some nudges may also have unforeseen consequences [27].

According to behavioral scientist Fogg [10], motivation is one of the three elements that change behavior. RQ1, therefore, aimed to investigate how motivated women were by the various nudges. This may indicate if nudging has the potential to influence behavior in this context.

The ethics of nudging have been discussed by researchers for a long time [26, 28, 29]. RQ2 aimed to investigate how ethical women perceived the various nudges. This provide insights on how nudges in this context can be designed to be ethical. According to Diepveen et al. [25] the public's acceptance of nudging is important for policy-makers when developing measures to change health behavior. If the public does not accept nudging, it may provoke strong reactions and prevent the nudging from being effective. Having knowledge of public acceptance is also important in order for policy-makers to act in the public's best interest.

Text messages have increasingly been used as an alternative to letters and telephone reminders in healthcare [19]. Research shows that this been effective in various healthcare interventions [19, 20, 21, 23]. RQ3 aimed to investigate how participants related to receiving an invitation through a text message. This could indicate whether text messages are an effective platform for screening invitations.

Because of the wide target population to cervical screening (women between 25-69 years old), RQ4 aimed to investigate if different age groups responded differently to the nudges. This could indicate if digital nudges should be adapted to various age groups, or if a "one size fits all" approach should be applied. The age groups that have been used are the same as the Cervical Screening Program uses [2].

Chapter 2

Related Work

This chapter presents relevant literature, theories, and findings from previous studies.

2.1   Non-attendees to cervical screening

Cervical cancer is a type of cancer that can be prevented to a certain extent by regular participation in screening [2]. The Screening Program in Norway was established in 1995 with the goal of getting more women to participate in screening [2]. Several measures have been taken to achieve this. The cervical cancer program currently recommends all women between 25-69 years old to participate in screening every third year. Invitations to are sent either digitally (60%) or physically (40%) two months before it is time to take a new pap smear (See appendix B) (Personal communication, The Norwegian Cervical Screening Program, January 26, 2021). Women are recommended to schedule an appointment with their general practitioner (GP) to take the pap smear. Additionally, the program launches a campaign (#sjekkdeg) every year in September to create awareness on the importance of attending cervical screening. Yet, numbers show that many women choose to not attend [3].

Through a number of studies, researchers have investigated why women do not participate in cervical screening. Results show that the reasons are complex, but forgetting to book an appointment [5, 6, 7], having to book an appointment yourself [8, 9], and the current invitation being too weak [8] is among the reasons. Ekechi et al. [7] conducted a study in 2014 where 937 women living in London answered a questionnaire. 28% answered that they wanted to attend screening, they just "did not get around" to

schedule an appointment. A study from Denmark reported similar results, as 32 % of women who participated answered that they had not participated in cervical screening because they forgot to schedule an appointment [6].

A recent study [8] provides valuable insight as to why Norwegian women do not participate in cervical screening. A group of researchers gathered 41 non-attendees to screening to get an in-depth understanding as to why they do not attend. The women were divided into nine focus groups, and four main themes were identified: "Women have to arrange their own appointment", "It's easy to forget about it", "It has to be a must" and "It's a humiliating situation" [8, p. 4]. The current invitation letter was also referred to as "too weak". It failed to motivate women to schedule an appointment to attend cervical screening. Additionally, women found it easy to postpone screening as they did not perceive it as critical, rather optional. It is not communicated as a "must" through the information in the letter. Some expressed that the letter should contain a scheduled appointment as invitations to breast screening do. Others compared the invitations to a dental appointment, which often includes a fee for not attending. Older women reported that they found it more difficult to attend cervical screening now than before, as they don't feel like they have a valid reason to schedule a pelvic examination. The majority preferred to have a female taking the pap smear. Some preferred to go to a gynecologist instead of their RGP. The researchers suggested that improvements in the current invitation strategy may increase the attendance to cervical screening.

This study only represents the perspective of women who have postponed screening for a shorter time period. It is therefore not representative of women who has postponed screening for a longer period of time. Women with a non-immigrant background and a high socioeconomic status were over-represented. The findings may therefore not be representative of the population for cervical screening.

2.2 Why nudge?

According to Thaler and Sunstein [12] people do not always make rational decisions for themselves. Bad decisions are made due to several factors, such as lack of self-control or lack of information. Several governments and policy-makers have used nudging to influence people to make what is considered a "better choice" for themselves [13, 14, 15, 21, 26]. The idea behind nudging is that small details can have a significant impact on people's behavior [12]. Nudging has proven to be effective in

various health interventions [13, 21, 30]. A recent study also reported that nudging increased participation in cervical screening among women in London [13].

Research shows that women do not attend screening because they forget to schedule an appointment [5, 6, 7], needs to schedule it themselves, [8, 9], not perceive it as important [8] and are not motivated by the invitations [8]. These are all reasons that occur before the actual screening. Influencing them to participate in this phase, which is when they receive an invitation, could therefore be an effective measure to get more women to participate in screening. According to behavioral scientist Fogg [10], motivation is one of the three elements that change behavior.

Designing effective digital nudges requires a thorough understanding of how people make decisions. Additionally, it requires knowledge of how to design persuasive technology, and which nudges that have been effective in similar contexts.

2.3   Human-Computer Interaction and Health

New technology is constantly evolving, and more industries are becoming digital, including the healthcare industry. A large part of the communication between health services and the public is currently done digitally [31]. This is due to the development of digital solutions in the last decade [31]. A number of measures have been initiated by the Norwegian government to keep up with the speed at which technology is being developed [32]. The first action plan for information and communication technology (ICT) in the health sector was issued in 1997. The goal was to make electronic message exchange the "normal" method of communication by the year 2000 [32]. Another measure to strengthen the ICT field in the health sector was the creation of the "Directorate for e-Health" in 2016. The directorate is supposed to strengthen the digitization in the health sector and create modern and effective health services that are easy to use [32]. In recent years (2019-2020) a proposition for a new e-health law has been formed in order to improve digital solutions in the sector [33]. In the proposition, made by the government, a report from OECD (The Organization of Economic Co-operation and Development) is mentioned. The report entitled "Health in the 21st century" states that the health sector is 10-15 years behind in digitization and electronic data, compared to other sectors [32].

As technology plays an important role in the delivery of information from healthcare services, HCI practitioners have become interested in this field [31]. Health inter-

ventions are often developed to reach out to large parts of the population, and some of them are complex. Most people will need some kind of a health intervention during their lifetime, so it is important that they are easy to use for a variety of people. According to Blandford [31] HCI practitioners are essential in the design and development of these interventions to ensure that they are user-friendly. There should be cooperation between technology developers, health experts, and HCI practitioners to ensure that these systems are fit for the purpose [31].

2.4   Persuasive Technology

Persuasive technology has been widely used to change, shape, or influence behavior in a variety of application domains [10]. The field was introduced in the 1990s by behavioral scientist Brian Jeffery Fogg. He defines persuasive technology as "computing systems, devices, and applications that are designed to change users attitude or behaviors" [10, p. 1]. To design persuasive technology Fogg has presents a behavioral model which consists of three different elements: Motivation, Ability, and Prompt [34]. All of these have to occur at the same time in order to change behavior. A person must have high motivation, high ability, and an effective trigger for a behavior change to take place. According to Fogg [34], there was a need for such a model in order to create successful persuasive technology. Several researchers had previously failed in the design of persuasive technology because as they lacked a basic understanding of human behavior.

Fogg [10] believes that people often treat computers as they were human beings, which is why he refers to computing products as social actors. Five types of social cues are presented, which Fogg believes can be used by computing products to persuade users: Physical, language, psychological, social dynamics, and social roles [10].

According to Fogg [10], the more attractive and "real" the interface or hardware is the more persuasive it becomes. This provides an opportunity to persuade through physical cues and can be achieved by using realistic figures, images, and other characteristics. People have different opinions as to what they find attractive, it is therefore important that designers understand their target population when designing persuasive technology [10]. Using language to persuade can be achieved either through text messages or chat-bots. Personalized text messages like using people's first names may be effective. Additionally, Fogg believes that social dynamics can be used to persuade

people [10]. Computing products may utilize information on how people would have interacted in reality, and recreate this in the digital environment. He also proposes social roles as a cue for persuasion. By social roles, he believes that people behave differently with authorities. Computer products may also act as an authority, which gives the opportunity to persuade. Finally, psychological cues may be effective to persuade people through emotions. Computing products may express different emotions, such as happiness and sorrow, through the use of text and images [10].

Persuasive technology is widely used within Human-Computer Interaction and can be seen in a variety of application domains such as marketing, education, politics, and health [20]. Over the past decade, governments and policy-makers have used it to improve the health of the population [11]. Orji and Moffatt [11] conducted an empirical review of 85 papers where persuasive technology has been used for health or wellness. They reported that it has been an effective approach for shaping/changing behavior in the range of health and wellness. As much a 92% of the studies in their review reported positive outcomes. They also reported that persuasive technology is most frequently used in mobile and handheld devices [11].

2.5 Digital Nudging

A way of influencing behavior is the use of nudging [12]. Researchers around the world have used nudging to guide, change or influence human behavior. It has been used both by private companies to achieve higher income, and by governments to improve the health of the population. According to Thaler and Sunstein [12] the idea behind nudging is that small details can have a significant impact on people's behavior. A nudge should not exclude any alternatives, it is only supposed to influence people´s behavior in a predictable way and has to be easy to avoid. By using this knowledge researchers have designed online environments that guide users towards desired behavior by making small changes in how the information is presented [12]. This is often changes that require small resources and are cost efficient. Nudging has been used in both physical and digital environments. However, there is a difference in how digital nudges are designed compared physical nudges. Weimann et al. [35, p. 1] defines digital nudging as " the use of user-interface design elements to guide people's behavior in digital choice environments". Choice architects, therefore, have significant power to influence the choices by organizing how it is presented. According

to Schneider et al., [27] nudging is used in online environments by making changes to the interface. There are several ways this can be done. Modifying how something is presented, like changing the order, color or shape are some of the methods that are used by choice architects [27]. The timing of the nudge is also an important part of successfully nudging in digital environments. According to Thaler and Sunstein [12] how a nudge performs depends on the situation in which it is used. Nudging people at the right time is therefore important to achieve what is desired. People are more susceptible to being influenced by a nudge in a situation they have not experienced before or which they find difficult [12].

According to Schneider [27] people are nudged every day. How something is presented to us will affect what we choose, which makes it difficult not to nudge. This is consistent with what Thaler and Sunstein [12] believe. According to them, there is no such thing as a "neutral" design. People will always be influenced in one direction or another, whether we want to be or not.

Can nudging be harmful?

Although nudging is referred to as a promising tool to change behaviors, there are situations where nudging fails to be as effective. Unexpected effects of a nudge implementation may occur, which can cause the nudge to have adverse effects. Results from a study on physical activity trackers [36] showed that feedback with social comparison only motivated the participants if the comparison were similar to the participant's performance. Such unexpected effects may cause more harm than good, especially if the nudge has not been tested before it was if implemented.

Nudges are often developed to suit an entire population, individual differences are therefore not considered [37]. When nudging is used in health intervention, the target population often consists of hundreds of thousands of people. In these cases, a "one size fits all" approach is commonly used. As individual differences are not accounted for, this may end up doing more harm than good for some people [37].

Through a review of technology-mediated nudging in HCI, the sustainability of a nudge was discussed [38]. A small number of studies reported that nudging successfully influenced behavior, but failed to influence behavior over time. Most of the studies that were reviewed had a duration time from one day to a month. It is therefore unsure how effective a nudge is in a long-term perspective.

Libertarian Paternalism

Thaler and Sunstein [39] introduced the contradictory movement of libertarian paternalism in 2003, which became known when they published their book on nudging. The libertarian principle is all about free choice, while paternalism is the interference of choice architects to influence behavior. Economists believe that humans have all the information they need to make rational decisions, this kind of human is called for a homo economicus [12]. The movement libertarian paternalism was formed because Thaler and Sunstein believe that we are only humans, not homo economists. People are influenced by the environment in one way or another when they make a choice. Some of the reasons why people make bad decisions are because they lack information or self-control, or because they are not paying attention. The idea behind libertarian paternalism is that it should be possible to influence behavior and at the same time respecting freedom of choice [12].

2.5.1 Nudging in Healthcare

Governments and policy-makers have increasingly applied theory from digital nudging to improve the health of the population [13, 14, 15, 16, 17, 18]. It has thus received a lot of attention in the health sector in the last decade. During Barack Obama's presidency, he created his own department for nudging [40]. Cass R Susntein, who introduced nudging together with Richard Thaler, has advised this department with his expertise. David Cameron, former UK prime minister, created a team called The Behavioural Insights Team (Also called the Nudge Unit) [41] to improve public services. Richard Thaler has advised this team with his knowledge in this field.

According to Harrison et al., [42] some nudges are more effective than others in health interventions. He recommends five nudges as best practice: Default options, enable/active choice, prompt implementation intention, frame information, and provide information [42]. Those who are seen as most effective, if implemented right, are defaults and enable/active choice. These are provided at the time when the decision is made. A way of using the default nudge is to change from an opt-in condition to an opt-out condition [42].

In an attempt to get more health care workers to take an influence vaccination, Lehmann et al. [16] tested whether a nudge with a scheduled appointment would have an effect. The study included 122 health workers. Participants were divided into

two groups. One group received the scheduled appointment and the other received an encouragement to take the vaccine. Results showed that participants who received the scheduled appointment were more likely to take the vaccine. According to Kahneman [43] when people are faced with several choices they often choose the default option because it does not require any reflection or time.

