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The potential of a smart phone app to support consumers in preventing household food waste

Potensialet for en app til å støtte forbrukere i
forebygging av matsvinn i hjemmet

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Preface

This master-thesis was carried out at the Faculty of Chemistry, Biotechnology and Food Science at the Norwegian University of Life Sciences.

As I progressed through my master courses, it became evident that my master-thesis would have something to do with food security or food waste. I am grateful that I got the opportunity to write about something that engages me to this extent. Not only has writing this thesis given me knowledge about the causes of, and possible solutions to food waste. It has also taught me about people, and why they behave in the manners they do.

There are so many people that I would like to thank for their contribution and impact. First and foremost, I would like to thank my supervisor Marije Oostindjer for the exceptional guidance and support during this process, for the great interest in the thesis and for giving me motivation when I needed it. I would also like to thank my co-supervisors Valérie Lengard Almlie and Bjørg Egelanddal for valuable help and advice, all the people who volunteered for interviews, and the staff at the Writing center and friends for helping me with the text.

When I finished my bachelor's degree in Oslo, I thought I had experienced all that the student life had to offer. Little did I know of what lay ahead of me for the next three years here in Ås. Thank you so much to my girlfriends in Collegium Alfa (who have probably had a greater impact on me than I can even imagine) for all the fun and memories. Thank you to my classmates, and especially the guys at Sol & Glede, for being awesome people that I have a lot of fun with. Thank you to my boyfriend who has waited patiently through this time for me to finish my studies.

Finally, I would like to thank all the people that I have encountered in my time here at NMBU. Some have become my friends, some acquaintances and some I have only met randomly. Either way, all have influenced me in some way or another. Thank you to all the people who make Ås (and Samfunnet) the best place to be a student.

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Abstract

Background: Food waste is one of today's greatest threats against sustainability. One of the most important reasons for food waste generation in developed countries is the un-willingness of many consumers to buy or consume sub-optimal foods. This study investigated whether an app can contribute to changing consumers' attitudes towards sub-optimal foods and support consumers in reducing household food waste.

Methods: The study involved 150 participants distributed over three intervention groups based on their sociodemographic characteristics. The app intervention was designed based on a brain storming session and group interviews. One group received a targeted app with a special focus on preventing waste of dairy products (full app), the other a more general version of the app (light app) and the third a printed version of the app (paper). The app's effect on household food waste reduction was compared between the groups after three weeks through an evaluation survey.

Results: People attributed low usefulness of the app for wasting less food and there was no effect observed effect on attitude towards sub-optimal foods. There was no significant difference between the two app groups. However, the paper group was more likely to find the app useful than both app groups. 49 % of participants in the app groups experienced technical issues. Nevertheless, 25 % of participants across all groups reported to have attained talking to friends or family about food waste during the intervention period.

Conclusion: This study tested whether an app can support consumers in reducing household food waste. The current study provides no evidence that an app can support people in reducing household food waste. However, it might raise awareness. The limited effect can partly be attributed to technical issues and lack of desired features mentioned by interview informants. An app might be useful for wasting less food in households, but further development of the app is necessary to investigate this possibility further.

Sammendrag

Bakgrunn: Matsvinn er en av de største truslene mot en bærekraftig verden. En av de viktigste årsakene til matsvinn i den vestlige verden er at forbrukere i liten grad ønsker å kjøpe, eller konsumere, sub-optimale matvarer. Denne studien undersøkte om en app kan bidra til å endre forbrukeres holdninger til sub-optimale matvarer og benyttes som et verktøy for å redusere matsvinn i husholdningen.

Metode: Studien involverte 150 deltakere fordelt over tre intervensjonsgrupper basert på deres sosiodemografiske egenskaper. Intervensjonen (app) var designet basert på idemyldring og gruppeintervjuer. Én gruppe mottok en app med spesielt fokus på forebygging av svinn av meieriprodukter, én gruppe mottok en mer generell versjon av appen, og én gruppe mottok appen i papirformat. Appens effekt på reduksjon av matsvinn i husholdninger ble evaluert etter tre uker ved bruk av et spørreskjema. Effekten ble sammenlignet mellom de tre gruppene.

Resultater: Deltagerne i studien tilskrev appen lav nytte for å forebygge matsvinn, og det var ingen observert effekt på deres holdninger mot sub-optimale matvarer. Det var ingen signifikant forskjell mellom de to app-gruppene. Derimot var det mer sannsynlig at papir-gruppen oppfattet appen som nyttig enn app-gruppene. 40 % av deltagerne i app-gruppene opplevde tekniske problemer. 25 % av deltagerne, uavhengig av gruppe, rapporterte at de hadde startet å snakke med venner og familie om matsvinn i løpet av intervensjonsperioden.

Konklusjon: Denne studien undersøkte om en app kan fremme matsvinnforebyggende adferd i forbrukeres husholdninger. Resultatene ga ingen evidens for at en app kan hjelpe folk å redusere matsvinn i husholdningen. Likevel kan appen bidra til økt bevissthet om matsvinn. Den begrensede effekten kan delvis tilskrives tekniske problemer og mangler ved appen. En app kan være nyttig for å forebygge matsvinn i husholdninger, men videre utvikling av en slik app er nødvendig for å undersøke denne muligheten videre.

Definitions

COSUS: COsumers in a SUStainable food supply chain. A project targeting consumer related food waste, and part of the EU SUSFOOD ERA-net program.

Date labelling: Tool that indicates the shelf life of food products. “Use by” is associated with food safety, and safety cannot be guaranteed past this date. “Best before” is associated with food quality, and optimal quality cannot be guaranteed past this date.

FAO: Food and Agriculture Organization of the United Nations

Food waste: “(..) any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea).” (FUSIONS 2014, p. 6)

FUSIONS: Food Use for Social Innovation by Optimising Waste Prevention Strategies. European project working towards reducing food waste in Europe through social innovation.

FSC: Food Supply Chain. An overview of the food’s process from farm to fork. Figure 1 shows the presentation chosen for this thesis.



Figure 1. The food supply chain. Adapted from: Papargyropoulou et al. (2014), Monier et al. (2011).

TIB: Theory of Interpersonal Behavior (Triandis 1977). A modified version of TPB. In TIB, the individual’s intention to perform a behavior, habits and facilitating conditions are central for explaining the behavior. Intention is influenced by attitude (evaluation and beliefs about outcomes), social factors (norms, roles and self-concept) and affect (emotions).

TPB: Theory of Planned Behavior is “*a theory designed to predict and explain human behavior in specific contexts*” (Ajzen 1991, p. 181). In TPB, the individual’s intention to perform a behavior is central for explaining the behavior. The intention is influenced by attitude towards the behavior, subjective norm and perceived behavioral control. These three factors together form the individual’s actual control over the behavior. Attitude is the individual’s positive or negative evaluation of the behavior. Subjective norm is the influence of other people’s opinion. Perceived behavioral control is the individual’s perceived ability to perform the behavior.

Suboptimal food: Food products that still hold good quality but 1) are close to, or beyond, the best before-date, 2) deviate in appearance (visually or in other sensory perception) or 3) have damaged packaging (Aschemann-Witzel et al. 2015; de Hooge et al. 2017)

WRAP: Waste and Resources Action Programme. A non-profit organization in the United Kingdom with the mission to accelerate the move to a sustainable, resource-efficient economy.

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1. Introduction

One-third of all produced food is wasted, which amounts to 1.3 billion tons of food every year (Gustavsson et al. 2011). As wasting food has a great negative environmental, economic and social impact, food waste is one of today's greatest threats against sustainability. Sustainability matters concern the whole world population, so the obvious question called for is: What measures can be made to assist people in wasting less food?

FUSIONS' definitional framework (2014, p. 6) is chosen for defining food waste in this study and reads:

«Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed¹.»

The current definition excludes food that is utilized for animal feed or biobased materials and biochemicals processing. Whether this type of utilization of excess food should be considered food waste is debatable, because it is not used for its intentional purpose, which is to be consumed by humans (Chaboud & Daviron 2017).

The causes of food waste are complex and differ between different parts of the world as well as between and within countries (Aschemann-Witzel et al. 2015; Gustavsson et al. 2011; Parfitt et al. 2010). In developing countries, most of the food waste relates to the production, post-harvest handling, and storage of food (Gustavsson et al. 2011). Food waste often occurs at these stages because of technical limitations, lack of infrastructure and limited opportunities for optimal storage. In developed countries, more food is wasted later in the food supply chain (FSC) due to regulations, market standards, packaging logistics and ultimately the consumer.

1.1. Rationale for reducing food waste

On September 25th 2015, the United Nation (UN) member states agreed on The UN Sustainable Development Goals (UN 2015a). Development goal 12.3 reads:

«By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses».

The environmental impact associated with food production and hence food waste is great, so reaching this ambitious goal is an important part of the strategy to ensure a sustainable future.

¹ including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea

Food and agriculture is one of the top three categories that have the largest environmental impact across their life cycle (Akenji & Chen 2016). One-third of all greenhouse gas emissions are produced as a result of food production (Garnett 2011). Producing food also requires extensive use of water, land, energy and nutrients (FAO 2013; Foresight 2011). When food is wasted, the resources used to produce the food have also been wasted.

Producing food that is not eaten causes unnecessary carbon dioxide (CO₂) emissions (Gustavsson et al. 2011). The carbon footprint associated with food that is not eaten is 3.3 Gigatons of CO₂, estimated by FAO (2013). This means that, if food waste was a country, it would be the third most emitting country in the world, after China and USA. The carbon emissions from food waste are associated with production, processing, transportation, storage, consumption and disposal of food (Monier et al. 2011). The further down in FSC, the more emissions are associated with the food waste. For example, 22 % of the food waste occur at the consumption phase, which accounts for 37 % of the carbon footprint associated with food waste. Food production does not only involve emissions of greenhouse gas, but also emissions of nitrogen that is used in fertilizers (Rockström et al. 2009). Rockström et al. has identified the nitrogen cycle as one of the earth-system processes where humans have exceeded the boundaries for exploitation.

Agricultural production world-wide has a larger water footprint than any individual country (Hoekstra & Mekonnen 2012). The production of animal products (meat and milk) have an especially large impact. The latest estimates of land usage show that the land usage in 2007 for food that was never consumed was equal to 28 percent of the total agricultural land area (FAO 2013). Excessive exploitation of land, such as in modern agriculture, can lead to land degradation.

The economic global cost of food waste is 750 billion USD, which equals to 1.5 times the 2014 GDP for Norway (FAO 2013; Trading Economics 2017). All parts of the FSC are affected by the costs related to food waste.

Due to economic growth, the future will be characterized by population growth and increased urbanization, which further leads to a rise in the global food and energy demand in the coming years (FAO 2009; US Energy Information Administration 2016). The world population is expected to exceed 9 billion people in 2050 and currently 1 in 9 of the world's population still undernourished (Akenji & Chen 2016; UN 2015b). The increased demand for food and energy increases the necessity of utilizing these resources in a sustainable manner to ensure food security for all. The food sector is responsible for 30 % of the global energy use, which emphasizes the relationship between sustainable food- energy utilization (FAO 2011). Reducing food waste is, together with alternative diets (such as reduced meat consumption), considered as an important step towards food security in the future

(Foley et al. 2011; Godfray et al. 2010; Guyomard et al. 2012; Schönhart et al. 2009). Achieving food security can also be supported on a local level, with redistribution as a good alternative for handling surplus food that would otherwise go to landfill (Alexander & Smaje 2008).