The behavioral insight team was established by the UK Cabinet Office in 2010 [14]. In 2013 they conducted one of the largest randomized controlled trials ever done in the UK, where they tested if different persuasive messages could get more people to sign up as organ donors. They implemented eight different message variants on a website with high traffic, to nudge visitors to sign up as organ donors. The various messages were created based on the MINDSPACE framework, which is created by the same team [44]. The messages were based on social norms, loss/gain frames, commitment, and affect. The message that got most people to sign up as organ donors were a message based on commitment. People were told that if they would ever need an organ donor, they would probably want people to sign up. They should therefore sign up to help others themselves [14]. Even though most of the messages led to more people registering, not all of the variations performed as well. They tested the same message with and without a stock photo and reported that the picture had no effect. According to the authors, the stock photo may have given the participants a feeling that it was a marketing gimmick. Findings show how much difference small changes can make. The researchers even stated that if they were to use the message that performed the best throughout the year, it would have lead to around 96,000 more registrations.

Nudging in screening

To ensure high participation in screening programs policy-makers has started using nudging as a tool [26]. Some of the most used interventions to increase screening attendance are persuasive messages, pre-screening reminders, personalized letters, and scheduled appointments [26, 29]. According to Hofmann and Stanak [26], who reviewed 109 studies related to nudging in screening, the outcome of a nudge is dependent on the context. One target population may react completely differently than another. It is therefore important that the design and implementation of a nudge are adapted to fit the context. Several studies have addressed the question of nudging in screening, and whether this may be effective or not. However, there is apparently less

empirical research on how nudging has actually performed in screening, especially cervical screening.

Huf et al. [13] investigated whether text message reminders with a specific content would have an impact on the cervical screening rates in Northwest of London. Women between 24-64 who were invited for cervical screening in 2015 participated in the study, in total 14,538 women. They were divided into two different groups: women between 24-29 years old who receive their first invitation (Study 1) and women between 30-64 years old (study 2). Participation in the screening program in this area of London is declining especially among women who receive their first invitation (women between 24-29 years old). Women in this group received either no text message reminder or a reminder directly from their GP. This was done to test the effect of a text message reminder. The other group of women was exposed to various nudges to see which one that were the most efficient. The messages were based on the MINDSPACE framework. One included "social norms" and two others were based on the "gain-and loss frame". Additionally, this group also received a message directly from their GP. Results showed that SMS reminders improved attendance among women in this area of London. The most efficient message was the one that was sent by their GP. The SMS with no nudge had the second-highest improvements in uptake, which according to the researches [13] might be because of the short, simple message that does not require any cognitive effort to read. The messages with social norms did not seem to have any major effects, which according to the authors might be because of the way it was formulated. The message consisted of the number of women who participated in screening last year. This number may have been lower than what the participants expected. The gain- and loss-framed messages did not either have a significant effect on the uptake. However, when the researchers compared the gain - and loss-frame, the result showed a significantly higher uptake with women who had received the loss-frame. This study is one of few that looks at the effect of nudging through text messages for cervical screening. The results are interesting and relevant for this study. Both the design of the messages, implementation, and execution.

Gotlieb et al [45] investigated whether gamification could lead more women to attend cervical screening in Norway. The Cancer Registry of Norway collaborated with Simula Research Laboratory to develop a mobile application which was called *Fight-HPV*. The goal was to nudge women to attend screening and to inform them about the importance of HPV vaccination. The application was launched in 2017, the same

time as the study was published, so the researchers have not reported if the intervention actually increased attendance to screening. However, it shows that the Cervical Screening Program in Norway is aware of nudging as a tool to increase participation in screening.

Nudging women to attend cervical screening through an application was also tested by Klasjna and Pratt [22]. They investigated whether the combination of a text message and an app could increase cervical screening rates. The study took place in London, and 1464 women who were at least six months overdue to screening were identified. The participants received a text message that they were overdue to screening, with a link to an app they could download to schedule an appointment. Findings showed that scheduling an appointment through an application was more acceptable with younger women than the older ones. Out of all the women who got the message 10% ended up ordering an appointment, however, only 1/4 of these women downloaded the app and booked directly from there. The researchers, therefore, concluded in their study that the "key" ingredient was the text messages and not the app. For future research they suggested looking at different message variants, to determine what is the optimal message.

Ethical implications of nudging in screening

Criticism has been directed to some screening programs due to several issues, such as the fact that it can lead to over-diagnosis [26]. This has led to a discussion about whether nudging in screening is ethical or not. Some believe that participants should be free to choose for themselves, while Hofmann and Stanek [26] believes that nudging is ethical in screening as long as the benefits of screening is higher than the harm. They believe that it is hard to offer screening in a way that does not influence what people choose. The question is not if a screening program should nudge or not, rather how to nudge in an ethical way [26].

Nudging through text messages

As a large part of the healthcare industry has been digitized over the past decade, letters and phone reminders are increasingly being replaced by text messages [19]. A large part of the communication between health services and the public is currently done digitally [19]. Research shows that text messages have been effective in various

health interventions [19, 20, 21, 22, 23].

One of the reasons why mobile phones are so prevalent for health interventions is because they have become ubiquitous [20]. People carry with them their phone everywhere, which makes them available at all times. Mobile phones also have countless capabilities (text messages, internet, applications etc), and most people are familiar with the interface. They are affordable considering the numerous different versions, and accessible as they are easily available. Thackeray and Hunter [46, p.577] define mobile devices as "A communication device that uses wireless technology to send information or communication across distances to other devices or people. Cell phones are the most common". According to Klasnja and Pratt [20] people are more open to interventions through their phones as each individual has created a customized phone to which they are positively attached. Receiving a text message or another form of intervention may, therefore, be more acceptable as the user have an emotional relationship to their phone. Mobile phones also open up for interaction with the user, whether it is through a phone call, text messages, or communication through an application. Statistics from Norway show that by 2020 99% of people in the age of 9-79 owned a mobile phone, and 96% had access to a smartphone [47].

According to Guy et al. [23] short text message reminders have proven to increase attendance to scheduled appointments in healthcare. Through a literature review of 18 studies where text message reminders were used in healthcare, all of them reported that it had significant effects on attendance to scheduled appointments. Short text message reminders are therefore viewed as an efficient intervention for attendance to health services [23].

It has also been reported that text messages have been effective to increase attendance to cervical screening and breast screening [13, 21, 22]. Kerrison et al. [21] reported that text message reminders increased participation in breast screening. The study included 2240 women who received their first invitation to breast screening. All of the participants received a regular invitation, while half also received a text message with a reminder of the appointment. Results showed that were significantly more women who participated in screening from the group who received the text message.

Digital nudge design

There are several approaches, frameworks, and "toolkits" for designing digital nudges. Since this study addresses digital nudging in healthcare, it is relevant to look at which nudges are used within this field. As previously mentioned, Harrison et al. [42] have proposed defaults and enable/active choice as the most efficient nudge implementations in healthcare. Additionally, there are two frameworks that are widely used: The MINDSPACE framework [44] and Caraban et al. [38] framework on technology-mediated nudging in HCI. The first one, MINDSPACE [44] is presented as a "toolkit" or a "checklist" by the authors. It consists of nine different elements for behavior change (see Figure 1). According to Dolan et al., these [44] are the most robust effects when it comes to influencing behavior, based on past and repeated founds. This "toolkit" has been widely used by policy-makers to increase public health. In 2013 the behavioral insights team designed nudges based on the MINDSPACE framework in one of the largest randomized controlled trials in the UK [14]. Huf et al. [13] also used the MINDSPACE framework to design nudges with the goal of increasing participation in cervical screening. The framework does not provide an explanation of how it should be integrated, as it should be implemented with consideration for the surroundings. The context in which the nudge is presented will affect how it performs [44].

Table 1
The MINDSPACE framework for behavior change.

MINDSPACE cue	Behaviour
Messenger	We are heavily influenced by who communicates information to us
Incentives	Our responses to incentives are shaped by predictable mental shortcuts such as strongly avoiding losses
Norms	We are strongly influenced by what others do
Defaults	We 'go with the flow' of pre-set options
Salience	Our attention is drawn to what is novel and seems relevant to us
Priming	Our acts are often influenced by sub-conscious cues
Affect	Our emotional associations can powerfully shape our actions
Commitments	We seek to be consistent with our public promises, and reciprocate acts
Ego	We act in ways that make us feel better about ourselves

Figure 1: The MINDSPACE framework.

Caraban et al [38] present a systematic review on different types of nudging that have been identified in the field of HCI. Nudging has been researched for many years, however, the researchers missed a framework on how to effectively implement nudge interventions. They identified 23 different nudging mechanisms used in HCI, which were placed in 6 categories; *Faciliate, Confront, Deceive, Social Influence, Fear, Reinforce*. The identified nudges are presented as a framework for future digital nudging in HCI [38]. Both of these frameworks contain nudges that have shown to be effective in vari-

ous health interventions. However, some are more commonly used in health interventions than others:

Default: Default is repeatedly mentioned as one of the most effective nudges in health interventions to influence behavior [38, 42, 44]. According to Kahneman [43] when people are faced with several choices they often choose the default option because it does not require any reflection or time. Currently, The cervical Screening Program in Norway sends open invitations where it is recommended to attend screening. Lonnberg et al. [30] investigated whether it could be effective to change the default from being a recommendation to a scheduled appointment. Results showed that this increased participation in cervical screening.

Changing the default from being an opt-in to opt-out has also been effective in getting more healthcare workers to take an influence vaccination. Lehmann et al. [16] changed the default from being a recommendation to a scheduled appointment. Results show that the participants who received the scheduled appointment were more likely to take the vaccine than those who only received an encouragement.

Social Norms: Nudges based on social norms is mentioned in both the framework on technology-mediated nudging in HCI [38], and in the MINDSPACE framework [44] as effective nudges to influence behavior. Additionally, social norms are similar to one of Fogg´s social cues for designing persuasive technology: Social dynamics. [10]. According to Axelrod [48] established norms within a group can have significant power, as it is behavioral expectations individuals try to achieve. It represents what is an acceptable way of behaving within a group of people or a society [48]. People want to deliver what they feel is expected from them, which is what the social norm nudge takes advantage of [38].

An experiment conducted by Wagner et al.[49] tested whether people that had no intention to participate in screening could be motivated to attend if the uptake to screening were higher than they had expected. The results showed that this was an effective way to motivate people to attend screening.

Affect: According to Dolan et. al [44] and Caraban et al. [38] emotional messages are powerful in decision-making. The MINDSPACE framework has called this way of influencing behavior *affect*. Several studies have designed nudges that are based on fear-appeals [13, 14, 50], which exploits the person's feelings in order to make them behave in a certain way. Fear-appals can be implemented by presenting something in

a way that makes the person afraid of missing out or afraid of losing something. This may lead to the desired behaviour. Emotional messages are similar to one of Foggs [10] social cues for persuasive technology: Psychological cues.

In a meta-analysis of 127 articles, Tannenbaum et al. [50] examined the effect of fear appeals on influencing behavior. In almost all of the studies, it was reported to be effective. It was found that messages with a significant degree of fear were the most effective. Within the category of fear-appeals, messages containing a loss-frame are commonly used and have proven to have a small positive effect on participation in cervical screening [13], and to get more people to sign up as organ donors [14].

Incentives: According to the MINDSPACE framework [44] economic incentives can be a robust effect to influence behavior, as people are sensitive to cots. According to Kahneman [43] people dislike losing more than then they like winning the same amount. The significance of an economic loss depends on who sees it, as people have different reference points [43].

A study by Volpp et al. [17] investigated whether incentives could motivate weight loss. The participants deposited an amount of money and were told that they would get it back if they lost weight. Results showed that the incentives worked, as the participants lost a significant amount of weight. It has also been reported that incentives were effective for smoking cessation [18]. In a study from the United States, two groups of people received information about smoking cessation, of which one also received economic incentives to quit smoking. The results showed that it was significantly more people from the group that received incentives who stopped smoking than from the other one.

2.6   Behavioral Science

Human behavior is complex and shaped by several factors, such as previous experiences and physical, emotional, and cultural factors [51]. Each person's reference point influences how they behave and the choices that are made. According to Glanz and Bishop [51], an understanding of the most influential factors as to why people behave as they do may lead to more knowledgeable health programs. It is therefore important to have a thorough understanding of how people make decisions to ensure participation in health programs.

Psychologist Daniel Kahneman, who was awarded the Nobel Prize for his work

in economics, has spent a lot of his time trying to understand how people make choices [43]. Much of today's literature in this field is therefore based on his findings. In order to understand how people make choices, there are two theories that are of interest: The dual-process theory and status quo bias.

Dual-process theory

According to Kahneman [43], our choices are based on two ways of thinking, the automatic and way (system 1) and the reflective way (system 2). The automatic way is responsible for skilled actions, actions that we don't have to reflect on but perform automatically, like riding a bike. We often use emotions or previous experiences to make choices fast. According to Kahneman, [43] this way of thinking is responsible for 95% of our daily decisions. In situations where the automatic way of of of thinking is used we apply heuristics in order to make fast and efficient decisions, which are mental shortcuts. Even though heuristics helps us to make fast decisions, it often leads us to choose the default option, instead of using the time to consider all the options. According to Thaler and Sunstein [12] nudges influence automatic choices, and rarely the reflective ones. The reflective way of thinking is the opposite, it's goal-oriented and slow, and is only used in situations the automatic system cannot handle.

Status quo bias

According to Samuelson and Zeckhauser [52] people usually have a *status quo* alternative when making decisions. We could either choose to do nothing, to keep the status quo, or we could choose the option that improves the current situation. Experiments show [52] that people usually stick to the status quo instead of choosing the option that in a long-term perspective could be the most beneficial. According to Samuelson and Zeckhauser, [52] this means that people often choose the default choice.