1.2. Food waste in developed countries

Most of the food waste in developed countries is related to the consumer (Gustavsson et al. 2011). Food waste at the consumer level relate to both consumer behavior and lack of coordination between the different actors in the FSC. In addition to the consumers' own food disposal, consumer behavior also leads to food waste in earlier stages of the FSC (Gustavsson et al. 2011; Koester et al. 2013). The producers, industry and retailers must adjust their decisions and actions according to the consumers' preferences. For example, supermarkets reject food from the producer if its appearance is not within the given appearance quality standard that they expect the consumer to purchase, which results in a lot of food not ending up for human consumption.

FAO have estimated that approximately 280-300 kg food is wasted per capita per year in Europe, North America and Oceania, of which 30-40 % is accounted for by the consumer (Gustavsson et al. 2011). In comparison, 125-170 kg food waste is generated per capita per year in Sub-Saharan Africa and South- and Southeast Asia, whereas 4-9 % is contributed by the consumer. In Norway, 61 % of the food waste is estimated to be produced by the consumer (Stensgård & Hanssen 2016). The numbers imply that consumers play an important role in the generation of food waste in the industrial countries, and thus play a critical part in the solution to the problem.

Many people are concerned about food waste, as they think it is fundamentally wrong and want to do the 'good' thing (Aschemann-Witzel et al. 2015). Still, the same people waste food. This has partly to do with trade-offs and priorities. For example, the wish to be a good provider for the family and ensure everyone is satisfied with the meal, makes people tend to cook too much food. The same wish may result in not wanting to serve leftovers. Apart from environmental concerns, people are also concerned with health, weight management and allergies in their choices related to food, which may be prioritized in expense of preventing food waste (Akenji & Chen 2016).

Food can be of good quality and highly palatable after the best before-date. Still, many consumers rely solely on the date in their assessment of edibility (Van Boxtael et al. 2014). Stensgård and Hanssen (2016) estimated that 42 % of household waste in Norway occur due to that the product has passed the expiry date, which might be explained by food safety concerns and lack of knowledge. Other possible explanations might be that consumers are generally unable to determine food quality,

or habitually waste food past the best before date (Grunert 2005; Newsome et al. 2014). Dairy products typically maintain their quality well after the best before-date, particularly fermented products such as yoghurt, sour cream and cheese

Changing the consumers' food waste behaviors requires a change in attitude, knowledge and awareness and must be facilitated by the society as well as by the food retailers and industry (Gunders 2012; Thyberg & Tonjes 2016). Facilitating food waste prevention requires raising awareness in all parts of the FSC (Gustavsson et al. 2011). Opportunities for change include providing information, educating consumers in food skills, creating awareness and changing social norms (Aschemann-Witzel et al. 2015). It is important to note that although most people care about sustainability, they disengage if there is no clear and meaningful way for them to address the challenge (UN Environment 2016).

Several initiatives and projects have addressed the food waste problem in developed countries. Among the projects are FUSIONS and COSUS (EU FUSIONS 2016; Oostindjer 2014b). This current study is part of the COSUS (COnsumers in a SUsustainable food supply chain) project. The aim of the project is to increase the consumers' acceptance of suboptimal foods (foods that deviate in appearance, but not quality), by implementing targeted strategies that are based on consumer insight (Oostindjer 2014b). Former studies in COSUS have analyzed the issue of food waste and investigated how personal attitudes and environmental influences (such as labels) affect consumer acceptance of suboptimal foods (Oostindjer 2014a). The findings in the former studies create the foundation of the intervention in this study.

Apps are frequently used tools to target health related behavior. Some apps for preventing food waste already exist (Foodlist 2016; Too Good To Go 2017) . Limited research has been performed on the effect of such apps to reduce food waste, and currently no app exists for targeting food waste in Norwegian households.

The main objective in this thesis is to reduce household food waste by providing knowledge and awareness through a targeted app. Dairy products will be emphasized, because dairy products often hold a good quality after their expiration date.

1.3. Research questions

The research question for this thesis is:

Can an app, with targeted content about food waste, be useful as a tool for reducing food waste at the consumer level?

To further elaborate the potential effect of the app, the study includes the following sub questions:

What do consumers think should be part of an app that can help them waste less food (with a focus on dairy products)?

Does the use of an app that aims to help consumers to waste less dairy products change the attitude towards suboptimal foods?

Is an app with targeted content about food waste reduction, with a special focus on dairy products, more useful than a general app?

Is an app more useful than providing the information in a paper format?

2. Background

2.1. Consumer insight

There are several important factors that influence the amount of food that is wasted in a household, with key factors being household composition and people's age. Families waste more than single-person households, but single-person householders waste more per capita. Households with children waste more than households without children. Despite that young people report being more conscious about food waste and the environment, they tend to waste the most. The age group that wastes the least food is the generation of 65 years or older (Aschemann-Witzel et al. 2015; Quedsted et al. 2013). This is, however, the group that reports to be the least concerned with the environment. People over 65 years manage their home differently than the rest of the population. They are more motivated by economics and thriftiness rather than by environmental concerns.

The most important factors that affect food waste behavior can be divided into three main groups (knowledge, awareness, attitude), each with two sub groups (table 1). Some of the main reasons for wasting food that are reported by consumers are lack of planning, that the food has expired, and a careless attitude towards food (Gustavsson et al. 2011). Food waste occur during cooking, as leftovers after meals and due to food not being used in time (Monier et al. 2011).

Table 1. The most important factors associated with food waste behavior*.

KNOWLEDGE		AWARENESS		ATTITUDE	
Practical (skills)	Theoretical	Own situation	Overall	Priorities	Other
<ul style="list-style-type: none"> •Correct treatment and storage of food •What to do with leftovers 	<ul style="list-style-type: none"> •Date labelling •Food safety •Food quality 	<ul style="list-style-type: none"> •The amount of food wasted in their own home •Own benefits of reducing waste 	<ul style="list-style-type: none"> •The total amount of food wasted •The impact of food waste on the environment, social issues and economics •The resources required to produce food 	<ul style="list-style-type: none"> •Variety in meals •Social identity and social relations •Preference •Diet, lifestyle and health 	<ul style="list-style-type: none"> •Expect flawless food •Do not care about wasting food •Behavioral habit •Culture of consumerism

*Adapted from: (Aschemann-Witzel et al. 2015); Canali et al. (2014); Gustavsson et al. (2011); Koester et al. (2013); Monier et al. (2011); Quedsted et al. (2011)

Behaviors such as planning, correct storing, correct portioning, and using leftovers are associated with food waste reduction in households (Quedsted et al. 2013). According to WRAP's conceptual

framework, the behaviours are affected by attitudes and values; motivation, habit; perceived social norms; knowledge and skills; awareness of the issue; and facilities and resources. The same values were found to be important in a review by Parfitt et al. (2010). Aschemann-Witzel et al. (2015) in their review concluded that the most important factors that affect food waste are lack of planning and management; low price level of food; consumer price orientation; evaluating quality by appearance; food safety concerns; high quality standards; and macro-economic factors.

Consumers are aware and concerned about food quality and food safety and discard food when they are not sure whether it is safe or still holds the desired quality (Grunert 2005; Neff et al. 2015; Van Boxtael et al. 2014). The concerns about food safety and quality can be related to that many consumers misinterpret the date-labels of foods due to not being able to distinguish between “best before” and “use by” (Monier et al. 2011; Newsome et al. 2014). The misinterpretation of date labels leads to the disposal of good quality-food, and can be associated with a lack of knowledge and skills related to food. In addition to knowledge about date-labelling and food safety, knowledge and skills include knowledge about correct storing as well as cooking skills.

2.2. Sub-optimal foods

A common reason for generation of food waste at the consumer level is that the consumer perceives the food as sub-optimal (Aschemann-Witzel et al. 2015; de Hooge et al. 2017; Loebnitz et al. 2015). Food can be sub-optimal with regards to either 1) being close to, or beyond, the best before-date, 2) deviation in appearance (visually or in other sensory perception) or 3) damaged packaging, without having any negative influence on the quality and safety of the food (Aschemann-Witzel et al. 2015; de Hooge et al. 2017). The non-selection of sub-optimal foods can occur in the super market or in the home. Studies show that people are more susceptible to choose the sub-optimal products in the home-situation than in the in store-situation (Aschemann-Witzel et al. 2015; de Hooge et al. 2017). This behavior can originate from the wish to utilize the products that they have already bought, while wasted products in the supermarket are not their responsibility. Sub-optimality related to dairy products are often with regards to them being close to, or beyond, the best before date.

2.2.1. Date-labelling

There are two types of date labelling intended for the consumer: “Best before” (Norwegian: Best før) and “Use by” (Norwegian: Siste forbruksdag) (International Dairy Federation 2012). “Use by” is associated with food safety, and products past this date should not be consumed. “Best before” indicates the period for which the quality can be guaranteed by the producer.

Tsiros and Heilman (2005) explored the willingness to pay (WTP) for different perishable food categories and found that WTP for milk was 30 % of list price one day before the expiration date. De

Hooge et al. (2017) found that more than 40 % of consumers in their study were fine with consuming milk or yoghurt past the best before-date in the home. While only 10 % or less would select the same product in the supermarket. Sen and Block (2009) also found that consumers are more likely to consume products past the best before date when they already own it. The reasons for consuming the product can be that they have already paid for it, and they know about the product's history (Bolton & Alba 2012). That 40 % of consumers reported being fine with consuming milk and yoghurt past the best before-date indicates that there is potential for people to attain this behavior. Neff et al. (2015) emphasized the need to teach people about food safety in order to increase acceptability of foods that appear less attractive due to being close to the expiry date.

To reduce food waste, it is necessary to facilitate sustainable consumption and production of food (Aschemann-Witzel et al. 2015; Papargyropoulou et al. 2014). . This requires several actions to be carried out simultaneously, targeting the whole FSC, as actions in one part of the supply chain affect other parts (Gustavsson et al. 2011; Guyomard et al. 2012). The effect of preventive measures at the industry and producer levels will only be minor if the current high levels of food waste in households are maintained. Governments and businesses can facilitate food waste reduction for the consumer by clarifying the meaning of date labelling, promote awareness campaigns and develop packaging sizes more suitable for the consumers' needs (Gunders 2012; Halloran et al. 2014; Priefer et al. 2016). Retailers should cut promotions that encourage overbuying (Gunders 2012). Additionally, retailers can be an arena to educate consumers in handling and storing of food, because of the frequent encounter between the consumer and the retail. In any case, reducing food waste requires food waste reduction to be a priority, both for the government, industry and, inevitably, the consumer.

2.3. Quantification and managing of food waste

To conduct preventive measures against food waste, it is first necessary to quantify the amount of food that is wasted (Gunders 2012). Food waste can be quantified in several ways, and no single method can be applied to estimate food waste in all steps in the food supply chain (Møller et al. 2014). A challenge with quantifying food waste is the lack of an international standard methodology and consistency in the definitions (Lebersorger & Schneider 2011). The lack of consistency in quantification methodologies and definitions complicates the evaluation of the effects of preventive measures. Several studies emphasize that there are major data gaps in the knowledge of the extent of food waste, both in Europe and globally (FUSIONS 2014; Gustavsson et al. 2011; Monier et al. 2011). Regardless of the actual amount wasted, there are frameworks to manage food waste.

Papargyropoulou et al. (2014) have proposed the food waste hierarchy as a framework for managing food waste (fig 2). The reversed pyramid ranks the different strategies for managing food waste based

on priority. The preferred strategy, according to the authors, is to avoid generating food surplus and prevent avoidable food waste. The second most preferable option is reuse, or redistribution, of food. Next is recycling in the form of animal feed or compost, followed by energy use. The least favorable option is disposal of food in landfills. The current thesis will focus on food waste prevention for managing food waste.

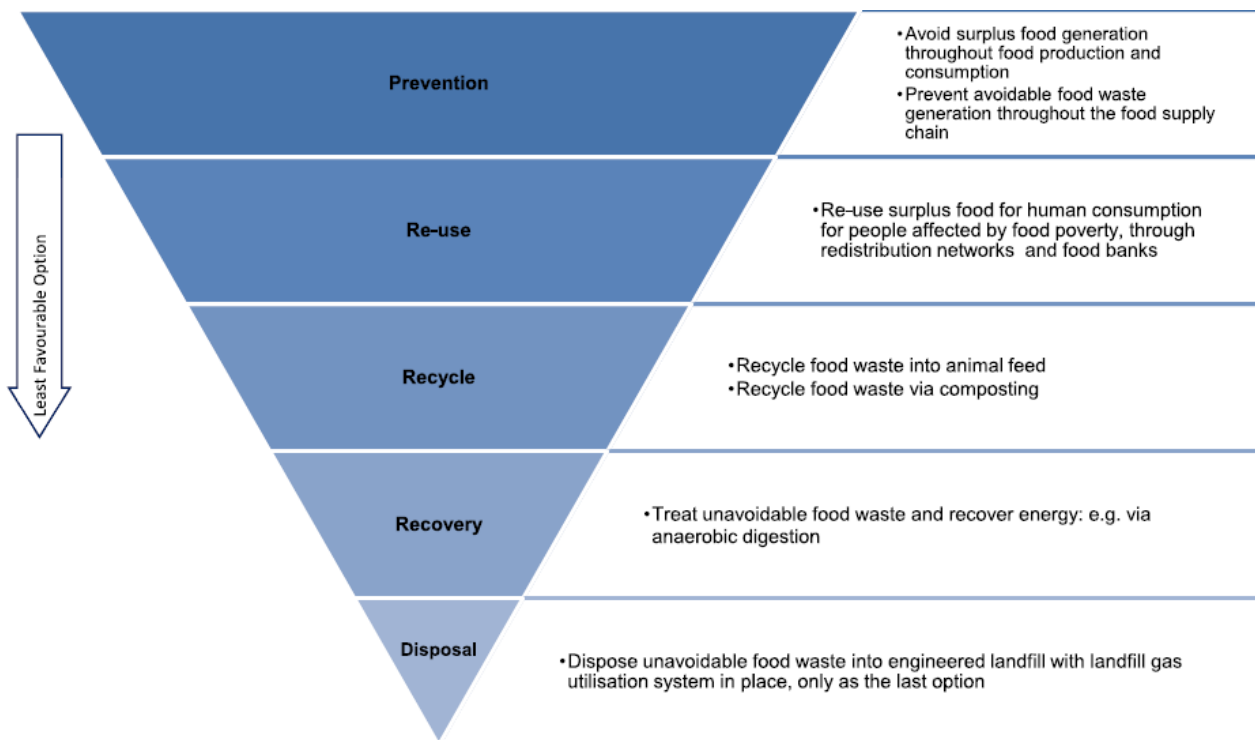


Figure 2. The food waste hierarchy (Papargyropoulou et al. 2014).

2.4. Previous and ongoing initiatives in Norway and potential for action

Various initiatives for reducing food waste have been conducted in recent years, both globally and in Norway (Monier et al. 2011). Among them are awareness campaigns, research programs and food redistribution (e.g. to charities, foodbank). Matvett AS is an initiative from the food industry, which aims to facilitate food waste prevention, and reduction, in Norway (Matvett 2017). The organization facilitates a food waste reducing effort for the industry, and targets consumers with knowledge and awareness. Matvett AS managed the ForMat project, which was conducted during the period 2011-2015 (Stensgård & Hanssen 2016). The project was a collaboration between the food industry, organizations and authorities. The aim of ForMat was to investigate the extent and causes of food waste in Norway, and implement preventive actions. During the period of the project, the estimated food waste per capita in Norway was reduced by 12 % (Stensgård & Hanssen 2016).

2.5. Behavioral change

Studies show that the best time for implementing behavioral change is during shifting phases of life, for example when people attain studies or are retiring (Aschemann-Witzel et al. 2015; UN Environment 2016). There is a consensus that effectively shifting people towards a more sustainable lifestyle relies on understanding what shapes people's behavior (Akenji & Chen 2016; McEachan et al. 2011). This knowledge can be transferred into changing people's food waste behaviour.

Models of behavior help identify underlying factors for specific behaviors (behavior change practical guide). Along with models for theories of change, models of behavior can be helpful tools for promoting behavioral change. Studies show that behavior change interventions are more likely to have an effect when they are embedded in behavior change theory (Noar et al. 2008; Webb et al. 2010). No model of behavior is a perfect reproduction of the real world, so different models should be combined when designing an intervention. The theory of planned behavior (TPB) is central whenever talking about behavior change (Ajzen 1991; McEachan et al. 2011) and has previously been successfully utilized in at least one study addressing household food waste (Graham-Rowe et al. 2015). In TPB, the individual's intention to perform a behavior is central for explaining the behavior.

In contrast to approaches that aim to change people's conscious behavior, nudging is a way of changing people's behavior without seeking to influence the conscious decision-making process (Dreibelbis et al. 2016). For example, by changing the environment such that it becomes easier to make the right decisions. This can for instance be to place healthy food items within easy reach in the retail store.

For the purpose of this study, small amendments were applied to TPB (fig. 3). Habit and emotions were included in the model, inspired by the Theory of interpersonal behavior (TIB), a modified version of TPB (Triandis 1977).

Interventions based on TPB have been shown to have effects on behavior (Webb et al. 2010). One way of presenting interventions is through apps. The TPB model can be utilized to develop an app that target most elements of TPB, such as attitude and perceived behavioral control. Attitude may be targeted by providing awareness. Perceived behavioral control can be targeted by giving the users tools to change behavior. Social norm can also be targeted in an app through communication with significant others, presuming there is a social aspect to the app.

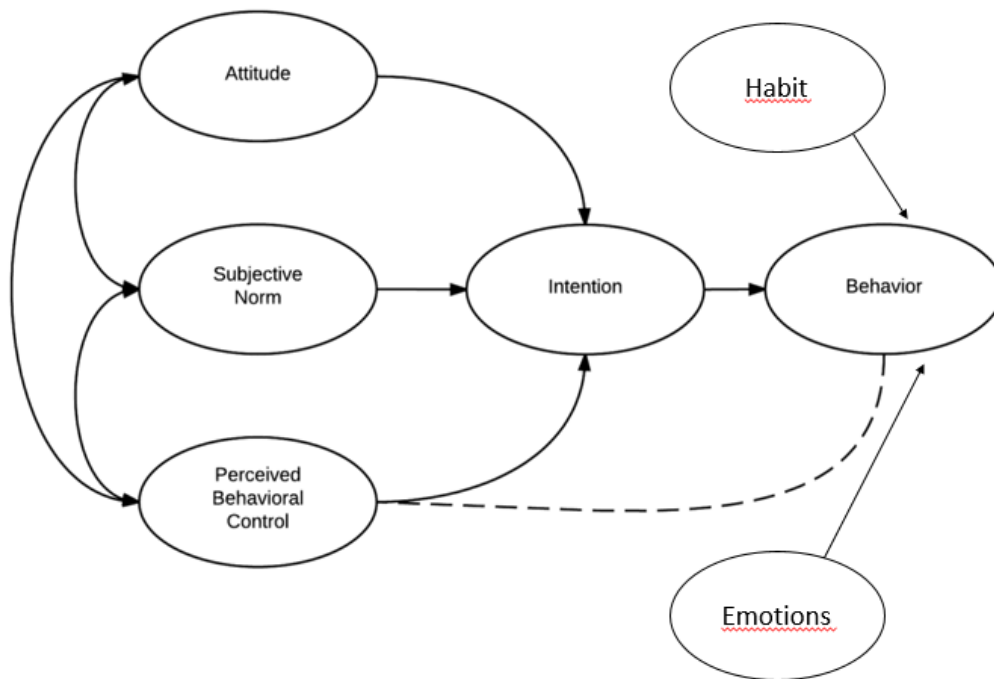


Figure 3. Adapted Theory of Planned Behavior (Ajzen 1991).

2.6. Smart phone apps

Apps are frequently designed for behavior change purposes, most of which are health and physical activity apps (Research2guidance 2013). Currently, there are more than 97 000 mobile health application listed in the app stores. Apps have the advantage of being readily accessible to people, as most people own smart phones. Eighty percent of the Norwegian population owned a smartphone in 2015 (Medienorge 2017). Presenting a behavior change intervention in an app format brings the opportunity to communicate the message through text, pictures, video and interactive functions (Elbert et al. 2016; Middelweerd et al. 2014). It also brings the opportunity of customizing the content for each individual's wants and needs. Through notifications it is possible to bring the individual's attention to the app even when they are not using it.

Former research has shown that apps can be useful for weight loss (Flores Mateo et al. 2015) and increasing fruit and vegetable intake (Elbert et al. 2016). Wang et al. (2016) found that using diet and physical activity apps influenced behavior, awareness and knowledge about nutrition and physical activity. Teo et al. (2017) explored users' need from a mobile health app. Some of the findings were that the information should be up to date and preferably presented through pictures and video. The app should have a positive focus, be simple to use and subjectively pleasing. Social connectivity and reminders were mentioned as desired features. As far as known by the author, there exists no app targeted towards the Norwegian market that aims to help consumers waste less food in their household. However, Foodlist and Too Good To Go are two apps that target consumers in retail and food service, respectively (Foodlist 2016; Too Good To Go 2017).

2.7. Methodology

2.7.1. In-depth interviews

Qualitative research is conducted for collecting in-depth information to explore and understand the meanings that individuals or groups ascribe to a certain problem (Creswell 2014). A common method for generating data in qualitative research is in-depth interviews (Tjora 2012). The purpose of an interview is to gain knowledge about the views, experiences, beliefs and motivations of the participants in relation to a certain topic (Gill et al. 2008). Interviews can occur with one interviewee or with groups (DiCicco-Bloom & Crabtree 2006). Group interviews demand fewer resources than one to one-interviews and let the participants exchange and discuss thoughts and ideas amongst each other (Qu & Dumay 2011). Simultaneously, group interviews require that the interviewees are comfortable with discussing the topic in front of others. The moderator should ensure that all the interviewees can express their thoughts. The interview informants are not randomly selected, but rather selected based on the selection criteria of relevant experience with the topic (Tjora 2012).

Semi-structured interviews consist of open-ended questions, whereby all participants respond to all questions (Richards & Morse 2012). The main questions are supplemented with probes, either in advance or arising from the participants' answers, to obtain more in-depth information. In-depth interviews have a certain structure. First, a warm-up question is presented, second, several in-depth reflective questions are asked (the interview's core), and last, end questions are asked (Tjora 2012). The different parts require different levels of reflection.

It is often beneficial to audio record the interviews in order to transcribe them verbatim afterwards (Gill et al. 2008). Recording the interview can minimize bias and make it easier to analyse the results. The interviewer must ask for the informants' permission to record the interview.

When the topic is narrow but not sensitive, a focused interview may be considered (Tjora 2012). The difference between a focused interview and a normal in-depth interview is that while in-depth interviews normally last one hour or more, focused interviews can last for 30 minutes. The advantage of conducting a focused interview is that they save time and are less tiring for the interviewees.

Qualitative approaches allow the researcher to explore and better understand complex phenomena without imposing limitations (Graham-Rowe et al. 2014). Interviews provide more detailed information than surveys and enable for digression which can increase insight into the topic (Boyce & Neale 2006; Tjora 2012) Interviews also have some disadvantages. Interviews are time-consuming, as they take time to conduct, transcribe and analyze. Bias can occur as informants often wish to answer what they perceive as correctly, as they want to give a good impression. Further, the quality

of the data relies on the skills of the interviewer. Finally, the results gained from interviews are not generalizable because of the small sample size and the individuals are not representative.