Johnson and Goldstein [15] investigated whether changing the defaults in organ donation could be effective to get more organ donors. Results showed that changing the default to an opt-out condition has the possibility to double the number of organ donors. In this condition, people have to opt-out if they do not want to be an organ donor, as opposed to an opt-in condition where they have to sign up.

2.7   Ethical Implications

There is an ongoing debate on whether nudging is ethical or not [28, 53, 54]. Much of the criticism is directed at the fact that nudging is manipulative. According to Thaler and Sunstein [12], the idea behind nudging is that people should not be aware that they are being nudged. Goodwin [53], which is an opponent of the concept of nudging, believes this undermines human control. Additionally, Goodwin argues that nudging should be rejected as it does not solve the "big problems" faced by society, such as health.

According to Thaler and Sunstein [12], a nudge preserves the freedom of choice based on the idea of libertarian paternalism. Goodwin disagrees [53], arguing that influencing people to adapt to a different behavior does not preserve freedom of choice. Another researcher who has engaged in this discussion is Wilkinson [54]. He believes that whether a nudge is manipulative or not depends on what the intentions of the nudger are. If the nudger has manipulative intentions the nudge becomes manipulative.

Thaler and Sunstein [12] believe that nudging is ethical as long as the nudge is easy to avoid and does not exclude any options. They believe that people will always be influenced in one direction or another, whether they want to be or not. According to Hansen and Jespersen [28], the level of transparency of a nudge is what decides if it is ethical or not. If the intentions of the nudge are clear, the nudge is ethical.

2.7.1   Public acceptance of nudging

The public's acceptance of nudging is important for policy-makers when deciding on which intervention to use to change health behavior [25]. If the public does not accept nudging, it may provoke strong reactions and prevent the nudging from being effective [25]. Having knowledge of public acceptance is also important in order for policy-makers to act in the public's best interest.

Through a number of studies, researchers have investigated the public acceptance of nudging. Results show that a high proportion of people found it acceptable [24, 55, 56]. Cass and Sunstein [56] reported that people from six European countries (Denmark, France, Germany, Hungary, Italy, and the United Kingdom) supported nudging. The data was collected through a variety of surveys. Participants accepted the nudge if they believed that it matched most people's interests. Additionally, results

showed that a majority of people did not support a nudge that contained economic incentives. Hagman et al. [55] reported that the acceptance of nudging was also high in Sweden and the United States [55]. However, the acceptance of nudges related to social welfare was higher than nudges that focused on private welfare.

2.8 Summary

This chapter reveals that digital nudging has increasingly been used by governments and policy-makers to improve the health of the population. It has thus received a lot of attention in the health sector in the last decade.

Several approaches, frameworks, and "toolkits" for designing digital nudging have been published. A majority of the nudges that have been used in health-related studies can be found in two frameworks: The MINDSPACE framework [44] and Caraban et al´s [38] framework on technology-mediated nudging in HCI. However, some nudges are more commonly used than others in health-related studies, these are *default, social norms, incentives and affect/fear*.

Several studies have addressed the question of whether nudging can be effective in increasing participation in screening. However, there is apparently less empirical research on how nudging has actually performed in screening. There are also few studies on how digital nudging has performed over time in health interventions. Most studies have investigated the effect of a nudge with a duration time of one day to one month. It is therefore uncertain how effective digital nudges are in a longer time perspective.

There is an ongoing debate on whether nudging is ethical or not. Some believe that nudging is ethical as long as the nudge is transparent, while others believe that it manipulates the user's choice. However, there seems to be an agreement among some researchers that the intention behind the nudge decides whether it is ethical or not.

Chapter 3

Research Method

This chapter presents the methodology approach. Detailed information about the execution, participants, digital nudge design, and measures taken to ensure reliability and validity are provided.

3.1 Methodology

The aim of this study was to explore if digital nudging could get more women to participate in screening. To investigate this, several research questions needed to be addressed. First of all, it was relevant to examine different nudges. Previous studies report that the outcome of a nudge is dependent on the context [13, 14, 26]. Additionally, it was relevant to examine how motivated women were by the different nudges, to determine if it would have influenced them to participate in screening. According to behavioral scientist Fogg [10], motivation is one of the three elements that change behavior.

There has for a long time been a discussion among researchers whether nudging is ethical or not in healthcare and in screening [26, 28, 29]. It was, therefore, relevant to investigate if women found it ethically justifiable to be nudged. Since the target population for cervical screening is so large (Women between 25-69 years old), it was also relevant to investigate if there were any differences in how the groups related to nudging.

Text messages have been increasingly used as an alternative to letters and telephone reminders in healthcare [19]. Research shows that it has been effective in various healthcare interventions, including screening [19, 20, 21, 22]. It was, therefore,

relevant to investigate whether participants found it desirable to receive an invitation through a text message.

To answer these research questions, data representing the target population for cervical screening had to be collected. Quantitative research was therefore considered relevant, as it facilitates the collection of data from a large number of people that is descriptive of a user population [57].

The data was collected through a survey where the goal was to get as many women as possible from the target population to cervical screening to answer. Five different text messages were presented. Four of them contained a nudge and one did not. Respondents were asked how motivated they were by the various messages and if they found them ethically justifiable by the Cervical Screening Program to send. Additionally, questions about age, previous experiences, and attitudes were asked to analyze if there were any differences between groups.

Asking participants how they perceive the different nudges gives an indication of whether they would be effective in the specific context. The advantage of using this method is that it is possible to predict how the nudges will perform. Some nudges have previously proven to do more harm than good [44]. According to Hofmann and Stanek [26] some nudges may work against their purpose resulting in low attendance, as some social groups can experience it differently than others. By using a survey, such issues are identified before they can do any harm.

3.2   Choice of method

In order to collect data that were representative of the target population, a survey was considered the most relevant. According to Lazar et al. [57, p. 105] a survey is a "well-defined and well-written set of questions to which an individual is asked to respond". Some refer to surveys as a questionnaire, which has led the two terms to be used interchangeably [57]. According to Dillmann [58, p. 149] a questionnaire is "only one element of a well-done survey". A survey is seen as the methodology approach which includes the whole process of collecting and analyzing data [57]. This study will therefore use the term survey as it reflects the whole process of data collection and not just the list of questions.

A survey was seen as appropriate as it reaches out to a wide target population that is geographically spread in a short period of time [57]. It provides valuable de-

scriptive information on characteristics and attitudes from a larger number of people. Additionally, a survey can be kept anonymous, which may result in more respondents. According to Lazar et al. [57] surveys are frequently used in HCI.

One limitation is that participants may misunderstand questions, which gives incorrect results. It is also possible that the answer alternatives do not reflect what the participant wants to answer. Additionally, a survey is dependent on measures that ensure validity and reliability for the results to be representative and accurate [57].

Several methods were considered before choosing to use a survey. The fact that physical contact has been limited during the Corona pandemic, made some methods less suitable. In a study on non-participants to the Norwegian screening program [8] focus groups were used to get an in-depth understanding as to why some women do not participate in screening. This method was considered as it would have provided an in-depth understanding of what kind of messages would influence women to participate in screening. In contrast to a survey, focus groups provide the opportunity to ask open-ended questions that gives a deeper understanding of the addressed subject [57]. Discussions that arise in focus groups can provide new viewpoints and reveal similarities between the participants [57]. According to Lazar et al. [57], this method requires the researcher to have observational abilities for it to be successful. Little experience with this method was one of the reasons why it was not chosen. Additionally, the data that are collected through focus groups would not be relevant to answer the study's aim. Due to the corona pandemic, it would not have been possible to convey this method physically. It may therefore be that digital discussions would have limited the flow of the conversation.

Other similar studies have used field experiments to nudge the target population [13, 14, 30]. Huf et al. [13] collaborated with the screening program in London, and implemented persuasive messages in their current invitation program. The messages were sent directly to participants of the screening program. One group received a persuasive message while a control group did not. Testing how persuasive text messages in the representative environment performs could have been relevant for this study, and was therefore considered. However, time restrictions and resources did not make it possible. The Cervical Screening Program in Norway does not currently use text messages in their program. It would therefore have been too extensive to implement.

Few similar studies have used surveys to test the effectiveness of a nudge. Most of the studies have tested the effectiveness through field experiments, but there is ap-

parently less research on how it is perceived by the receiver. According to Jung and Mellers [24] an understanding of how the public perceives nudges are important to successfully implement them.

Surveys give an opportunity to ask additional questions that may provide a deeper understanding as to why some messages are more influential than others. It is also possible to investigate whether internal or external factors such as age or previous experiences affect how influenced participants are by different nudges. Additionally, it is possible to ask a large number of participants if it is desirable to receive an invitation through a text message.

3.3   Survey design

To collect the necessary data, an online survey was conducted. The entire survey can be seen in Appendix A. The survey design and details are described below.

Target population

The target population for this study was women between 25-69 years old who are recommended to participate in cervical screening in Norway. In order to get a representative sample of participants, an attempt was made to spread the survey through various channels by people in different age groups. Due to the corona epidemic, it was difficult to recruit participants. A total of 280 women between 25-69 years old responded. According to Lazar et al., a [57] large sample size may increase the validity of a survey and reduce random errors.

Random sampling of participants has usually been considered as a sign of validity [57]. According to Lazar et al. [57] research communities view this differently. Surveys without random sampling have been considered valid for many years in the HCI community [57].

Questions

To ensure that each question in the survey was neutral, comprehensible, and not biased, guidelines for designing questions for surveys were followed. According to Gripsrud et al., [59] each question should be kept to a minimum and only contain words that are familiar to most people. This resulted in a total of eleven questions.

Additionally, Gripsrud et al. [59] recommend that a question only asks for one thing. Nor should they be biased or nudge respondents to respond in a particular way. To ensure that all of these guidelines were properly followed, a pilot was conducted, which are presented later in this chapter.

Most of the questions had Likert scale answers instead of Yes/No answers. This was done to get more detailed and representative answers [60], but also to not increase the user's cognitive load. Similar answer alternatives allow participants to become familiar with the options. Participants were asked to answer the extent to which they agreed or disagreed with different statements. They responded using a five-point Likert scale.

Construction

The survey consisted of three parts that were divided into three pages. This was done to prevent the participants from going back to change their answers. A short introduction gave a description of the theme and purpose so that the participants understood the context. It was also informed that the survey was anonymous.

According to Malhotra, [60] it is important that the visual presentation of the survey represents the content. To keep the design neutral, a grey color was chosen for the background, along with a standard font for good readability. Google Forms was chosen as the program for the survey due to previous knowledge.

Pilot test

A pilot test was conducted to identify and eliminate any questions that were confusing, biased, or misunderstood [57]. Pilot testing was done three weeks before the actual survey, with eight people from different age groups. The youngest participant was 26 years old while the oldest one was 62 years old. The pilot was conducted digitally due to corona restrictions. In order to get immediate feedback while the participants were taking the survey, they were called on Facetime. Any doubts related to a question were carefully analyzed.

Some of the feedback provided by the participants were related to comprehensible words, vague formulations, and biased text. An example of an adjustment that was done after the pilot was to change the word "convinced" to "motivated" in the sentence "Based on this message, do you feel convinced to take a pap smear?". Some

of the participants perceived this differently. It was also mentioned that it would have been nice to know the approximate time it takes to answer all the questions. This was therefore implemented in the introduction.

Some women in the oldest age group had some technical issues when answering the survey on their mobile phones. In order to see all the answer options, you had to "swipe" on the screen, which was not intuitive for all. It was therefore written in the introduction that it was recommended to conduct the survey on a computer, in addition to an explanation of how to do it on a mobile phone. After the adjustments were made, the survey was tested again on four people from the same group, to ensure that the new adjustments were understood correctly.

Reliability and validity

Measures have been taken to ensure the reliability and validity of the survey. According to Lazar et al. [57, p.59] an experiment is reliable if it can be repeated by other researchers and give the same results. For this to be possible, it is important that the questions are understood correctly and similarly by all participants. This was ensured through a pilot with participants that were representative of the target population. Questions that were confusing were rephrased. To make sure that the new adjustments were understood correctly, some of the same participants conducted the survey once more. Likert scale answers were mostly used instead of Yes / No answers so that participants could indicate a degree of how much they agreed. This gives more nuanced answers.

According to Lazar et al., [57] validity refers to how accurately the survey measures the concept, and to which degree it is representable for the entire population. A pilot test is also important to ensure the validity of a survey [57], as well as the reliability. It gives a good indication of what the result of the survey will be, which makes it possible to see if this is accurate with the study's goals. Another measure to increase the validity of a survey, is according to Lazar et al. [57] to have a large enough sample size that is representative of the population. An attempt was therefore made to get as many respondents as possible from a wide range of the target population. A total of 280 women between 25-69 years old responded. The participants were classified into three age groups (25-39, 40-54, 55-69). This ensured that participants of all ages responded, which makes the survey more representative.

In addition to the persuasive messages, a control message was designed. A control condition is often used in studies to test the effect of an experimental condition [57]. This ensured that only the nudge itself was tested, as this was the only independent variable. It is a way of securing that only what is meant to be tested is tested.

3.4   Digital Nudge Design

The aim of this study was to investigate whether nudging can get more women to participate in screening. This was done by implementing a nudge in a text message that contained a general encouragement to take a pap smear. Since women are currently receiving a written invitation to participate in the screening program, this way of implementing the nudge was seen as appropriate. Similar studies have reported that this way of nudging has shown to effectively influence behavior [13, 14]. The nudges were designed based on literature from persuasive technology and digital nudging.