2.7.2. Questionnaires

In quantitative research, the methods are used to collect numerical data (Neuman 2002). One way of collecting quantitative data is through questionnaires.

A questionnaire is a standardized set of questions used to collect information about the same variables from all the participants in a sample (De Vaus 2013). The questionnaire is well suited for collecting information from a large number of participants about different variables of interest, for example activities, level of knowledge and attitudes and behavior within the topic (Rattray & Jones 2007; Siniscalco & Auriat 2005). A large number of participants ensures some level of representativeness. Questionnaires are quick for the participants to complete. The results can easily be quantified and analyzed, and be used for comparison within or between groups (Libweb n.d.).

For existing concepts, it should be considered whether a suitable questionnaire already exists (Siniscalco & Auriat 2005). In some cases, as with less explored topics, suitable questionnaires may not be found in the literature and need to be developed for the study. To achieve numerical data with response categories that are easy to code, closed questions are preferred. Closed questions give the respondent a restricted set of responses, which makes the questionnaire quick and easy to answer. This permits the opportunity for more variables to be measured in a short amount of time. Open-ended questions may also be included to allow respondents to add new information to the topic.

Constructing a questionnaire involves numerous trade-offs. On the one hand, the researcher is interested in gaining as much information as possible. On the other hand, long questionnaires and large scales can lead to confusion or tiredness for the respondent and thus lead to lower quality of the data (Cape 2012; de Jong 2005). Hence, all decisions regarding questionnaire length, wording, scales and so on must be carefully considered by the researcher and pilot tested.

A lot of the decisions in question making depend on the research question, the target population and the context in which the questionnaire is developed (Lietz 2010). However, there are some general rules that apply in constructing questions (Siniscalco & Auriat 2005). The vocabulary should be simple and the questions kept short, to make sure the participants interpret the question in a right manner. As well as to increase the respondents' understanding of the question this also reduces the risk of social desirability bias. Social desirability bias can occur if the respondent feels the desire to 'look good' or is afraid of being perceived as ignorant (Lietz 2010). Double-barrelled questions (two questions in one question) and hypothetical questions should be avoided, as they can reduce the

reliability and validity of the results (Lietz 2010; Siniscalco & Auriat 2005). Reliability refers to the dependability, or repeatability, of the measures (Neuman 2002). Validity refers to the truthfulness of the measures.

There are certain challenges that arise in constructing rating questions (Siniscalco & Auriat 2005). The respondent might give items similar ratings based on their proximity, rate most items in the middle category or give all items high, or low, ratings.

The order of the questions plays an important role in how the respondents will answer, and hence the data quality (Lietz 2010). For instance, general question should precede specific questions, to avoid creating a certain context for the general question (Lietz 2010; Scharz & Sudman 1992). For example, a question asking how concerned the respondent is about the environment should come before a question of specific environmental friendly behavior. The questions should be specific and focus on recent behavior (such as the last week) and current attitudes (Lietz 2010).

. Likert scales are commonly used to measure attitudes, and can be used in different ways (Bertram 2013). Normally, Likert scales have 5 or 7 points, ranging from 'strongly disagree' to 'strongly agree', with a neutral rating in the center (Likert 1932). Having more than seven points on the scale gives more detailed information to the researcher, but might confuse the respondent and thus lead to lower quality of the data (Dwivedi 2012). Another option for scaling is to have responses that range from 'not at all likely' to 'extremely likely'. In any case, the scale should match the question.

There are some disadvantages associated with questionnaires. The respondent can be forgetful of their previous behaviour (Libweb n.d.). Also, the respondents' interpretation of the question can differ. In designing the questionnaire, the researcher may have misassumptions of what is, and is not, important. Closed questions, which are commonly used in questionnaires, may reduce the response's depth. However, the depth can be increased by conducting qualitative research, for example an interview, prior to the questionnaire, or afterwards to help understand the questionnaire results. This would be an example of a mixed method design (Creswell 2014). Combining knowledge from different types of studies allows for a fuller understanding of the topic of interest (Neuman 2002).

2.7.3. Interventions

An intervention begins with a hypothesis of cause and effect (Neuman 2002). In an intervention, one or more factors are modified, and the outcome of the modification is measured. The purpose of the intervention is to have an impact, for example by causing an effect in attitude or behavior. Measuring the effect of an intervention can be done within or between groups, or both. When comparing the

effect between two or more different groups, it is first beneficial to create similar groups by random assignment. The groups should thus be identical except for the intervention.

3. Methods

A selection survey was conducted to recruit participants and gather baseline information. The selected participants were distributed across three intervention groups. The effect of the intervention was measured after three weeks. An overview of the study design is presented in figure 4.

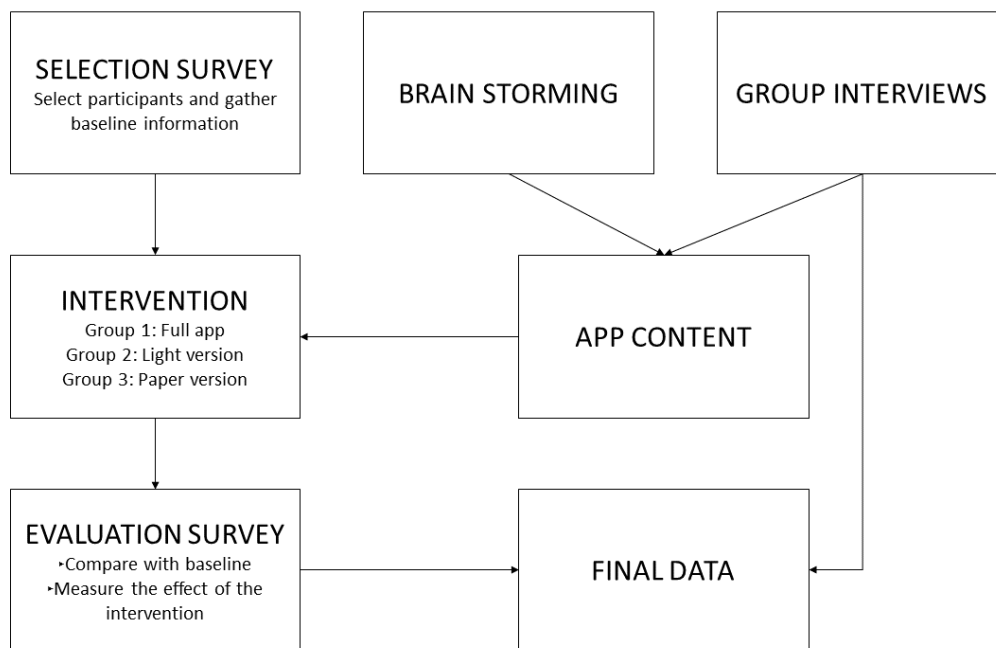


Figure 4. Study design.

3.1. Group interviews

Semi-structured group interviews were conducted to obtain in-depth information for creating content for the app. The researchers performed a brain storming session prior to the interviews to get a certain idea about the content before constructing the interview guide (a summary of brain storming session is presented in Appendix 1). The brainstorming resulted in an outline of the app content, with specific ideas for each section in the app.

The participants for the group interviews were recruited in mid-January 2017 through posters distributed at The Norwegian University of Life Sciences (Ås municipality), and adverts posted on study related groups on Facebook. Approximately half of the informants showed initiative to participate, the other half were contacted directly. The recruited study participants were encouraged

to use their social network to recruit more participants. The majority of the informants were students at the Norwegian University of Life Sciences and familiar with the interviewer.

An interview guide (Appendix 2) was constructed based on the research question “What do consumers think should be part of an app that helps them waste less food (with a focus on dairy products)?”. A test interview was conducted prior to the research interviews to explore the timing and clarity of the questions, and minor amendments were made to improve the interview guide’s clarity and consistency.

Fifteen participants were recruited to the interviews, and evenly spread across five groups. Inclusion criteria for participating in the interview were that they drink milk and own a smartphone. People who consumed other types of milk than cow’s milk (e.g. almond milk, soy milk) were excluded because those products have different characteristics than cow’s milk. The informants remained anonymous.

Two informants canceled the same day as their interview, which made the total number of informants thirteen. The interviews took place in a meeting room at the university, after work hours. The informants were served coffee, tea, water and some sweets to make them feel comfortable. Monetary compensation for the participation was not given. The interviews lasted 30 minutes and were recorded using an Olympus WS-821 voice recorder. Additionally, notes were written by hand to get the main points down on paper immediately (this also served as a security in case something happened to the recordings). The recordings were transcribed verbatim, using Express Scribe Transcription Software. After transcription, the data was categorized into themes. The themes were *Food disposal*, *Utilization of sub-optimal dairy products*, *Who can benefit from the app*, *Content for the app*, *Arguments for and against the app*, *Personal gains from not disposing food* and *Tips*. The themes were made based on the questions, except from *Arguments for and against the app* and *Tips*, which evolved from what the participants said.

3.2. Selection survey

Three hundred and twenty-five people participated in an online 15-minute survey prior to the study to select eligible participants for the study and collect baseline information. The respondents were recruited by Faktum Markedsanalyse, a Norwegian marketing research company. The purpose of the study was to select eligible participants for the study, organize them into three similar and comparable groups for the intervention, and to collect baseline information. The different sections of the study are presented in table 2.

Table 2. Sections in the selection survey, including number of questions and content for each section. The survey had a selection part and a part for collecting baseline information.

Section		No. of questions	Questions' content
Selection	Demographics	2	Gender
			Age
	Usage and interest in technology and smart phones	3	Interest in technology
			Daily time spent on their phone
Operating system			
Interest in trying the app	1	Survey ends here if they do not have an interest in trying the app	
Baseline information	Food involvement and opinions about food waste/environment	19	Food preferences and criteria
			Interest in cooking
			Attitudes towards leftovers
			Opinions about food safety
			Environmental commitment ¹
	Choice task with pictures	6	Choice between optimal and suboptimal milk and yoghurt
			Evaluation of perceived characteristics of suboptimal milk and yoghurt
			Likelihood to dispose suboptimal milk and yoghurt
	Sociodemographics	4	Household composition
			Education
			Occupation
	Responsibility for shopping and cooking	2	Responsibility for shopping
			Responsibility for cooking
Post address	1		

¹ The respondents continued with a shortened version of the Commitment to Environmental Sustainability Scale (Alcock 2012).

People who indicated that they did not want to participate in testing the app was automatically excluded from the survey. The rest of the participants continued to the collection of baseline information. The questions included statements such as “When I do grocery shopping, I compare the date labelling of the products to be sure that I choose the alternative with the longest shelf life”, “I

often buy too much food”, “I would rather waste food instead of using it if I’m not sure it’s still good to eat”. The participants were urged to state how much they agreed or disagreed with the statements, ranging from 1 (strongly disagree) to 7 (strongly agree).

In the choice tasks, the participants were told to choose between an optimal and sub optimal milk and yoghurt, as well as evaluating the products’ characteristics and the likelihood that they would dispose them. The products are presented in figure 5.





	Sub-optimal product	Optimal product
Neutrally designed milk. “Best before today” vs “one week left”		
Neutrally designed yoghurt. “Best before today” vs “one week left”		

Figure 5. Pictures of sub-optimal and optimal dairy products in the selection survey. The participants were told to choose between an optimal and sub optimal milk and yoghurt, as well as evaluating the products’ characteristics and the likelihood that they would dispose them

In further steps, the study excluded people who 1) Did not take any responsibility for cooking or grocery shopping; 2) were not at all interested in new mobile technology and apps; 3) did not pick any of the milk or yoghurts in the choice task (as they may not use these products); 4) have other operating systems than Android/iOS on their phone; 5) spend less than 10 minutes on their phone per day. That made a total of two hundred and thirty four participants (N=234) who were recruited to participate in the study.

Of the 234 participants, 150 participants were evenly distributed over three groups (n=50), with an equal distribution of gender, age and household composition (with and without children in the household) in each group. The groups were also balanced based on group average (deviating

maximum 0.2 points) with regards to highest completed education, choice for the suboptimal milk/yogurt, special focus on food, waste or environment in their work/field of study, and likelihood to dispose the suboptimal milk in the choice task. The groups were similar with regards to: time spent on their phone; use senses to determine if foods are still good to eat; job situation; environmentally friendly; dislike to throw food.

The ratio of men and women in the study was 50:50. Mean age was 30 years (0.9). Most people had a bachelor's or master's degree, were full-time employed and lived together with their partner/spouse and children. The majority reported spending 1-2 hours on their phone each day. For further descriptive statistics, see table 3.

Table 3, part 1. Descriptive statistics overall and across intervention groups.

	Overall N=150	Full app n=50	Light app n=50	Paper n=50
Gender N (%)				
Female	50	50	50	50
Male	50	50	50	50
Age group N (%)				
18-30	12	12	12	12
31-40	24	24	24	24
41-50	48	48	48	48
51-60	12	12	12	12
60+	4	4	4	4
Household composition N (%)				
I live alone	7.3	8	6	8
I live together with partner/spouse	21.3	22	22	20
I live together with partner/spouse and children	60.7	60	60	62
I live alone with children	9.3	8	10	10
I live together with friends	1.3	2	2	0
Education N (%)				
Primary school	1.3	2	2	0
High school	10.7	6	14	12
Vocational school	10.7	10	10	12
Bachelor's degree	39.3	46	38	34
Master's degree	36.7	36	34	40
Ph.D.	1.3	0	2	2

Table 3, part 2. Descriptive statistics overall and across intervention groups, continued.

	Overall N=150	Full app n=50	Light app n=50	Paper n=50
Occupation N (%)				
Fulltime employed	84	84	84	84
Parttime employed	5.3	6	8	2
Unemployed	0.0	0	0	0
Student	3.3	4	2	4
Volunteer	0.7	0	2	0
Self employed	4.7	6	2	6
Retired	0.7	0	0	2
Other	1.3	0	2	2
Time spent on their smartphone per day N (%)				
11-60 minutes	26.7	24	28	28
1-2 hours	42.7	44	44	40
3-4 hours	22	24	18	24
5-6 hours	6	4	8	6
More than 6 hours	2.7	4	2	2
Profession or study related to food or environment (%)	10.7	3.3	4	3.3
Choose the suboptimal milk (%)	87.3	92	88	82
Main responsibility for grocery shopping M (SD)	1.57 (0.5)	1.54 (0.5)	1.6 (0.5)	1.58 (0.5)
Main responsibility for cooking M (SD)	1.69 (0.7)	1.62 (0.7)	1.74 (0.7)	1.72 (0.6)
Commitment to environmental sustainability ¹ M (SD)	4.34 (1.4)	4.25 (1.2)	4.44 (1.6)	4.35 (1.5)
Look at the date labelling in store M (SD)	5.22 (1.7)	5.38 (1.5)	4.7 (2.0)	5.58 (1.4)

¹ Shortened version of the Commitment to Environmental Sustainability Scale (Alcock 2012).

3.3. Intervention: Smart phone app

The intervention was a system comparison, whereas an app being the system of interest. The app was constructed based on a brainstorming session (Appendix 1) and the information gathered from the group interviews. The app focused on elements from TPB.

One group was asked to evaluate the full app, the second group was asked to evaluate a light version of the app and the third group was asked to evaluate a paper version of the full app. Print screens are presented in figure 6. Further details about the intervention groups is presented in table 4. The participants in group one and two downloaded the app Foodsaver or Foodsaver light (dependent on group) from App store (iOS) or Google Play (Android). The participants in group three received the paper version in the mail.

Table 4. Interventions given to each group in the study.

Elements	Full app	Light version	Paper version
Fact sheet	Information about food waste, consequences, initiatives to tackle food waste, “Did you know’s”	Same as full version, with less information about date labelling.	Same as full version.
Tips and recipes	<ul style="list-style-type: none"> •Tips and recipes for specific dairy products, bread, fruit and vegetables, meat, fish, and eggs. •Information about storing and shelf life, how to know if the products are suitable for consumption and how to use them. 	<ul style="list-style-type: none"> •General tips and recipes for dairy products, bread, fruit and vegetables, meat, fish, and eggs. •Information about storing and shelf life, how to know if the products are suitable for consumption and how to use them. 	<ul style="list-style-type: none"> •Front page of the tips and recipes section. •Examples of tips and recipes for some product categories.
Registration	Register dairy products with their best-before-date.	No register function	Visual presentation of the register function.
Notifications	<ol style="list-style-type: none"> 1. Related to the registration function. Gives a reminder when the product is close to the expiry date. 2. Notification with facts about food and food waste from the “Did you know”-section 	No notifications	No notifications
Quiz	Quiz with seven questions about food waste, with a special focus on best before dates and milk.	Quiz with seven general questions about food waste.	<ul style="list-style-type: none"> •Quiz start page. •Examples of questions and scores.
Calculator (How much can I save?)	Calculates how much CO ₂ and water that can be saved by reducing their amount of food waste	Example of a calculation.	Visual presentation of the calculator with and without example of a calculation.

The main difference between the full and light versions of the app was that the full version had a special focus on dairy products and included interactive functions in the form of a registration function for purchased dairy products and a calculator to estimate the CO₂, water and personal economic impact of one’s own food waste. The light version contained general information about food waste, did not have a registration function and only showed an example of impact estimation.

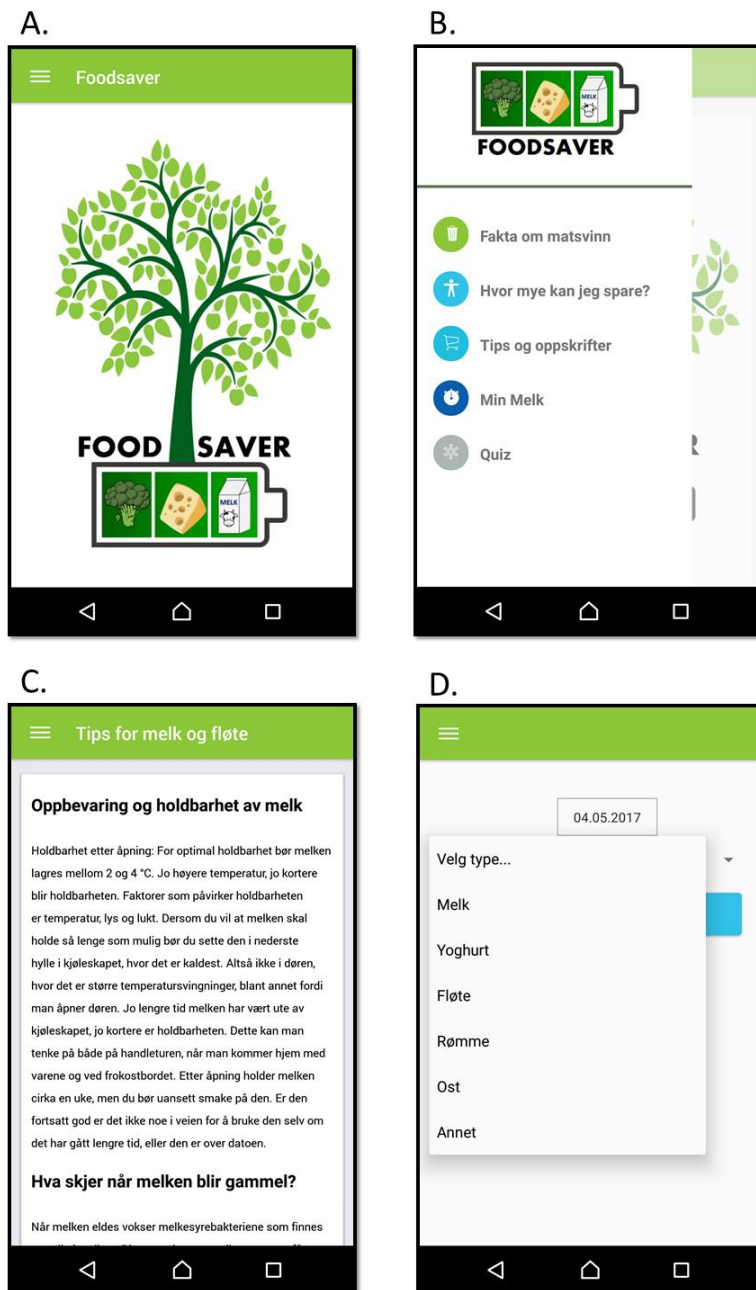


Figure 6. Screenshots from the Food Saver app in Norwegian. A) Front page, B) Main menu, C) Tips for milk and cream, D) Registration of dairy products.

3.4. Evaluation survey

After a three-week period, the participants were asked to evaluate the app in a final, web-based evaluation survey. The purpose of the evaluation survey was for the participants to evaluate the app and its usefulness, and to measure (to a limited extent) if their attitudes and behavior had changed since baseline. The survey was distributed by Faktum Markedsanalyse. The content for each section is presented in table 5.

Table 5. Sections and content for the evaluation survey

Section	No. of questions	Content
1. Food use and food waste	7	Statements about sustainability Likelihood of wasting sub-optimal milk and yoghurt
2. App usage	6	Frequency of use Ranking of time spent on each function
3. Layout/design	3	Text legibility Total impression
4. Usefulness	11	Perceived usefulness of the app for reducing their own food waste Which function was the most useful
5. Behavior	5	Food waste behavior prior to and during app usage
6. Technical	8/2*	Describing characteristics of the app and certain functions App group only: User friendliness Technical issues Opinions of certain functions Likelihood of continuing to use the app Paper group only: Likelihood of downloading the app
7. Further comments	1	Textbox for further comments

*App groups/paper group, respectively.

The first part of the questionnaire contained statements about sustainability, a question of importance of reducing the participant's own food waste and a rating task with pictures (fig. 7). The latter was to compare the responses from the responses from the selection survey. The participants were asked to rate the likelihood, on a 11-point scale from 0-100 %, that they would discard a suboptimal milk, yoghurt and sour cream, separately. The second section contained questions about how they used the app, in order to see if this had an impact on the further responses. Next followed a section with questions about layout/design of the app, to test overall liking of the app was designed. The fourth section contained 11 questions about the perceived usefulness of the app and the different functions. For example, a question about whether they believed different functions could help them waste less

food (Scale: Not at all, a little bit, somewhat, a lot) and another question of how useful they believe the app is for wasting less of different food products (10-point scale). This section is the core of the evaluation survey as it is central for answering the research question. The fifth section contained five behavior questions to see if the participant's behavior had changed in the intervention period by letting them compare their food waste behavior now with before the intervention. The sixth section contained technical questions. One question about the participant's perception of the app was mutual for both the app and paper version. Then, six questions followed for the app group only, which asked about user friendliness, what they thought of certain functions and if a social feature would influence their interest in the app, if they would continue to use the app and if they would recommend it to friends or family. For the paper group, this section included a question of whether they would download the app if it became available. The questionnaire ended with a text box where the participant could write further thoughts and comments. For a presentation of the complete questionnaire, see Appendix 4.

Some of the questions were inspired by the article from Wang et al (2016), although the questions did not address the same topic of interest. Examples are the question of whether they had a wish to reduce their food waste, and questions regarding behavior prior to, and after, using the app.



Figure 7. Pictures of suboptimal products in the evaluation survey.