In addition to four persuasive messages, one control message without a nudge was designed. A control condition is often used in studies to test the effect of an experimental condition [57]. All of the messages was identical, except from the persuasive messages that contained a independent variable which was the nudge. The identical text on all of the messages was "It is now time to take a new pap smear", and "Click here to read more about the cervical screening program". This was inspired by the original invitation letter (See Appendix B). The first sentence was included as it informs the participants about why they are receiving the message. The second one contains a hyperlink that is connected to the Cervical Screening Programs website for those who want more information before they decide if they want to take a pap smear. This was included as the text messages are kept to a minimum to not increase the receiver's cognitive load. To make it intuitive that the hyperlink is clickable, it was underlined and blue. This is a common way of specifying that something is clickable, and can be seen in emails, websites, and text messages. According to Nielsen [61], the founder of Jacobs Law, users want their digital products to work the same as the ones they are used to. It may therefore be appropriate to follow certain industry standards to not increase users' cognitive load.

3.4.1 Chosen nudges

Commonly used frameworks for nudging in health-related studies are the MINDSPACE framework [44] and Caraban et al´s [38] framework on technology-mediated nudging in HCI. These frameworks will be used as a theoretical basis for the design and development of the various nudges. They will, however, be adapted to fit the context. The rest of this chapter presents the four messages and the control message.

Message 1 - Affect

According to Dolan et. al [44] and Caraban et al. [38] emotional messages are powerful in decision-making. Research shows that nudges based on fear appeals have been used to get more women to participate in cervical screening [13] and to get more people to sign up as organ donors [14].

An emotional message based on fear was designed. The message was designed based on statistics from the Cervical Screening Program on the number of cancer cases and deaths caused by cervical cancer [2]. According to Tannenbaum et al. [50] messages with a significant degree of fear have proven to be the most effective. It has also been reported that messages containing a loss-frame have been more effective than a gain-frame message in similar studies [14, 13]. The message was as follows:

"Every year, about 300 women are diagnosed with cervical cancer in Norway, where approximately 70 dies. It is now time to take a new pap smear. Schedule an appointment with your GP. Click here to read more about The Cervical Screening Program. Kind regards, The Cervical Screening Program"

Message 2 - Default

Through a literature review on nudging in screening, Hofmann and Stanak [26] found that default bias, such as scheduled appointments were one of the most commonly used nudges. Both the MINDSPACE framework [44] and the framework on technology-mediated nudging in HCI [38] reports that defaults are an effective way of influencing behavior. Additionally, Harrison et al.[42] propose defaults as one of the most efficient nudges in healthcare.

Studies show that defaults have been effective to increase participation in cervical

screening [30], influence vaccination [16], and to get more people to sign up as organ donors [15]. Changing the default from an opt-in to opt-out is commonly used.

The Cervical Screening Program is currently dependent on the participants themselves to schedule an appointment. A previous study on non-attendees to cervical screening reported that some women did not found it important enough to attend screening because they had to schedule an appointment on their own initiative [8]. Participants also mentioned that they were satisfied with the invitations to breast screening as they contain scheduled appointments. It was, therefore, relevant to investigate if changing the default from a recommendation (opt-in) to a scheduled appointment (opt-out) could make more women participate in screening:

"It is now time to take a new pap smear. You have received a scheduled appointment with your GP on 20.04.2021 at: 09.30. Click here to change the appointment. Click here to read more about The Cervical Screening Program. Kind regards, The Cervical Screening Program"

Message 3 - Social Norms

According to Axelrod [48] established norms within a group can have significant power, as it is behavioral expectations individuals try to achieve. It represents what is an acceptable way of behaving within a group of people or a society [48]. This has led researchers to use social norms for behavior change, by presenting how others have behaved in the same situation. Previous studies have reported that implementing a nudge based on social norms has successfully influenced behavior [44, 14]. Sallis et al. [14] reported that a message based on social norms had a positive effect on registrations for organ donations.

As social norms have proven to be effective for influence behavior in health-related studies, one of the messages was based on this. The Cervical Screening Program has reported that approximately 400,000 women participate in the screening program each year by taking a pap smear [2]. This number was used to represent the behavior of others in the same population. According to Dolan et. al [44], when descriptive norms are used they should match people's expectations, in order to be efficient. The norm should be as related to the target audience as possible to have the greatest effect.

In a study where persuasive messages were used to increase attendance to cervical screening, a social norm message only led to small differences in attendance. The

researchers concluded that the participants expected the statistics to be higher than what was presented [13]. Women's expectations of the screening uptake may determine how well this message works:

"Approximately 400,000 women take a pap smear each year, so should you. It is now time to take a new pap smear. Schedule an appointment with your GP. Click here to read more about The Cervical Screening Program. Kind regards, The Cervical Screening Program"

Message 4 - Incentives

Economic incentives can be efficient to influence or change behavior as people are sensitive to cots [44]. Research shows that nudges with incentives have been effective for smoking cessation [18], and for weight loss al.[17].

In a recent study on non-attendees to cervical screening [8], invitations for screening were compared to a dentist appointment, which usually contains a fee. It was mentioned that a fee for not showing up to a scheduled appointment could have been efficient in getting more women to participate in screening.

A message with economic incentives was designed. The message contained a fee for not showing up to a scheduled appointment, as people are sensitive to cots and want to avoid losses [43]. The fee is 50€, which is representative of what an appointment with a gynecologist or a GP costs. According to Kahneman [43] the significance of an economic loss depends on who sees it, as people have different reference points. It is, therefore, possible that women with different reference points react differently to this message:

"You have received a scheduled appointment with your GP on 20.04.2021 at: 09.30 to take a pap smear. You will be charged a fee of 50€ for not attending the scheduled appointment. Click here to change the appointment. Click here to read more about The Cervical Screening Program. Kind regards The Cervical Screening Program"

Message 5 - Control message

A control condition is often used in studies to test the effect of an experimental condition [57]. The two conditions are identical, except for a variable that is changed in the experimental condition, which the researchers believe has an effect. If the result shows that the experimental condition performs better, it indicates that the variable

changed by the researcher's worked [57]. An identical message without a nudge was therefore designed to compare against the messages with a nudge.

Similar studies have reported different results when using a control message. In an attempt to increase participation in cervical screening various persuasive text messages were tested together with a control message [13]. Result showed that the control message was the second-most influential. Sallis et al.[14] tested persuasive text messages to increase organ donors. The control message was reported as the least effective compared to the others. A message that only contained the standard text, without a nudge was therefore designed:

"It is now time to take a new pap smear. Schedule an appointment with your GP. Click here to change the appointment. Click here to read more about The Cervical Screening Program. Kind regards The Cervical Screening Program"

3.4.2 Visual considerations

According to Schneider [27] the way a nudge is presented is almost as important as what it contains. To make the five text messages look as realistic as possible, they were visualized to look as close to a real text message as possible. Research has shown that the more attractive and "real" the interface or hardware is the more persuasive it becomes [10]. According to Fogg [10] people have different opinions on what they find attractive, which is why designers need to understand their target population when designing persuasive technology. The design of the interface was based on how a message looks on most smartphones. Research shows that 99% of all people in Norway between 9-79 years old owns a mobile phone, and 96% have access to a smartphone [47]. It was therefore accounted for that most of the participants had seen a similar interface before. Indesign was used to design the interface, and Figure 2 shows the final result. The rest of the text messages can be seen in Appendix A.
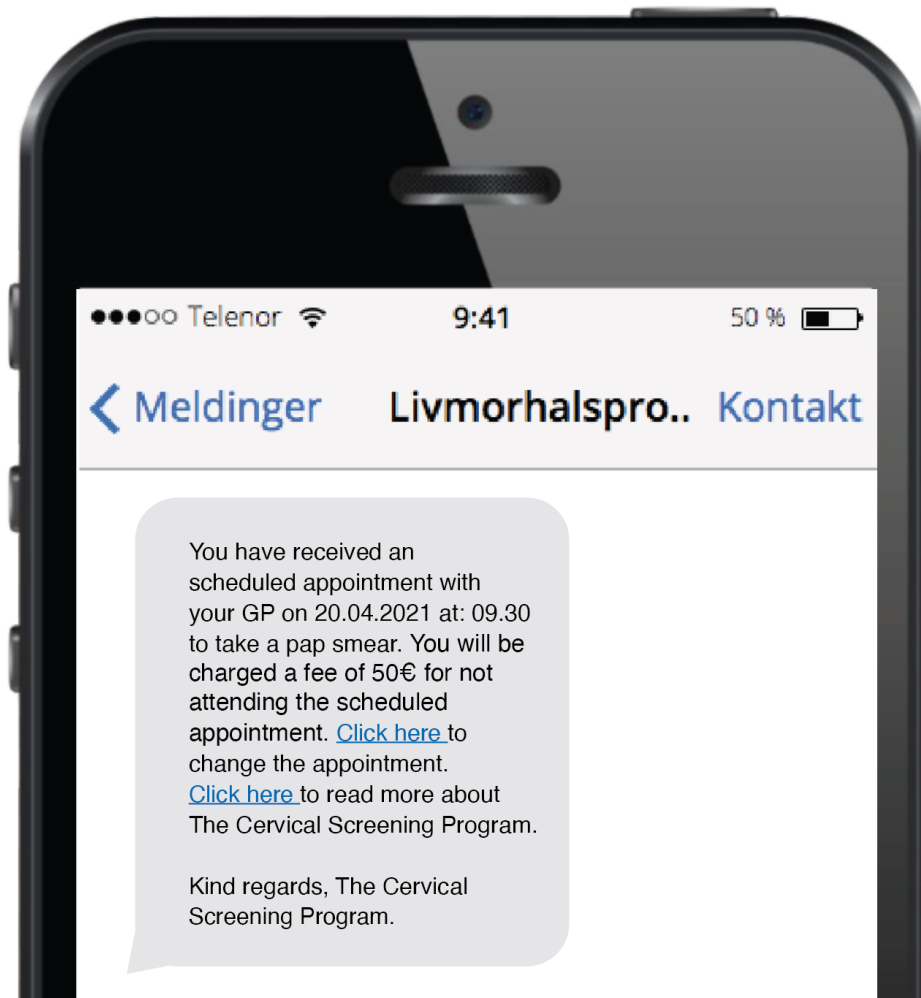
Figure 2: Visual representation of the message containing the *Incentives nudge*

Chapter 4

Findings

Data from the survey have been carefully cleaned and prepared before various statistical tests were performed in JASP. This chapter first presents the sample, choice of statistical tests, and then the results. Results will be presented with each research question. RQ4 "Do different age groups (25-39, 40-54, 55-69) respond differently to the nudges?" are relevant to both RQ1, RQ2, and RQ3, and will therefore be reviewed with them.

4.1   Sample

A total of 280 individuals has responded, of which 154 respondents (55,6%) are 25-39 years old, 87 respondents are 40-54 years old (31,4%) and 36 respondents are 55-69 years old (13%) (See Figure 3). Due to the varying number of respondents in the three groups, percentages have been used in the following analyzes.

A majority of the respondents have taken a pap smear before (240 participants, 90,1%), while the rest have not taken one (27 participants, 9,9%). Of all the participants who responded, 52% found it very important to take a pap smear, while 44% found it important. Only 3% answered that they were neutral, and 1% that they did not find it important.
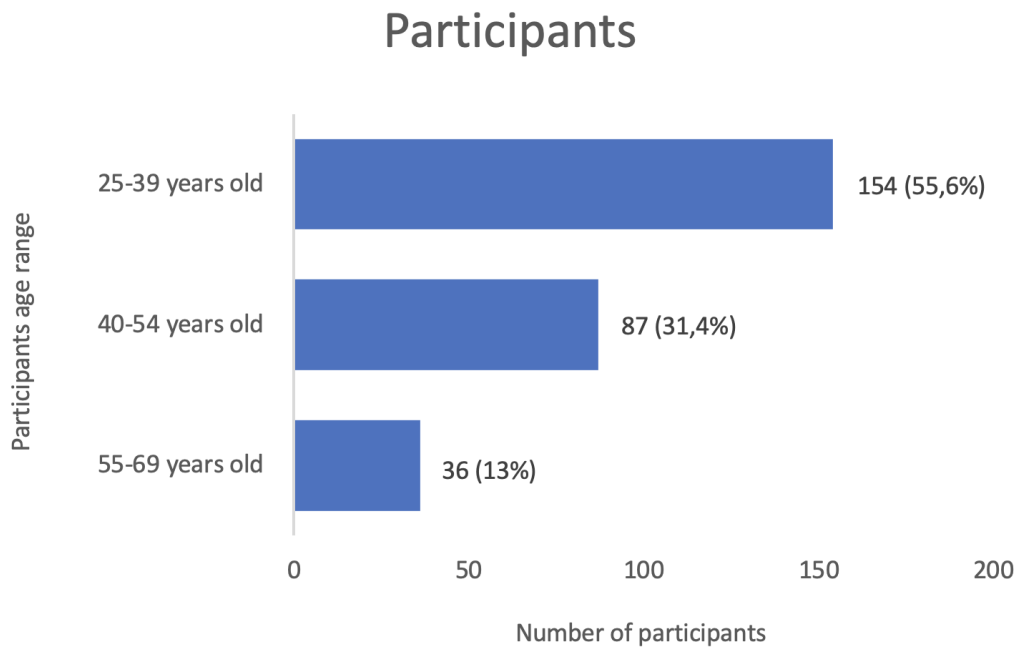
Figure 3: Number of participants by age.