3.5. Data analysis

Microsoft Excel and R commander (version 3.3.1) were used to analyze the quantitative data. P-values were used to present significance, with $p < 0.05$ as the chosen significance level. All numeric variables in the dataset were converted to factors in R. Multinomial Logit Models (MLM) were applied to assess the effect of group in R.

The main factors of interest were: Difference in likelihood to waste suboptimal milk/yoghurt; total app rating; function most useful for wasting less food; usefulness of factsheet/calculator/recipes for wasting less food; usefulness for wasting less fruit and vegetables/bread/dairy products/meat, fish and eggs/food in total; food waste-related behavior the last three weeks (wasted food past the expiry date, used food past the expiry date, used senses to assess food before wasting, talked to friends or family about food waste); likelihood of keeping using the app (app groups); likelihood of downloading the app (paper group).

The effect of group on the main factors was assessed using the following model:

$$\textit{Factor of interest} = \textit{Group}$$

A model selection analysis was run for sociodemographic factors (Usefulness for wasting less food = Group + gender + age + household composition + education + job + responsibility for cooking). No single sociodemographic factor significantly predicted the score for the usefulness of the app. The same was done for total rating of app, giving the same result.

The effect of attitudinal factors (Unsure about food safety; cooking skills; milk choice; sub-optimal milk safe/not safe/bad flavor/same flavor) on usefulness was assessed using the following model:

$$\textit{Usefulness for wasting less food} = \textit{Group} + \textit{attitudinal factor}$$

No post hoc analysis were available for MLM, so the differences in effect between groups are described as likely, not absolute.

4. Results

4.1. Interview results

Five interviews with thirteen informants in total were conducted to obtain in-depth information for designing the app. A description of the informants' level of commitment to food waste and the environment, as well as their consumption of milk, is presented in table 6.

Table 6. Description of participants in the group interviews.

Code	Informant no.	Interview no.	Environmental commitment	Milk consumption	
				Amount per week	Usage
1A	1	1	Middle	≤ 1 L	Cereal
					Porridge
					To drink
1B	2	1	Middle	≥ 2 L	To drink
1C	3	1	Middle	≥ 2 L	In coffee
					To drink
					Cooking
2D	4	2	Middle	≤ 1 L	Oatmeal
					To drink
2E	5	2	Middle	≤ 1 L	In tea
					Cooking
2F	6	2	Middle	≤ 1 L	Cooking
3G	7	3	Above middle	≤ 1 L	Cereal
3H	8	3	Above middle	≤ 1 L	Oatmeal porridge
					In coffee
					Cooking
4I	9	4	Above middle	1-2 L	Oatmeal porridge
4J	10	4	Low	≥ 2 L	To drink
					Cooking
4K	11	4	Above middle	≥ 2 L	Cooking
					To drink
5L	12	5	Above middle	≤ 1 L	Cooking
					Porridge
5M	13	5	Low	≥ 2 L	To drink.

The results from the interviews identified two types of behavior that led to food waste in the informants' households. One category of behaviors resulted in the informant's food becoming old. Participants commonly mentioned that they buy too much food and that they tend to forget what they have in the fridge, with the result that the food becomes too old to eat. Informant 2F mentioned (Original Norwegian quotes in Appendix 3):

- 1) *«Also, you forget that you have [the food]. For instance, cream cheese. You open it and use a little of it. Then you put it back and it might feel full. And because it is not see-through, then, you know, you might think it is unopened, and then it lasts longer, and then 'oh, it was opened' and then it has gone all green.»*

The other type of behavior that led to food waste was directly linked to the disposal itself. Some of the participants mentioned "past the expiry date" and change in consistency as reasons for them to discard food. Some participants had concerns about food safety. According to informant 4J:

- 2) *«And then there is milk. If it has been in room temperature for too long or overnight, or if it is too far past the expiry date (...). I think it's gross. Actually. I'm afraid I will get a bad stomach, and I don't think it tastes that good. But maybe it's psychological, I don't know.»*

Some threw away the food based on habit, and because they were not concerned about waste. Informant 1B spoke about a time he wasted a yoghurt:

- 3) *«I guess it was laziness. The easiest way out. Instead of using it for dishes and such. Just get rid of it. Get it out of the way.»*

Informant 2F said the following about wasting cream cheese:

- 4) *«So, yeah, both that you forget it but also that it's not that important. So it's ok to throw it. If it's like 'Oh, that has become green', you don't weep about it. You just throw it and don't think about it anymore, really.»*

Although some reported that they are worried about food safety, many informants had knowledge about when it was safe to use food past the expiry date. It was commonly mentioned that milk could be used for waffles after expiry date. Nearly all the informants claimed to use their senses before disposing milk. Informant 1C said the following:

- 5) *«But milk I don't necessarily think is ruined just because it's past the expiry date. We have had milk at home at least for 14 days without it becoming bad. So sometimes longer than*

others. When it starts separating and smelling bad.. It actually doesn't happen that often because it's usually used for something, we spend it all. »

The most commonly mentioned desired feature for the app was recipes for leftovers or products past the best before date. Another commonly mentioned feature was information, specifically about shelf life and how to know whether a product is safe to consume. Other frequently mentioned features were fun facts and economic and environmental effects of their choices. Some would like a reminder to use their product with tips to what they can use it for, although they were not interested in spending too much time registering their products. Informant 1A said:

6) *«And.. Yeah. I also think that there should be recipes. That for example, if you have a milk you can press 'milk' and see what you can do with it. Also, it would be fun to see.. Because, for example, when it comes to meat, everyone says that if you reduce.. or if you don't eat meat once a week you save the environment this and this much. It would be fun to see.. If you reduce your own waste, how that would affect the environment (..). I think it is easier for people to relate to that instead of just 'Now you did something good for the environment'. You like to know what you did. »*

Informant 4K suggested:

7) *«But perhaps also that the app can give you information about the different dairy products and what you can eat when. What is unsafe and what is ok. And how you can for example smell or see if it's bad or not. And, like, suggestions for recipes, like.. Yeah. You can put some sour milk in the waffles, or like good old housewife tips.»*

It was important for the informants that the app was user friendly, had the most common products, and that the recipes should not be too advanced. There should be pictures and figures in the app. Some mentioned a social aspect, for example to be able to compare with their friends how much they had saved on not wasting.

Informant 1C (8) and 3H (9) said the following about desired features:

8) *«It has to be simple. It can't be like you have to browse through.. that it takes too much time. I picture that.. Like how you [other respondent] say that you see a milk carton and you see an ox and then you press it. So that it's simple. »*

9) *«What is fun about apps is that they are social, at least for me. That there is a social aspect to the app. That is what makes it fun. Or, I don't know if fun is the right word to use. Or that*

the app is tidy and easy to understand. That it's not like [sigh] when you're using it. More like 'Oh, this was fine and easy'.»

The interviews identified three personal gains from not wasting food: Saving money, making a difference to the environment and to get a 'good feeling'. Informant 1A said the following:

10) «It is of course the economic part of it, or, yeah. You don't have to spend money on something you already have in the fridge. Also, you get a better conscience. »

The general opinion was that this type of app was not fun, but rather useful, and could be used as a tool when they had products that they did not know what to do with. The informants thought the app would be suitable for young people who lack knowledge about cooking and want to save money. According to the informants, older people would not benefit from the app, due to having more experience with food and cooking.

A conceptual model was constructed based on data gathered in the interviews (fig 8).

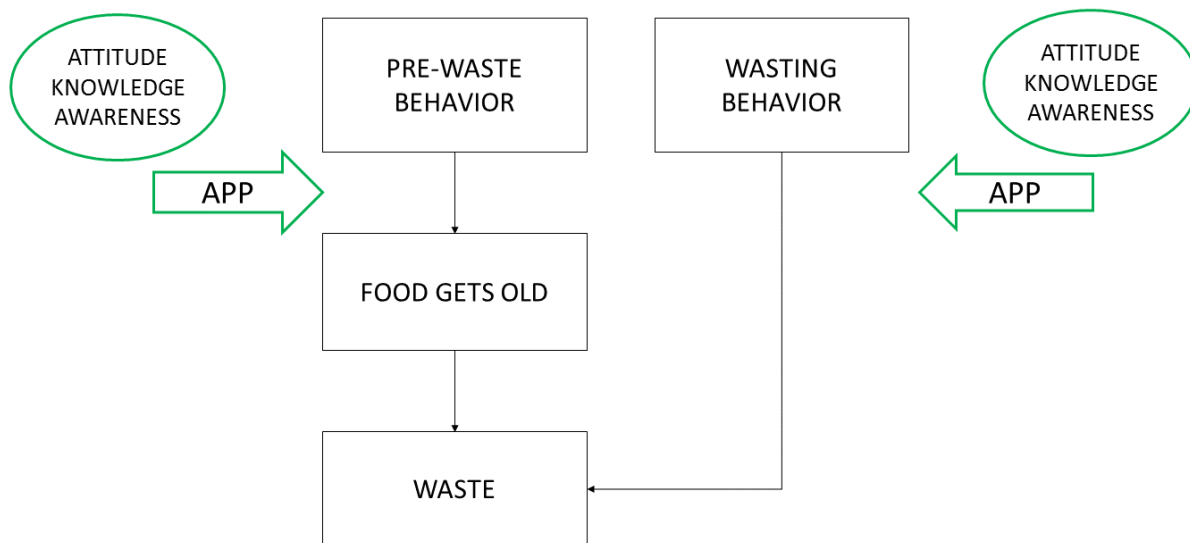


Figure 8. Conceptual model based on findings in the interviews. The model shows behavior that led to waste of dairy products and how an app can influence those behaviors. Pre-waste behavior refers to behavior such as buying too much food, leaving left overs in the fridge and forgetting about their products, resulting in the food getting old and wasted. Wasting behavior refers to behavior such as wasting products as soon as they are past the best before-date and to waste fresh leftovers. The behaviors are influenced by attitude, knowledge and awareness.

4.2. Survey results

144 participants completed the evaluation survey. Data from 11 participants was excluded from the results due to mismatch between group and reported format of the app. Final N=133 (table 7).

Table 7. Final number of participants included in the data analysis.

N=133	Full app (group 1)	Light version (group 2)	Paper version (group 3)
	n=45	n=47	n=41

4.2.1. Likelihood of wasting sub-optimal foods

In both surveys the participants were asked to indicate the likelihood of disposing sub-optimal milk and yoghurt. The results from each survey were compared and presented in figure 9. There was no significant effect of group on changed likelihood of wasting the suboptimal yoghurt ($p=0.20$;MLM). However, there was a trend indicating that the mean perceived likelihood for disposing milk was reduced by ~0.3 points for the full app group and increased by ~0.5 points in the paper group on a 11 point scale ($p=0.097$;MLM). The change in likelihood of wasting milk and yoghurt in the light app group was <0.1 for both products.

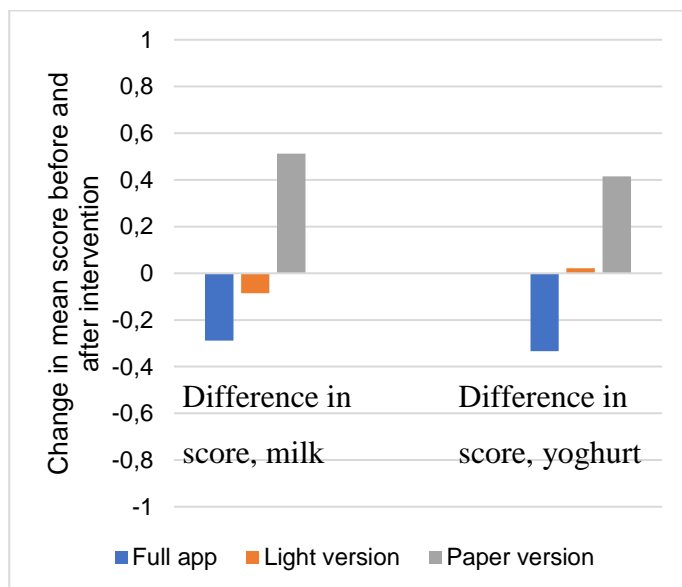


Figure 9. Mean difference in score, before and after intervention. The question used an 11-point scale where the participants indicated the likelihood to waste the product, ranging from 0-100 %.

Most of the respondents (65 %) did not show any change in likelihood to waste the sub optimal milk or yoghurt, of which the full app group showed the highest likelihood of not changing (73 % of respondents in the group, not shown in figure). The light app group was the group most likely to show a decrease in likelihood to waste the suboptimal milk, independent of score difference (19 % of

respondents in the group). The mean score difference for people who had decreased likelihood of disposing the milk across groups was -3.1. The paper group was the group most likely to report increased likelihood of wasting the milk, independent of score difference (29.3 % of respondents in the group).

4.2.2. Time spent on the different app functions

The participants were asked to rate the app functions after how much time they spent on them, ranging from 1 (spent least time on) to 5 (spent most time on). The results are presented in figure 10. There was no significant effect on group on what function was spent the most time on ($p=0.15-0.55$;MLM). The fact sheet was the function most looked at, and the registration the least looked at, independent of group.

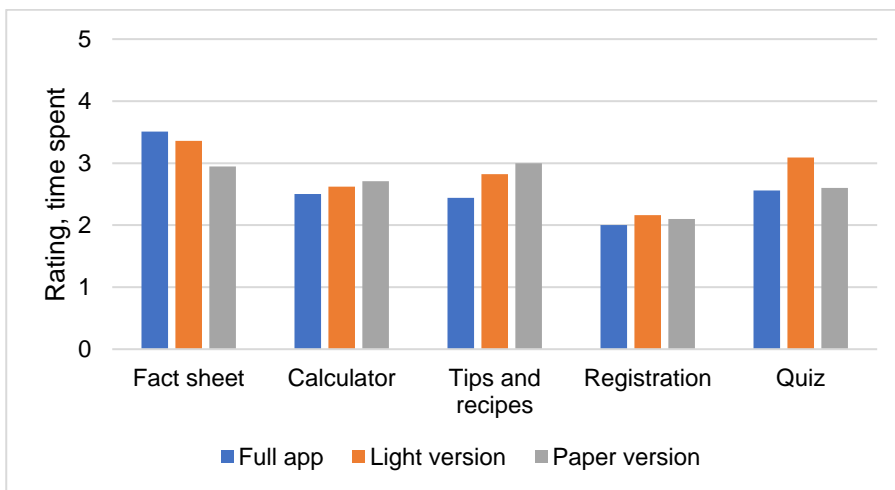


Figure 10. Rating of time spent on each function, sorted by group. 1 indicates ‘spent the least time on’. 5 indicates ‘spent the most time on’.

4.2.3. Liking of the app

Group had an effect on the rating of the app ($p<0.001$;MLM). The paper group was more likely to give a higher score than the app groups. Mean scores were 2.5, 2.7 and 3.4 out of 6, for the full app, light version and paper version respectively. The different ratings are presented in figure 11.

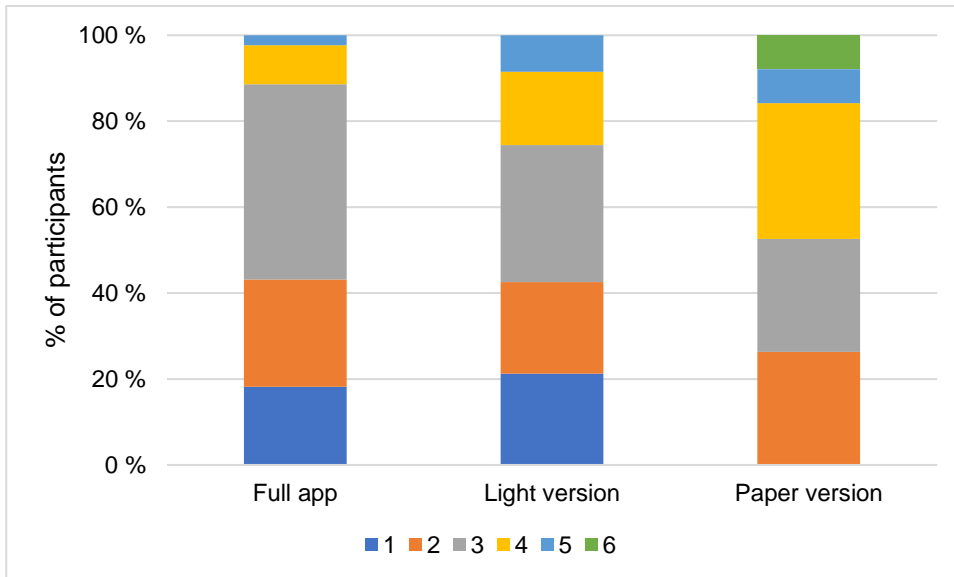


Figure 11. Percentages of the different groups' rating of the app. 1 is the lowest and 6 the highest score.

4.2.4. Perceived usefulness of the app

There was a trend indicating that the app groups found the fact sheet most useful, while the paper group found the tips and recipes most useful, for helping them waste less food ($p=0.08$) (figure 12).

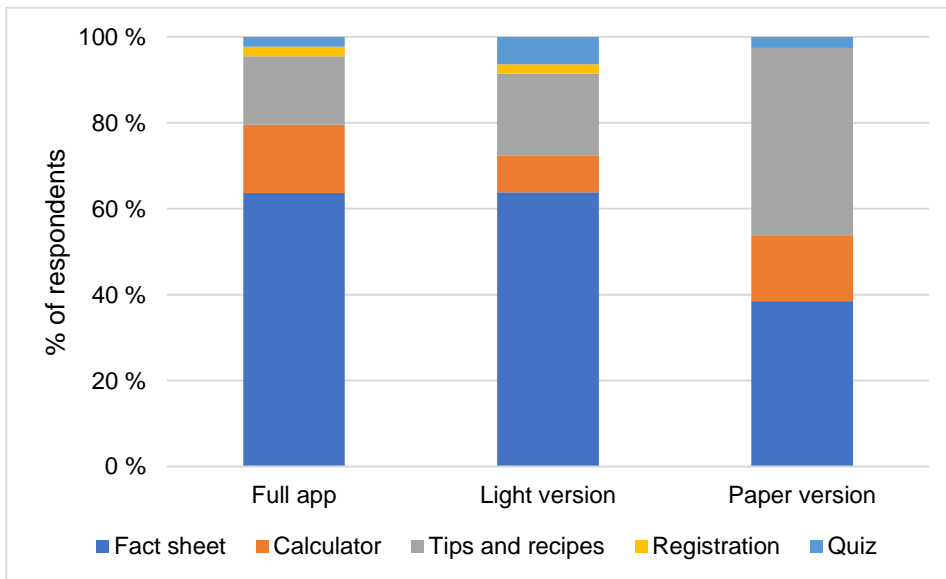


Figure 12. Percentages of the different groups' impression of which function would be the most useful to help them waste less food.

There was no significant effect of group on the perceived usefulness of the fact sheet for wasting less food ($p=0.22$;MLM). 73 % of all respondents thought the fact sheet would be useful to some extent or large extent to help them reduce food waste.

Group had an effect on the perceived usefulness of the calculator ($p=0.02$;MLM). 65 % of people in the paper group reported that the calculator would be useful to some extent or to a large extent. For the app group, the corresponding numbers were 47 % for the full app and 43 % for the light version.

Group had an effect on the perceived usefulness of the tips and recipes ($p=0.03$;MLM). 58 % in the app group reported that they thought the tips and recipes could help them waste less food to some extent or a large extent, against 65 % in the light app group and 90 % in the paper group.

Group had an effect on the perceived usefulness for reduction in food waste from dairy products ($p=0.002$;MLM). The results are presented in figure 13. The full app group and the paper group perceived the app to be more useful for reducing food waste from dairy products than the light app group (mean scores: Full app group 4.7 (2.8), light app group 4.0 (2.5), paper group 5.2 (2.3)). For fruit and vegetables, bread, meat, fish and eggs, as well as food in total, group had no significant effect ($p>0.05$). However, for meat, fish and egg there was a trend ($p=0.06$;MLM). The paper group was more likely to give a higher score overall. The full app group was more likely to give a higher score than the light app group, except for fruit and vegetables. The mean scores for overall usefulness for the different food categories is presented in table 8.

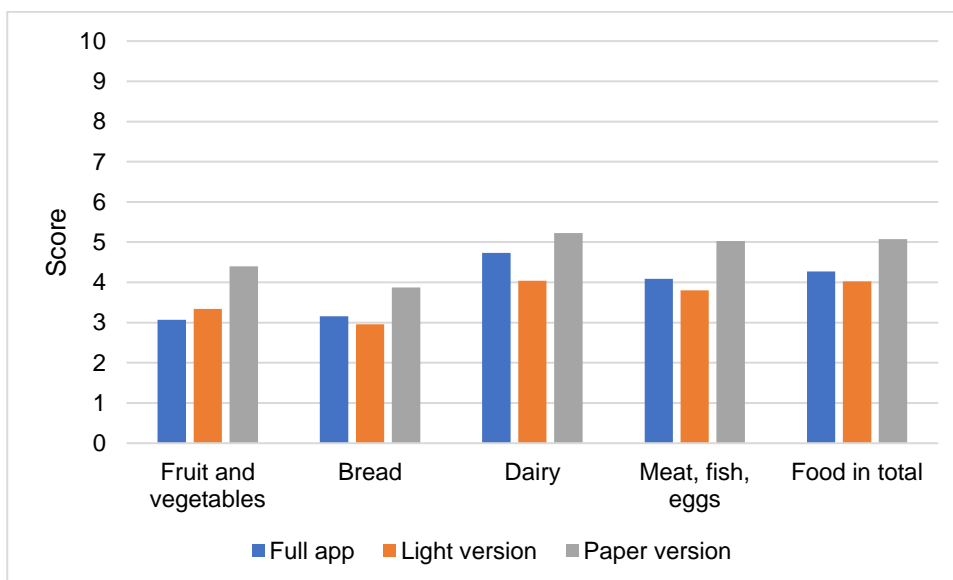


Figure 13. Mean perceived usefulness of the app towards four different food categories and food in total. The participants were asked to rate the usefulness on a scale from 1-10, 1 being not useful at all and 10 being very useful.

Table 8. Mean scores for usefulness for reducing food waste in the different food categories on a 10-point scale, independent of group.