4.2 Statistical considerations

A majority of the questions in the survey can be answered through a five-point Likert scale. The choices range from 1 =Very small degree, 2 =Small degree, 3 =Neither, 4 =High degree, and 5 =Very high degree. How Likert scales should be analyzed has been discussed for over 50 years [62]. According to Carifio and Perla [62], who have addressed this ongoing debate, the "ordinalists" say that Likert scales should be analyzed using non-parametric statistics as it is ordinal numbers. Other requirements must also be met to use parametric methods, such as having a large enough sample size and normally distributed data. On the other side, Norman [63] argues that parametric statistics can be used for Likert scales without any fear of getting the wrong conclusion. He presents an example where he shows the small difference between a non-parametric (Spearmans rho) and parametric (Pearsons r) test even though the data was not normally distributed. Both Carifio and Perla, [62] and Norman [63] refer to several empirical studies which show that parametric analysis is robust enough to be used for Likert scale measurement. Due to the ongoing debate among professionals, several papers are published with arguments from both sides. I used parametric tests for my analysis, even though my data is ordinal, as it allows for several forms of

analysis for which non-parametric analysis has no alternatives.

Parametric tests

I used a repeated-measures ANOVA to compare means across two or more groups of data in the survey [64]. Repeated measures ANOVA was used since the data were within groups [57]. In those cases where sphericity is violated, I have chosen to use a Greenhouse-Geisser correction. Sphericity can be violated when you have three or more levels in the repeated measures ANOVA, which I had in several of the analyzes. In some cases, it is relevant to see if there are any differences between individuals, like males vs. females or children vs adults. For this data set, it is relevant to discover if the answers differed between the three age groups (25-39, 40-54, 55-69), or if women who have taken a pap smear before answered differently from those who have not taken one. To discover this, I used a repeated-measures ANOVA with a Greenhouse Geisser correction on the different groups and extracted the results with a between-subject effect test to see if the results differed between the individuals. When results from ANOVA tests showed a significant difference, Post Hoc tests with a Holm correction were done to explore where the differences occurred [64]. Holm´s Post Hoc test is an alternative to the original Bonferroni test.

4.3 RQ1: Do women find the following nudges motivating? (Social Norms, Default, Affect, Incentives, No nudge)

To answer this research question, all of the nudges were presented to the participants with the question "How motivated are you by the following nudge?". The participants responded based on their subjective perception of the nudges, through a five-point Likert scale. The result is presented in Figure 4 as a diverging stacked bar chart. The chart shows a clear trend, namely that women found the *Default nudge* the most motivating. 44% answered that they were highly motivated by it and 27% answered that they were motivated. The chart also shows that participants found *Incentives nudge* the least motivating. 25% answered that they are not motivated by it at

all, and 19% answered that they were not motivated.

A repeated measures ANOVA with a Greenhouse-Geisser correction shows that there is a significant difference in how motivating the participants found the five messages with the different nudges ($F(3.583, 985.279) = 42.132$, $p < .001$). Post Hoc tests were conducted to reveal specific differences between the nudges. There is a significant difference between all of the nudges ($p < .05$), except Social Norm nudge and No nudge ($p = .434$). There is a considerable difference between Default nudge (M = 4.007, SD = 1.005) and Incentives nudge (M = 2.924, SD = 1.471) ($p < .001$), which can be seen in Figure 4.

Neutral answers may indicate if there has been any uncertainty associated with the message. The message with the highest percentage of neutral answers (31%) was the one containing *No nudge*. The messages with the lowest percentage of neutral answers were the ones containing the *Incentives nudge* (16%) and the *Default nudge* (18%).
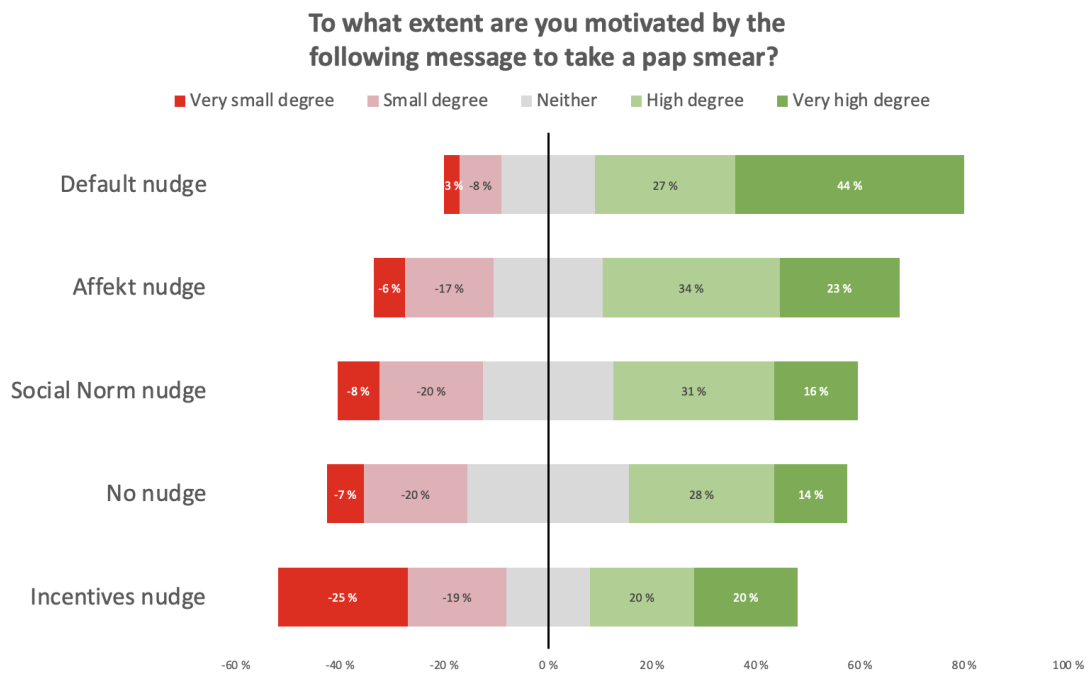

Figure 4: Motivation to take a pap smear based on each of the messages.

The participants were divided into three age groups: 25-39 years old, 40-54 years old and, 55-69 years old. It is relevant for RQ4 to see if these individual groups have responded differently. This can be a contribution to the discussion about whether to use a "one size fits all" strategy or if text messages should be adapted to fit different age groups. Figure 5 shows what the different age groups have responded to the question "How motivated are you by the following nudge". It shows that all of the groups

found the message with the *Default nudge* the most motivating and the *Incentives nudge* the least motivating. The youngest age group (25-39 years old) and the oldest one (55-69 years old) have answered similarly, with *Default nudge* as the most motivating, followed by *Affect nudge*, *Social Norm nudge*, *No nudge* and *Incentives nudge*. The remaining age group (40-54 years old) have answered that they are somewhat more motivated by the message including *No nudge* than the one containing *Social Norm nudge*, which was the only difference from the other groups. Apart from this, there is a similarity in the answers from the three age groups.

The repeated measures ANOVA test reported that there was no difference between group factors, which means there was no significant difference in how motivated different age groups were by the various nudges ($F(2,272) = 0.392$, $p = .676$).
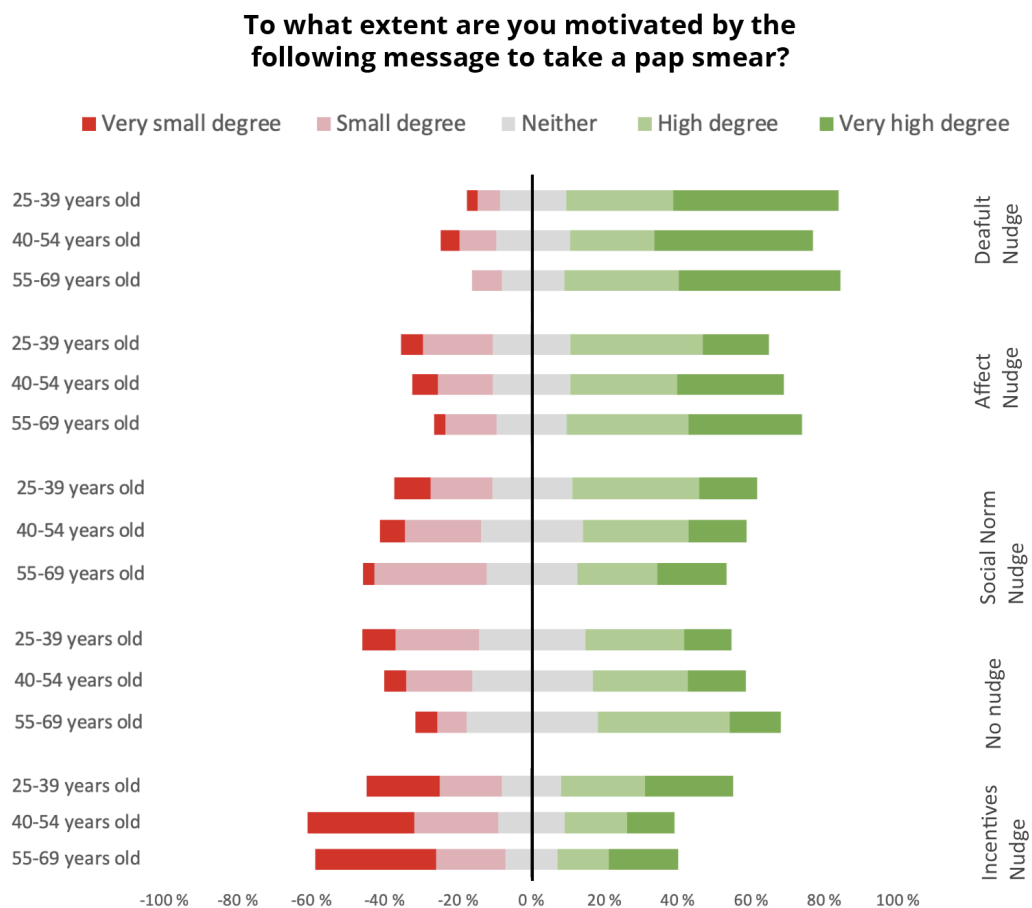

Figure 5: Motivation to take a pap smear based on each of the messages, across age groups.

Participants who have/have not taken a pap smear before

A majority of the respondents have taken a pap smear before (240 participants, 90,1%), while the rest have not taken one (27 participants, 9,9%). It's appropriate to investigate if there are any differences in how motivated women are by the various nudges, whether they have taken a pap smear before or not. This can give an insight into whether the invitations should be tailored towards women who have taken a pap smear before and those who have not. A repeated-measures ANOVA test with a Greenhouse-Geisser correction reported that there was no difference between group factors, which means there was no significant difference in ($F(1, 268) = 2.46$, $p = .118$) in how motivated women were by the various nudges, whether they have taken a pap smear before or not.

Participants who have had a negative experience with taking a pap smear

Another question in the survey was related to whether the participants have had a negative experience with taking a pap smear. 86,7% have not had a bad experience, 12,6% have had a bad experience and the remaining 1,1% did not want to answer. Further tests were done to see if this negative experience can have an effect on how motivated the participants were by the various nudges. A repeated-measures ANOVA test with a Greenhouse-Geisser correction reported that there was no difference between group factors, which means there was no significant difference ($F(3, 272) = 0.21$, $p = .888$) in how motivated women were by the various nudges, whether they have had a bad experience with taking a pap smear or not.

Do the probability of taking a pap smear increase after receiving a text message?

Participants were asked if the probability of taking a pap smear increases based on the various messages. Results are presented in Figure 6 and show that that the message containing the *Default nudge* had the most potential to get women to participate in screening. As many as 50% answered that the probability of taking a pap smear would highly increase by receiving this message, and 26% answered that it would increase. The nudges that were most likely to increase the likelihood of taking a pap smear, in ascending order, were *Default nudge, Affect nudge, Social Norm nudge, No nudge and Incentives nudge*.

Results show that most women agreed that the *Default nudge* would increase the possibility to take a pap smear. However, they were more divided on the remaining four messages which contained the *Affect nudge, Social Norm nudge, No nudge* and *Incentives nudge*. There are only a few more women who have answered that the probability of taking a pap smear would increase, than women who have answered that it would not.

A repeated measures ANOVA with a Greenhouse-Geisser correction shows that there is a significant difference ($F(3.373, 917.508) = 40.929$, $p < .001$) in which of the messages that increases the possibility of taking a pap smear. Post Hoc tests were conducted to reveal specific differences between the nudges. There is a significant difference between all of the nudges ($p < .05$), except *Social norm nudge* and *Incentives nudge* ($p = .247$), *Social norm nudge* and *No nudge* ($p = .799$), and *Incentives nudge* and *No nudge* ($p = .276$).

Women disagree on whether *Social Norm nudge, No nudge* and *Incentives nudge* will increase the probability of taking a cell sample or not. It is therefore relevant to check if this disagreement is due to the fact that the different age groups have answered differently. The repeated measures ANOVA test reported that there was no significant difference between group factors ($F(2,269) = 0.865$, $p = .422$), which means that the disagreement has nothing to do with age.
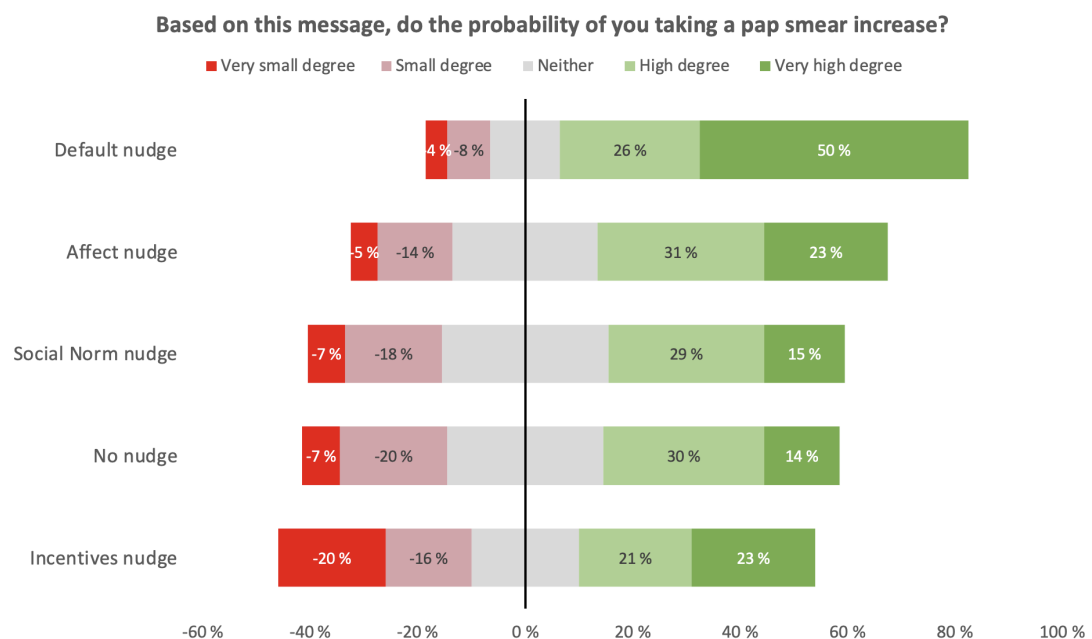

Figure 6: Women's perception on whether the probability of taking a pap smear increases after receiving a text message with a nudge.

4.4 RQ2: Do women find it ethically justifiable to receive a message with the following nudge? (Social norms, Default, Affect, Incentives, No nudge)

Due to the ongoing debate on ethical issues surrounding nudging, it was appropriate to investigate if participants found it ethical to be nudged. All five messages were presented to the participants, followed by the question "To what extent do you find it ethically justifiable to receive this message from the Cervical Screening Program?". The participants responded based on their subjective perception of the nudges, through a five-point Likert scale. The result is presented in figure 7 as a diverging stacked bar chart and shows a clear trend. Women found the message with the *Default nudge* the most ethical to receive, and the message with the *Incentives nudge* the least ethical. As many as 50% of the respondents answered that they found the message with the *Default nudge* highly ethically justifiable to receive, and 24% answered that they found it ethically justifiable. Only 5% of the participants answered that they did not found it ethically justifiable at all, and 8% did find it ethically justifiable. Unlike the message containing the *Default nudge*, women were more critical to the *Incentives nudge*. 33% answered that they did not find it ethically justifiable at all, and 25% answered that they did not find it ethically justifiable.

A Repeated Measures ANOVA with a Greenhouse-Geisser correction shows that there was a significant difference in how ethically justifiable the participants found the five messages ($F(3.621, 988.465) = 100.995$, $p < .001$). Post Hoc tests were conducted to reveal specific differences between the nudges. They showed that there was a significant difference between all of the nudges ($p < .001$) except for two combinations. There was no significant difference between *Default nudge* and *No nudge* ($p = .119$). Nor between *Social Norm nudge* and *No nudge* ($p = .119$).

**To what extent do you find it ethically justifiable
to receive this message?**

■ Very small degree ■ Small degree ■ Neither ■ High degree ■ Very high degree

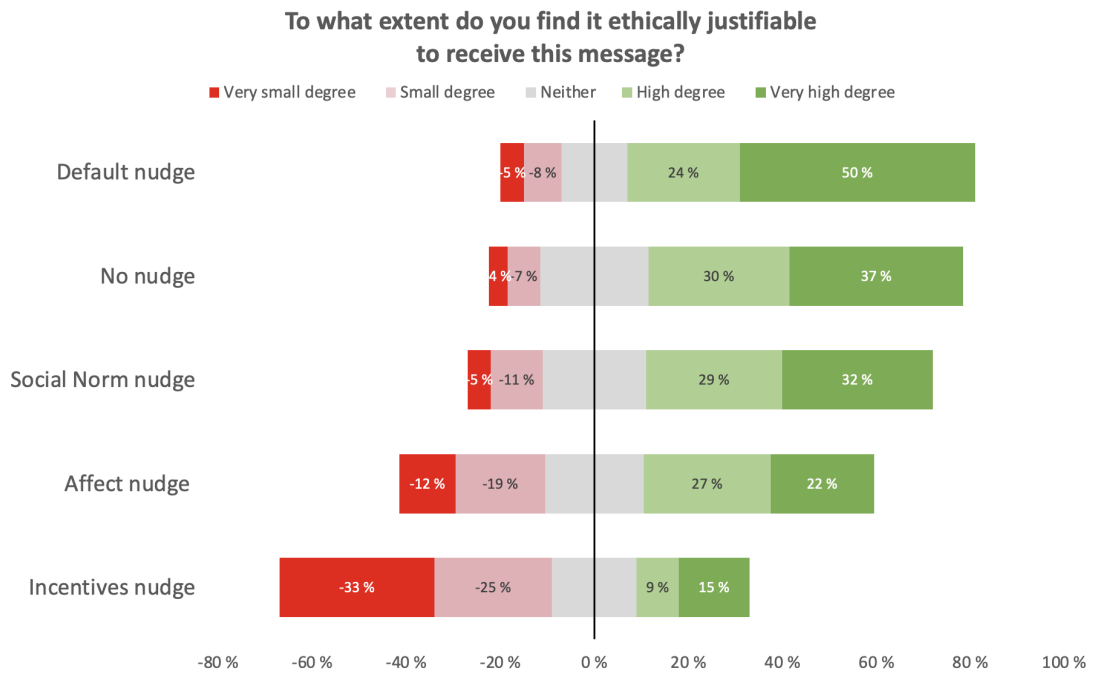|	Very small degree	Small degree	Neither	High degree	Very high degree
Default nudge	-5 %	-8 %		24 %	50 %
No nudge	-4 %	-7 %		30 %	37 %
Social Norm nudge	-5 %	-11 %		29 %	32 %
Affect nudge	-12 %	-19 %		27 %	22 %
Incentives nudge	-33 %	-25 %		9 %	15 %

Figure 7: How ethically justifiable women perceived the five text messages.

Tests were performed to explore if there were any differences in how ethically justifiable women in different age groups found the various messages. Figure 8 shows that women in the three age groups have answered quite similarly, with the message containing the *Default nudge* as the most ethically justifiable, followed by *No nudge, Social Norm nudge, Affect nudge*, and finally *Incentives nudge* as the least motivating. The diverging stacked bar chart shows (Figure 8) that a majority of participants across the three age groups found most text messages to be ethically justifiable, except the message containing the *Default nudge*.

The repeated measures ANOVA test reported that there was no difference between group factors, which means that there was no significant difference in how ethically justifiable the different age groups found the various messages (F(2, 270) = 0.069, p = .933).
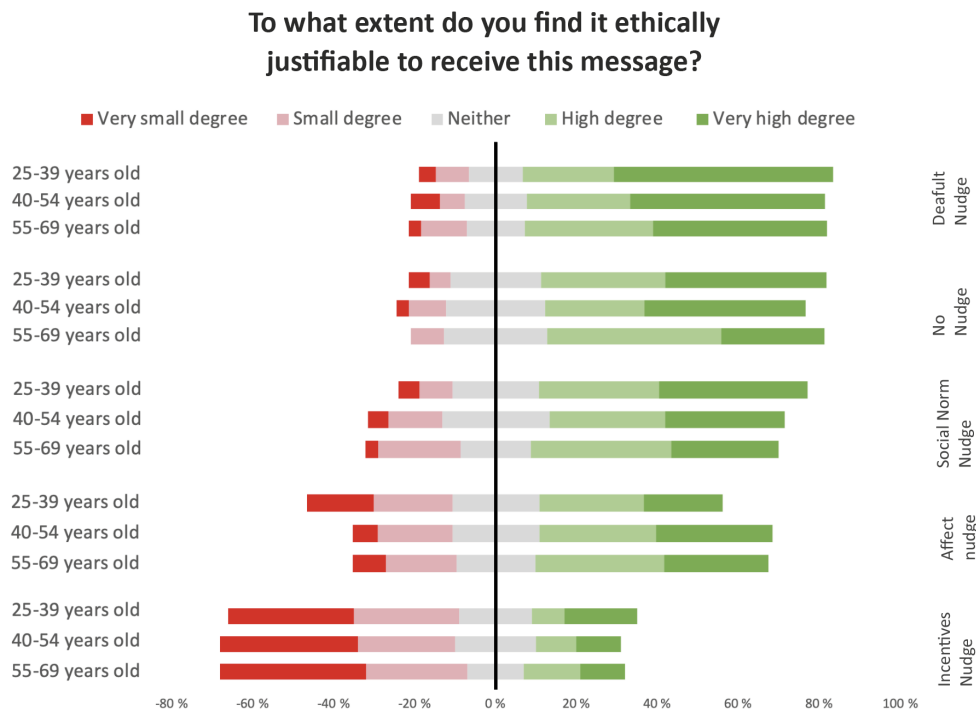
To what extent do you find it ethically justifiable to receive this message?

■ Very small degree ■ Small degree ■ Neither ■ High degree ■ Very high degree

Figure 8: How ethically justifiable women perceived the five text messages, across age groups.

4.5 RQ3: Do women want to receive an invitation to cervical screening through a text message?

After reviewing the five text messages, participants were asked "To what extent is it desirable to receive an invitation to cervical screening through a text message?". Figure 9 shows what the different age groups answered. A high percentage of women in all three age groups answered that it is desirable to receive an invitation through a text message. Results showed that 87% of all the respondents found it desirable to receive an invitation through a text message (68% answered highly desirable, 19% answered desirable). 7% were neutral, 6% answered that they did not want to receive a text message and 1% answered that it was highly undesirable. Results show that the group who were most positive about receiving the invitation through a text message was women in the youngest age group (25-39 years old). The age group that had the highest amount of participants who did not want to receive an invitation through a text message was the oldest age group (55-69 years old). 17% answered that they did not want to receive an invitation through a text message, while only 1% in the youngest

and the middle age group answered the same.

A one-way ANOVA test shows that there was a significant difference in whether the participants wanted to receive a text message or not ($F(2, 274) = 5.109$, $p < .007$). Post Hoc tests were conducted to reveal specific differences between the groups. They showed that there was a significant difference between how the youngest age group, 25-39 years old (M = 4.617, SD = 0.769), and the middle age group, 40-54 years old (M = 4.299, SD = 1.047) answered ($p = .027$). It was also a significant difference between how the youngest age group, 25-39 years old (M = 4.617, SD = 0.769), and the oldest age group, 55-69 years old (M = 4.194, SD = 1.142) answered ($p = .036$). There was no significant difference in how the middle age group, 40-54 years old, and the oldest age group, 55-69 years old answered (p = .834).
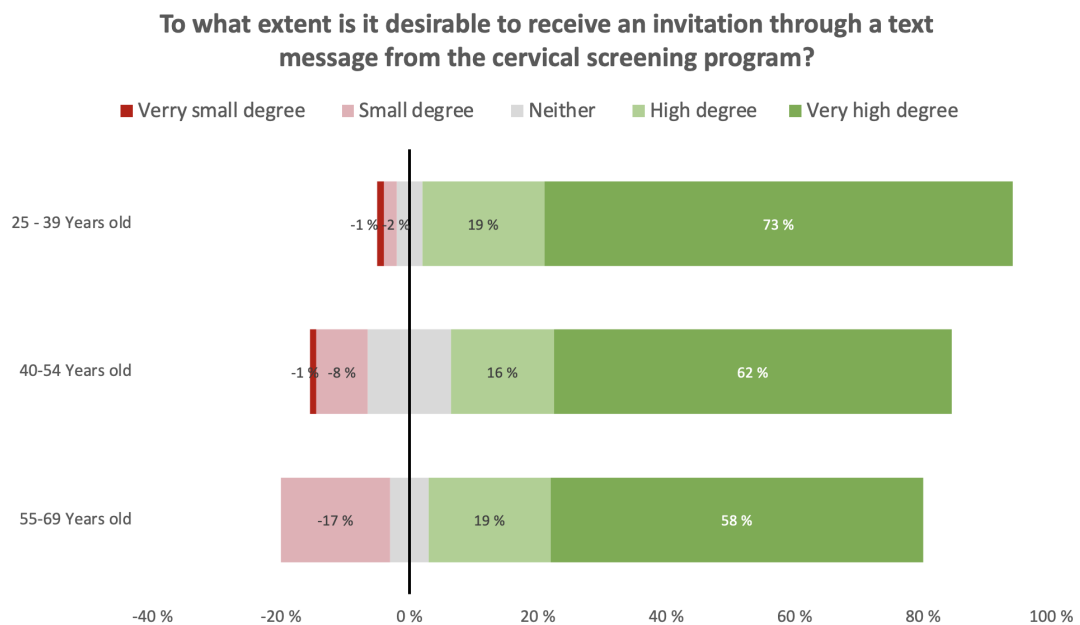

Figure 9: Women's desire to receive an invitation to cervical screening through a text message.

4.6   Qualitative survey answers

The last question in the survey was a voluntary qualitative question. Participants were asked if they had any other comments on the topic. This was done to reveal information that might be interesting to the research. In total 42 women responded to this question. The answers vary in length but are on average 2-3 sentences long. To analyze these qualitative answers, I have performed a thematic analysis, based on

Barbour´s [65]. As the data is already transcribed I have organized it and looked for trends to identified themes. Comments that were not relevant for the research, were not included. Based on this, three main themes were made; Fixed appointments could increase attendance, text messages rather than letters, and thoughts around taking the pap smear at your GP's office.

Fixed appointment could increase attendance

A total of eight comments were related to receiving a fixed appointment. It seems that women believe this can increase attendance. Some of the comments were "A fixed appointment will cause more women to take a pap smear", "Many women receive a letter in their mailbox but forget to order an appointment, a fixed appointment would make more women take the test" and "The long waiting time at the GP is a barrier for me when booking an appointment to get tested". Some of the comments also contained thoughts on possible issues. One said that if the fixed appointments are scheduled with your GP, it could be a dilemma for some women as they rather want to go to a gynecologist. Another said that a fixed appointment may feel like an invasion for some, while the fee for not showing up to your appointment was reviewed as problematic by one.

Text messages rather than letters

A total of six comments were related to receiving an invitation through a text message. Many believe that digital reminders like text messages will increase attendance to cervical screening, rather than physical letters that some still receive in their mailbox. Repeated comments were "I'm very positive to receiving an encouragement from the Cervical Screening Program as a text message", "It is a good idea to switch to digital reminders instead of letters in the mailbox" and, "I think a digital reminder can increase the screening rates". One woman emphasized that it is important that the text messages do not seem provocative.

Taking the pap smear at your GP's office

Several women expressed that they do not want to take the pap smear at their GP's office. Some have had bad experiences with poor follow-up by their GP after a test, while others have experienced minimal to no information about the importance of getting tested regularly. Several women answered that they prefer a gynecologist to take the pap smear rather than their GP. A total of nine comments were left regarding

these issues, some of them were "Not everyone wants their GP to take the test", "It should be easier and cheaper to take a test with a gynecologist rather than your GP", "I received minimal to no follow-up by my GP after taking the test" and "I wish my GP had more knowledge about it so I get the best possible answer".

Chapter 5

Discussion

The aim of this master thesis was to investigate if nudging in the form of persuasive text messages could make more women participate in cervical screening. This chapter discusses the quantitative data in the context of existing literature. RQ4 is discussed together with RQ1, RQ2, and RQ3.

5.1 General discussion

Results show that persuasive messages have the possibility to increase attendance to cervical screening. However, not all messages are equally effective. Findings are consistent with similar studies on nudging in screening, which reports that digital nudging can be efficient in getting more women to participate in cervical screening [13, 29, 30].

Results show that the two messages with the highest potential to increase attendance to cervical screening, in this context, were the message with the scheduled appointment (*Default nudge*) and the emotionally informed message (*Affect nudge*). The message containing a scheduled appointment was the most influential message and had the highest potential to motivate women of all ages to attend screening. According to Kahneman[43], when people are faced with several choices they often choose the default option because it does not require any reflection or time. This may be a possible explanation as to why this text message performed so well. The text message containing the emotional message, *Affect nudge* has the second-highest potential to increase attendance to cervical screening. One possible explanation may be that the content was experienced as intimidating and unpleasant, as it contained words such

as *death* and *cancer*. This may have led participants to realize the importance of participating screening, but also the possible consequences of not participating. Findings from previous studies also report that messages that rely on fear to change behavior were effective [13, 14, 50].

The text messages containing the *Social Norm nudge* and *No nudge* resulted in similar results throughout the study. Results show that they have less potential than the *Default nudge* and *Affect nudge* to increase attendance to cervical screening. Approximately half of the participants were likely to be influenced by these messages, while the other half were not. It is therefore uncertain to what degree these messages would increase screening attendance. Additionally, both these messages had the highest percentage of neutral answers. A neutral answer may indicate that participants were indifferent to the message or unsure of what to answer. The two messages do not contain as confronting or unpleasant text as some of the others, participants may therefore experience them as more neutral. A possible explanation as to why the message without a nudge was perceived as motivating by some may be because it was less complex compared to the other nudges. This was the shortest message and therefore requires less cognitive effort to process. A previous study also reported that a message without a nudge was found to have the second-largest effect on attendance to cervical screening [13].

A possible explanation as to why some participants did not perceive the *Social Norm nudge* as more motivating, may be because the statistics presented did not match the participant's expectations. A previous study [36] reported that social comparison only motivated the participants if the comparison were similar to the participant's performance. According to Dolan et al., [44] descriptive norms should match the expectations that people have, to be the most efficient. It is therefore possible that some expected the number of women who attend screening to be more than what was presented.

The message with the least potential to increase attendance to cervical screening was the one containing a fee for not showing up to the scheduled appointment (*Incentives nudge*). A majority of the participants reported that they did not find the message motivating or ethical. It is though interesting that 23% of women answered that the probability of taking a pap smear would highly increase by receiving this message (See Figure 6). One possible explanation may be that they would have participated because they do not want to pay the fee. According to Kahneman [43] people are sensitive to

costs and want to avoid losses. It is though uncertain whether such a message would have done more harm than good, as a majority of women did not find it ethical. Few participants responded neutral to this message, which indicates that most of them had a strong opinion.

Analyzes was done to find differences between user groups and how they were influenced by the messages. Participants were asked about their previous screening history and experiences. The results showed none of these factors affected which nudge participants were influenced by. Results also showed that there were small to no differences in which nudge women from the different age groups are influenced by. This observation is consistent with a previous study that reported no difference in how women from different age groups reacted to a message with a scheduled appointment [30]. This indicates that it is not necessary to adapt the messages to different age groups, but that a "one fits all" approach could be efficient in this case.

5.2 RQ1: Do women find the following nudges motivating? (Social norms, Default, Affect, Incentives, No nudge)

Results show that participants found some messages more motivating than others. Most women found the message with the *Default nudge* and the *Affect nudge* the most motivating. Using one of these may therefore have more potential to motivate women to attend cervical screening than a nudge they felt less motivated by, like the *Incentives nudge*. Previous studies within healthcare have reported successful results by implementing the best performing message. In a study where 8 message variants with different nudges were tested to get more organ donors, the most successful message resulted in 1,203 more organ donors [14].

The significant difference in how motivated women were by the message with *Default nudge* compared to the *Incentives nudge* shows that small changes in the text may result in considerable differences. The two messages were almost identical, except that the message with the *Incentives nudge* contained an additional sentence with a fee for not showing up to the scheduled appointment. This is consistent with the idea behind nudging, which is that small details can have a significant impact on people's behavior [12].

An invitation with a scheduled appointment (*Default nudge*) was mentioned by non-attendees to the screening program in Norway as desirable [8]. The Norwegian mammography screening program also uses this approach in their invitations [66]. According to Kahneman [43], we often make our decisions based on previous experiences. Familiarity with this kind of invitation strategy may be one of the reasons why so many women found it motivating. The age group that was the most motivated by it was the oldest one. This is also the target group for breast screening in Norway (Women between 50-69 years old) [66], and may be the reason as to why it performed so well among women in this age.

Results show that many of the participants have answered neutral to the *Social Norm nudge* and the message without a nudge. This indicates that respondents were uncertain whether they felt motivated or not. Approximately half of the participants answered that they were motivated, while the other half were not motivated. It is therefore uncertain how effective these messages would have been in getting more women to attend screening. Since there were no differences between user groups and how motivated they were by the various messages, there is no obvious reason as to why participants have answered so differently.

Few women were motivated by the message with the fee, which is perhaps not so strange considering that most people would have chosen to avoid a fee if they had been given the choice. One participant commented that "It may be problematic with a fee for not showing up to a scheduled appointment". It is likely that other participants also shared this view, as most of them did not find this message motivating. However, considerably more women in the youngest age group found it motivating compared to the other two groups. A possible explanation may be that younger women have a different relation to receiving fees than older women, and therefore found it more acceptable. Younger women may also be in a different financial situation where they have fewer financial expenses, such as children and mortgages, and therefore viewed the fee as a manageable cost. According to Dolan et al. [44] how large a financial loss depends on where it is seen from. People have different reference points, which affects how they experience a loss. It is therefore possible that younger women experienced the fee as a smaller loss than what older women did.

5.3 RQ2: Do women find it ethically justifiable to receive a message with the following nudge? (Social norms, Default, Affect, Incentives, No nudge)

There has for a long time been a discussion among researchers whether nudging is ethical or not [28, 53, 54]. RQ2 allowed participants to decide for themselves if they found it ethical to be nudged. Results show that there were considerable variations in which messages that were perceived as ethically justifiable, and which were not. The message with the scheduled appointment (*Default nudge*) was found as the most ethically justifiable. A possible explanation may be that participants were familiar with this invitation approach and perceived it as normal. According to Hofmann et al. [26] a scheduled appointment is one of the most common ways of nudging in different screening programs. Most women also found the message without a nudge and the one with the *Social Norm nudge* ethical. None of these messages contained any uncomfortable or confronting text. It is therefore possible that participants experienced them as comfortable.

The emotionally informed message (*Affect nudge*) was perceived similarly as the message with the *Social Norm nudge* and the one without a nudge. Results show that considerably more participants from the youngest age group found the message with the *Affect nudge* less ethical compared to the two older age groups. One possible explanation may be that they experienced the number of cancer cases and deaths as more frightening than the older groups. Younger women may also be less aware of the statistics around cervical cancer as many of them are new to the screening program.

Most participants did not find the message with the fee (*Incentives nudge*) ethically justifiable. According to Thaler and Sunstein [12], a nudge must be easy to avoid. This message requires the participants to either attend the scheduled appointment or change the appointment in order to avoid the fee. The message is therefore difficult to avoid, and it can be discussed whether it is ethical or not. In a study where different nudges were tested to investigate the public's support of nudging, a nudge with an economic incentive was not supported by a majority of the participants [56]. This result confirms that most participants in the screening also do not support a message with economic incentives.

5.4 RQ3: Do women want to receive an invitation to cervical screening through a text message?

Most participants answered that they wanted to receive an invitation to the screening program through a text message. Results showed that 87% of all the respondents found it desirable. Several women also commented that they believe text messages would increase attendance to cervical screening, rather than physical letters. Today, approximately 40% of the invitations to cervical screening are sent through physical letters (Personal communication, The Norwegian Cervical Screening Program, January 26, 2021). Previous studies also show that text messages have been effective in health-interventions [19, 20, 21, 22].

The youngest age group were slightly more positive about receiving an invitation through a text message than the older ones. One possible explanation may be that this age group is more used to receiving similar invitations on their mobile phones. A number of measures have been initiated by the Norwegian government to digitize the health sector in the last decade [32]. As a result, parts of the health sector have replaced letters and phone reminders with text messages. This may therefore be perceived as more normal for younger women than older ones, who are used to receiving letters. Women in the oldest age group had the highest percentage of women who did not want to receive an invitation through a text message. This may be because women in this group want to continue receiving letters.

5.5 Limitations

Methodology shortcomings

One of the limitations of using a survey is that participants may have understood questions incorrectly [57]. Technical problems may have accrued similar to those experienced in the pilot, where some participants in the oldest age group had difficulties taking the survey on their mobile phones. There was a significantly smaller proportion of participants in the oldest age group (13%) compared to the two other groups. This may be related to some of the same technical issues that occurred in the pilot. It may also be due to a lack of available technology. Due to the corona pandemic, it has not been possible to be physically present to assist the participants.

Sample bias

An attempt was made to spread the survey in various channels by people in different age groups, to get a representative sample of the population. Although an attempt has been made to reach out to a broad group of participants, the sample was not randomized. A consequence of this may be biased answers. Participants may have answered positively because they are familiar with the researcher and wanted to contribute. However, the varying number of participants from different age groups shows that a broad range of women had answered. This indicates that participants outside of the researcher's network also have responded the survey.

Error in the survey execution

An error was detected in one of the age groups after the survey was executed. The middle age group should have consisted of women between 40-54 years old, but a mistake made it instead 40-55 years old. This resulted in two age groups that contained the age of 55 years old (40-55 years old, 55-69 years old). The consequences of this may be that someone ended up in the wrong age group. It is difficult to be certain about how this has affected the result, as the participants have not stated their exact age. It is conceivable that 5.8% (87/15=5,8%) of women in the middle age group were 55 years old. This means that approximately 5.8% of the women in the middle age group belong to the oldest age group. It may have affected the results, but since the number of participants this applies to are so small, it has probably not had a remarkable effect. There are no reported results where differences between these two groups are so small that this error would have made a difference.

Nudge design

The nudge design was based on the MINDSPACE framework [44] and Caraban et al´s [38] framework on technology-mediated nudging in HCI. This is just a part of the wide range of frameworks that exist on behavior change concepts. It is therefore possible that other nudges would give different results.

5.6 Implications

Implications for practice

Findings indicate that persuasive messages may be an effective approach to motivate participants to attend screening. This should therefore be viewed as a promising approach for health interventions. A specific set of nudges were tested, and the result showed that some had the potential to influence behavior. This information can be used by practitioners to get more women to participate in screening. Other significant findings that may be of interest for today's practice is that participants responded equally to the messages regardless of age. This indicates that a "one size fits all" may be effective. Also, most participants answered that they wanted to receive an invitation through a text message. Screening programs currently use different platforms to send out invitations, including physical and digital letters. This finding suggests that text messages should be considered as an appropriate platform.

Implications for research

Findings from this study contribute to the field of digital nudging in healthcare. It provides valuable insights into how nudging in the form of persuasive messages performed in a health intervention. Previous studies have reported that nudging has the possibility to motivate women to participate in screening. Results from this study strengthen this finding.

The method used differs from what is common in similar studies. It was used to investigate how participants perceived the various messages. Similar studies have investigated the effectiveness of a message, but there is apparently less research on how it is perceived by the receiver. The results may therefore provide valuable insights from a new perspective. Further, findings from this study is a contribution to the ongoing discussion about whether a nudge is ethical or not. Various frameworks for ethical nudging exists, but few empirical studies have investigated what is considered ethical by the receiver of the nudge. The results may therefore be valuable for future studies when designing ethical nudges.

Chapter 6

Conclusion

The aim of this study was to explore if digital nudging could get more women to participate in screening. Persuasive text messages were designed based on theory from persuasive technology and digital nudging. The text messages were presented to participants for cervical screening through a survey. Quantitative research was considered relevant, as it facilitates the collection of data from a representative sample of the target population. Findings show that digital nudging in the form of persuasive messages can be effective to get more women to participate in cervical screening. However, not all messages were equally effective. This shows the importance of testing various messages before implementing one. The text message with the highest potential to increase attendance to cervical screening was a message with a scheduled appointment. The message with the lowest potential to increase attendance to cervical screening was a message that contained a fee for not showing up to a scheduled appointment.

Several research questions were investigated in order to address the problem statement. Because of the large target population for cervical screening, it was relevant to investigate if different age groups responded differently to the nudges. Results showed that there were small to no differences in which nudge women from the different age groups were influenced by. This indicates that a "one size fits all" approach could be appropriate when designing digital nudge interventions for screening.

As text messages have been reported to be effective to increase participation in various healthcare contexts, it was relevant to test if this also could be effective in cervical screening. As much as 87% of all the respondents answered that it is desirable to receive an invitation through a text message. Screening programs should therefore consider this platform as suitable for distributing invitations.

Additionally, this study is a contribution to the ongoing discussion about whether nudging is ethical or not. Various frameworks for ethical nudging exist, but few empirical studies have investigated what is considered ethical by the receiver of the nudge. Findings provide valuable insight into how future nudges can be designed to be ethical. Results showed that some messages were found more ethical than others. Most participants found a message with a scheduled appointment ethical, while a message with a fee for not attending a scheduled appointment was not found to be ethical. This amplifies how small changes in the text may result in considerable differences.

Findings are relevant for both research implications and implications for practice. The study provides valuable insight into how digital nudging have performed in a health intervention, which is relevant to the research field. The methodology approach differs from what is common in this field. A survey was used to investigate how participants perceived the various messages. Similar studies usually investigate the effectiveness of a message, but there is apparently less research on how it is perceived by the receiver. The results may therefore provide valuable insights from a new perspective.

Findings indicate that persuasive messages could be an effective approach to motivate participants to attend screening. Practitioners can use the results from this study to design effective screening invitations that motivate more people to participate in screening.

6.1   Further research

This study investigated how digital nudging in the form of persuasive text messages were perceived by participants to cervical screening. Future research should investigate how persuasive messages performs in the actual context. This may reveal how many people that actually participates in screening after receiving the text message. Such a study should also include a higher number of participants to get a representative sample of the target population.

Future research should also investigate what is the ideal time to send a persuasive message in this context. The timing of a nudge may be crucial to how it performs. This was not possible to investigate with the method that was used. Context-awareness and personalizing of nudges should also be investigated further by future research as it may lead to more effective nudges.

This study is based on the premise that participation in cervical screening can be improved by making changes to the invitation strategy. This is based on previous findings that have reported that the current invitation fails to motivate participants to attend screening. It is thus not certain that this is the most efficient approach. Future studies may investigate several parts of cervical screening to see if other measures could be more efficient. Several women commented that they prefer a gynecologist to take the pap smear instead of their GP. The current invitation to cervical screening recommends participants to schedule an appointment with their GP. Future studies may, therefore, investigate this further, in addition to other measures that may lead to increased participation in screening.

Additionally, future research may also draw attention to relevant stakeholders such as those responsible for the cervical program, general practitioners, and gynecologists. They may provide information from a different perspective that could be valuable in the job of getting more people to participate in screening.

The nudge design was based on two frameworks that are commonly used for health nudges in HCI. Research may also explore other nudges to see if they give different results.

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Appendix A

Survey

Undersøkelse i forbindelse med celleprøve-invitasjoner

I Norge er det anbefalt at kvinner mellom 25-69 år tar regelmessige celleprøver som et forebyggende tiltak mot livmorhalskreft. Allikevel er det mange som velger å ikke gjøre det. Denne masteroppgaven ser på en alternativ metode for utsendelse av invitasjoner. Målet er at flere kvinner skal ta celleprøve.

Undersøkelse er kort, og tar ca 5-7 minutter. Resultatene vil bli delt med Livmorhalsprogrammet. En nærmere vurdering vil bli gjort på om resultatene skal publiseres. Undersøkelsen er anonym. Om du tar den på mobil, må du «swipe» bortover på svaralternativene slik at du får opp alle. Anbefaler derfor å ta den på en datamaskin.

1. Hva er alderen din?

   ☐ 25-39 år
   ☐ 40-55 år
   ☐ 55-69 år

2. Har du tatt celleprøve før?

   ○ Ja
   ○ Nei

3. I hvilken grad

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Mener du at det er viktig å ta regelmessige celleprøver?	○	○	○	○	○
Er du motivert til å ta en celleprøve?	○	○	○	○	○

Del 2	Nedenfor ser du 5 meldingsvarianter som hver inneholder en oppfordring til å ta celleprøve. Under hver melding følger 3 spørsmål.

Melding 1

Ut i fra denne meldingen..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Blir du motivert til å ta celleprøve?	◯	◯	◯	◯	◯
Øker sannsynligheten for at du tar celleprøve?	◯	◯	◯	◯	◯
Opplever du det etisk forsvarlig av Livmorhalsprogrammet å sende denne meldingen?	◯	◯	◯	◯	◯

Melding 2

Det er nå tid for å ta ny
celleprøve. Du har fått time hos
din fastlege 20.04.2021 kl: 09:30.
Trykk her for å endre timen.
Trykk her for å lese mer om
livmorhalsprogrammet.

Mvh
Livmorhalsprogrammet

Ut i fra denne meldingen..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Blir du motivert til å ta celleprøve?	◯	◯	◯	◯	◯
Øker sannsynligheten for at du tar celleprøve?	◯	◯	◯	◯	◯
Opplever du det etisk forsvarlig av Livmorhalsprogrammet å sende denne meldingen?	◯	◯	◯	◯	◯

Melding 3

●●●○○ Telenor 🔒   9:41   50 % 🔋

‹ Meldinger **Livmorhalspro..** Kontakt

Rundt 400 000 kvinner i Norge tar celleprøve hvert år, det burde du og gjøre. Det er nå tid for å ta ny celleprøve. Bestill time hos din fastlege. Trykk her for å lese mer om livmorhalsprogrammet.

Mvh
Livmorhalsprogrammet

Ut i fra denne meldingen..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Blir du motivert til å ta celleprøve?	◯	◯	◯	◯	◯
Øker sannsynligheten for at du tar celleprøve?	◯	◯	◯	◯	◯
Opplever du det etisk forsvarlig av Livmorhalsprogrammet å sende denne meldingen?	◯	◯	◯	◯	◯

Melding 4

●●●○○ Telenor 🛜 9:41 50 % ▭

❮ Meldinger **Livmorhalspro..** Kontakt

Du har fått time til å ta ny celleprøve hos din fastlege 20.04.2021 kl: 09:30. Du vil bli belastet et gebyr på 500,- dersom du ikke møter til oppsatt time. Trykk her for å endre timen. Trykk her for å lese mer om livmorhalsprogrammet.

Mvh
Livmorhalsprogrammet

Ut i fra denne meldingen..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Blir du motivert til å ta celleprøve?	◯	◯	◯	◯	◯
Øker sannsynligheten for at du tar celleprøve?	◯	◯	◯	◯	◯
Opplever du det etisk forsvarlig av Livmorhalsprogrammet å sende denne meldingen?	◯	◯	◯	◯	◯

Melding 5

Det er nå tid for å ta ny celleprøve. Bestill time hos din fastlege i dag. Trykk her for å lese mer om livmorhalsprogrammet.

Mvh
Livmorhalsprogrammet

Ut i fra denne meldingen..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Blir du motivert til å ta celleprøve?	○	○	○	○	○
Øker sannsynligheten for at du tar celleprøve?	○	○	○	○	○
Opplever du det etisk forsvarlig av Livmorhalsprogrammet å sende denne meldingen?	○	○	○	○	○

Del 3

9. I hvilken grad..

	I svært liten grad	I liten grad	Verken eller	I stor grad	I svært stor grad
Er det ønskelig å få en oppfordring fra Livmorhalsprogrammet som en digital tekstmelding?	◯	◯	◯	◯	◯
Synes du temaet er ubehagelig å snakke om?	◯	◯	◯	◯	◯

10. Har du tidligere hatt en dårlig opplevelse med å ta celleprøve?

☐ Nei
☐ Ja
☐ Ønsker ikke å svare

11. Har du noen andre kommentarer rundt dette temaet? (Ikke obligatorisk)

_____

Appendix B

Invitation to the Norwegian Cervical Screening Program

Nå er det tid for livmorhalsprøve – en prøve som kan redde liv

(Information in English: kreftregisteret.no/cervix)

Det er legen din som tar livmorhalsprøven, og du må selv bestille time.
Dersom du nylig har tatt prøve, kan du se bort i fra denne påminnelsen.

Budskapet vårt er enkelt:

Bestill time hos fastlegen	Ta livmorhalsprøve	Reduser sjansen for livmorhalskreft	All nødvendig informasjon finner du i dette brevet eller på Kreftregisteret.no/livmorhals

Hvorfor er det viktig at du tar livmorhalsprøve, selv om du er frisk?
Regelmessige livmorhalsprøver kan oppdage alvorlige celleforandringer før de utvikler seg til livmorhalskreft. Celleforandringer er ikke det samme som livmorhalskreft og gir oftest ikke symptomer. Celleforandringer behandles med et enkelt inngrep. Halvparten av kvinnene som får livmorhalskreft har sjelden eller aldri tatt prøve.

Livmorhalskreft rammer kvinner i alle aldre, derfor bør alle kvinner mellom 25 og 69 år ta livmorhalsprøver regelmessig.
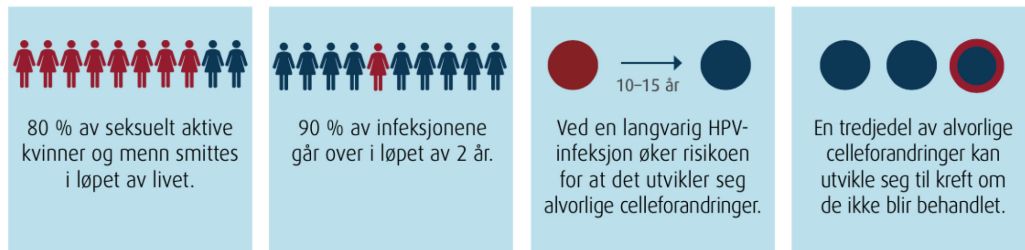
Vennlig hilsen

Ameli Tropé
Leder for Livmorhalsprogrammet

HPV er årsaken til livmorhalskreft

Alvorlige celleforandringer og livmorhalskreft skyldes en langvarig infeksjon med humant papillomavirus (HPV). HPV er den vanligste seksuelt overførbare infeksjonen.

80 % av seksuelt aktive kvinner og menn smittes i løpet av livet.	90 % av infeksjonene går over i løpet av 2 år.	Ved en langvarig HPV-infeksjon øker risikoen for at det utvikler seg alvorlige celleforandringer.	En tredjedel av alvorlige celleforandringer kan utvikle seg til kreft om de ikke blir behandlet.

Hvordan tar du livmorhalsprøve?

Prøven blir tatt ved gynekologisk undersøkelse som tar noen få minutter. Det skal ikke gjøre vondt, men noen ganger kan det være litt ubehagelig. Prøven din blir deretter sendt til et laboratorium og blir undersøkt i mikroskop for å oppdage eventuelle celleforandringer. Legen din mottar stort sett svar på prøven innen en måned. Ved unormale prøvesvar har legen ansvar for å gi deg informasjon og henvise til videre oppfølging. Ved normale prøveresultater anbefales du å ta en ny prøve om tre år. Livmorhalsprogrammet vil sende deg en påminnelse når det nærmer seg tid for ny prøve.

Ingen screeningprøve er 100 % sikker

Regelmessige screeningprøver reduserer sjansen for å utvikle livmorhalskreft med ca. 90 %, men screeningprøven kan overse alvorlige celleforandringer av ulike årsaker. Selv om prøveresultatene dine er normale, er det viktig at du kontakter lege med en gang dersom du får symptomer som for eksempel uregelmessige blødninger, blødninger etter samleie eller etter overgangsalderen, unormal utflod eller vedvarende smerter i underlivet. Gå inn på https://www.kreftregisteret.no/livmorhals for å lese om ulemper og fordeler med å ta livmorhalsprøve.

Hvor kan jeg ta livmorhalsprøve?

Fastlegen tar prøven. Ta gjerne med deg dette brevet til legen. Ønsker du å ta prøven hos gynekolog, kreves det i de fleste tilfeller henvisning fra fastlege. Noen jordmødre tar også prøver. Du må selv betale en egenandel for undersøkelsen.

Hvordan forbereder jeg meg til livmorhalsprøve?

Ikke ta prøven når du har menstruasjon. Blod i prøven kan gi feil svar. Unngå tamponger, fødselspreventivt skum, vaginale geléer, kremer o.l. ett døgn før du tar prøven da dette kan påvirke prøveresultatet.

Reservasjon og personvern

Kreftregisteret lagrer opplysninger om dine prøvesvar. Du kan reservere deg mot at opplysninger ved normale funn lagres i Kreftregisteret. Du har rett til å motsette deg at Kreftregisteret deler din prøvehistorikk med helsepersonell som ber om det til bruk i oppfølgingen av deg. Du kan be om innsyn i opplysninger som er registrert om deg i Kreftregisteret.

Du finner mer informasjon på våre nettsider
https://www.kreftregisteret.no/livmorhals
Ring legen din eller oss hvis du lurer på noe angående livmorhalsprøven din.
Kontakt oss på tlf. 22 45 13 00 hverdager fra 12-14.30 eller e-post
livmorhals@kreftregisteret.no

Fight HPV
Er du glad i å spille?
Last ned appen og lær mer om HPV