Food category	Mean score (SD)
Fruit and vegetables	3.6 (2.4)
Bread	3.3 (2.2)
Dairy	4.7 (2.6)
Meat, fish and egg	4.3 (2.5)
Total	4.5 (2.3)

Moderating effects

Based on comments in interviews and the final survey, the following factors were tested for effect on total app usefulness: *Unsure about food safety, good at cooking, choose environmentally friendly food, milk choice* (optimal/suboptimal), [suboptimal] *milk is safe*, [suboptimal] *milk has bad flavor*. No significant effect on perceived usefulness was found for any of the factors ($p > 0.1$)

4.2.5. Behavior

There was no significant effect of group on self-reported change in food waste behavior (figure 14). During the intervention period, 10 % of all respondents reported to attain the behavior *Use food past the expiry date*, 9 % of respondents reported to attain the behavior *Use senses to assess food before wasting* and 25 % of respondents reported to attain the behavior *Talk to friends or family about food waste*

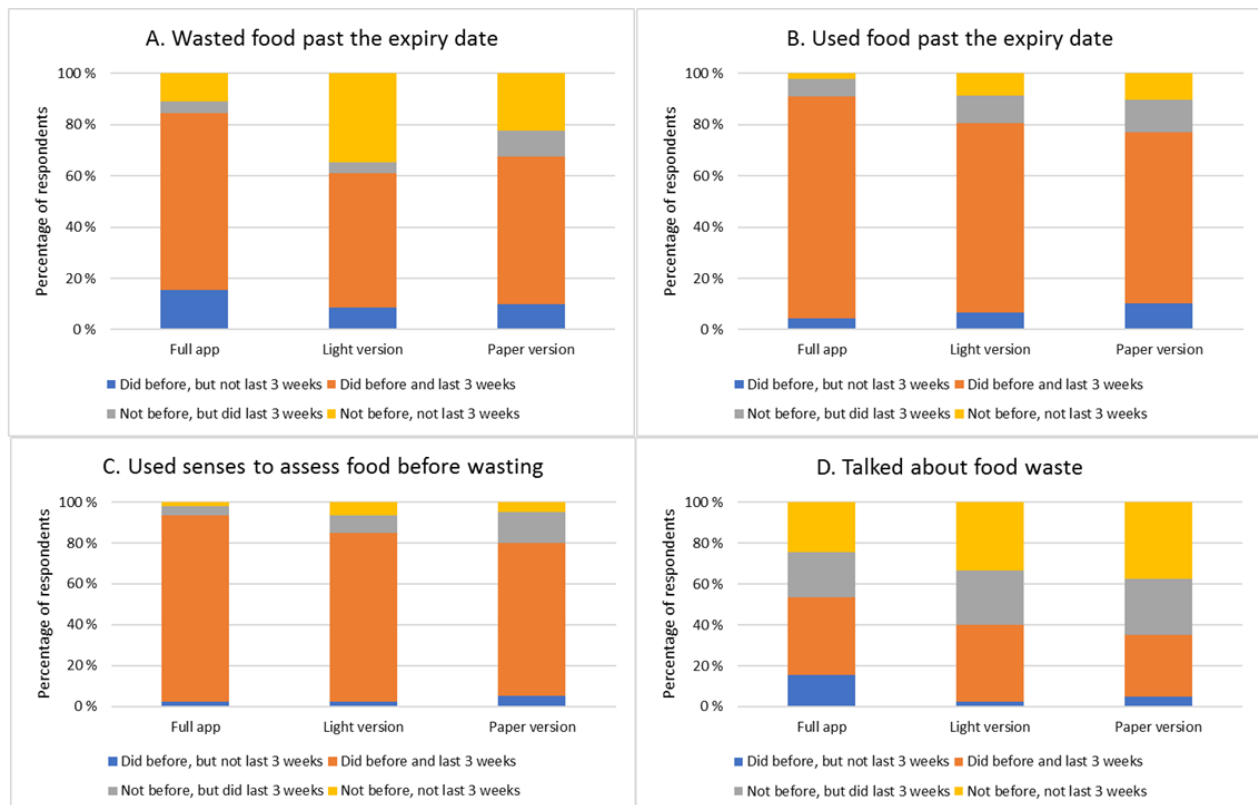


Figure 14. Percentages of food waste behavior among the different groups.

4.2.6. Likelihood of keeping using the app

The full app group was more unlikely to keep using the app than the light version group ($p < 0.001$). 71 % of respondents in the app group responded that it was ‘very unlikely’ or ‘quite unlikely’ that they would continue using the app, compared to 57 % in the light version group. 11 % in the full app group and 17 % in the light version group reported that it was quite likely that they would keep using it.

28 % of people in the paper group were quite likely or very likely to download the app.

4.2.7. Technical issues

In the app groups, 49 % of participants reported having technical issues. There was no observed effect of group or age concerning technical issues ($p_{\text{group}} = 0.99$, $p_{\text{age}} = 0.12$, $p_{\text{group*age}} = 0.96$; MLM), but there was a trend. Operating system had a significant effect ($p < 0.001$; MLM), and 14 % of Android users and 64 % of iOS users reported having technical issues. There was no interaction effect between operating system and group ($p = 0.34$).

4.2.8. Comments from participants

The comments regarding the app were mostly negative. Some reported that they did not need such an app, either because they already knew the information and tips, or because they thought it was just as easy to search it up online. Content and design were also frequently commented and some people said

there was too much focus on dairy products. Among the issues mentioned was a lot of text, little intuitive design and lack of interesting functions and multimedia. Participants commonly mentioned that tips and recipes was the most interesting function. However, this was also the function with most technical issues, and at least 17 participants did not have access to it.

5. Discussion

The aim of this study was to investigate whether an app, with targeted content about reducing food waste, can be useful as a tool to prevent food waste at the consumer level. The results showed that there were some positive changes in reported behavior and some people found the app useful on several points. However, all the three groups (full app, light version, paper version) attributed a low usefulness to the app. Based on the results, there is no evidence that the app in this study can support people in wasting less food. However, one needs to consider that an app with the aim to reduce food waste may be useful to a subgroup of people after technical issues are sorted out.

5.1. Usefulness of the app

The main aim in this study was to assess the usefulness of the app Food Saver for reducing household food waste in a three-week intervention period.

The overall usefulness of the app for reducing household food waste was perceived as low by the participants. Nevertheless, the score for perceived usefulness for wasting less dairy products and food in total was higher than for the other food categories, which indicate that some of the communication in the app did reach the consumers.

The results present no evidence that using the app during a period of three weeks had an effect on the attitude towards suboptimal dairy products. There was no significant change in likelihood to waste sub-optimal milk and yoghurt past the expiry date between groups during the intervention period. Additionally, there were only small score differences between prior and post-intervention measurements, independent of group. The lack of evidence that the app could influence the consumers' attitude towards sub-optimal dairy products can be seen in conjunction with the lack of evidence for overall usefulness. There was no single sociodemographic factor that predicted the score for the usefulness of the app, but that does not mean that people in this study with different sociodemographics wasted differently or not.

The full app group was more likely to give a higher score for usefulness for wasting less dairy products. The light version group was more likely to give the app a higher total score, and to keep using the app, than the full app group. Otherwise, no significant difference between groups emerged. This is contrary to the expectation that an app with more targeted information about dairy and food waste would be more useful. The reasons for the unexpected results can be that Norwegians do not perceive their waste of dairy products as problematic, as they think they waste more of other food products. Some of the participants in the study commented that there was too much focus on dairy products, for example: «[The app] had too much focus on dairy products. I missed facts about other

foods. » In another part of the study published by de Hooge (2017), Norwegians were asked to self-assess their household waste for six different food categories (Appendix 5). The results showed that Norwegians perceive their household food waste contribution from milk and dairy products to be 12 %. The real numbers are even less than what the consumers perceive, according to Stensgård and Hanssen (2016). Through the ForMat project, they found that the share of dairy products in household food waste was 6.4 % in 2015. Only bread had a smaller share. In contrast, fruit and vegetables contributed to 26.8 % of household food waste.

Yet, it was not mentioned by the interviewees that they did not think the app would be useful for dairy products. However, it was clearly messaged to the participants that dairy products would be in focus in the app, and the interview questions did not facilitate them giving information about not having a use for that. Nevertheless, the interviews gathered a lot of information about the use and wastage of dairy products in the informants' households, that indicated the need for increased knowledge about the shelf life and utilization of dairy products. To conclude, it seems like there is a need for content about dairy products in the app, but it does not need to be emphasized to the degree of the app used in this study.

The paper group was significantly more likely to indicate higher usefulness of the calculator and tips and recipes than the other groups. The paper group was also more likely to give the app a higher score on all questions. This is contrary to the expected outcome that an app will be more useful than presenting the information on paper. Nonetheless, the paper group reported a higher likelihood of wasting the sub-optimal milk and yoghurt after the intervention, which does not correlate with this group reporting the highest usefulness of the app. Further, the paper group did not receive all the tips and recipes, which weakens the possibility that they experienced a greater benefit than the latter groups. Former research has shown no effect of presenting a food waste intervention through brochures (Almli 2016). The reason for the paper group to report higher usefulness can be that it might be hard to evaluate a different format than what is presented. The people in this group might expect that there is more to the app than there is, and they do not experience technical issues. That might have resulted in them being more optimistic about the usefulness.

The results showed no effect on self-reported behavior during the three-week intervention period. Yet, some people in all groups reported that they had changed behavior, especially talking to friends or family about food waste. The changes reported by these people can indicate that using the app might have influenced knowledge and awareness for a subgroup of people. However, no measures have been made to investigate this assumption further. One must also keep in mind the tendency of people to over- and underreport a behavior in survey research due to social desirability (Edwards

1957). The lack of significant change in self-reported food waste can be due to the difficulty of estimating food waste. Studies show that consumers are often not aware of their own food waste, so estimating a change can be challenging (Neff et al. 2015; Quedsted et al. 2011). Aschemann-Witzel et al. (2016a) suggested that it is possible to segment people based on food related behaviors. Based on this, there might be foundation to construct an intervention for one or several subgroups. According to new theory in the innovation field, the people who reported a behavior change might be characterized as early adopters, and be potential key players in the further development and success of the app (Ries 2011).

5.1.1. Explaining the limited effect

The Food Saver app provided information about food waste as well as recipes and tips for how to use leftovers and sub-optimal products. Additionally, it provided interactive functions in the form of a calculator, registration function and quiz.

The fact sheets in the app provided information about the occurrence of food waste, and why food waste is a problem. The aim of the information was to raise awareness. The feedback from respondents was that the fact sheet had a lot of text and too little figures and pictures. Figures and pictures were also mentioned in the interviews as important for the informants to enjoy an app. The lack of figures and pictures, along with the content and length of the text, might have contributed to some participants disliking the app and thus found it not useful.

The information most interesting to the interview informants was with regards to knowledge about food utilization and food safety, which was mainly presented in the tips and recipes-section, and not awareness of food waste, which was the main content of the fact sheet. This is in line with the findings of (Aschemann-Witzel et al. 2016b), which argued that a positive focus, including not emphasizing the negative effects of food waste, was an important success factor for food waste preventing initiatives. However, the app had an overall positive focus, with the aim of helping people utilize their food and bring knowledge of how to know whether the food is safe to consume. Aschemann-Witzel et al. mentioned four other key success factors for the primary design of information and capacity building initiatives: Collaboration, timing, competencies and easiness. The Food Saver app was presented in a time where food waste is of great focus in society (Stensgård & Hanssen 2016), the developers had competencies within food and consumer research and the app provided information that was easy to put into practice. Collaboration was done to some extent, through the group interviews, but there could also have been collaboration with other parties. Thus, the Food Saver app fulfills four out of the five success factors. Despite fulfilling these factors, the app only had limited effect on food waste behavior, which indicates that other factors were important.

The most useful function according to the survey respondents was the fact sheet. This is not in line with finding in the interviews, as recipes with tips for how to use leftovers or products past the best before date, was the most commonly mentioned feature. The reason for the non-corresponding results can be the technical issues associated with the tips and recipes function. The assumption can be stressed by the fact that the paper group, which did not experience technical difficulties perceived the tips and recipes function as the most useful.

The respondents' comments, showed that some participants found the app boring due to not receiving any new content. Updating the app with new content could thus be a way to keep the participants interested and increase the likelihood that they would like to keep using it. The statement is supported by Lee and Raghu (2014), which identified continuous updates as one of the determinants for an app's success. Another way of increasing the users' interest in the app is to add gamification. Gamification is a way of supporting the users' interest in (for example) an app by adding game-like features to it, and is readily used in popular health and fitness apps (Hamari et al. 2014; Lister et al. 2014). Thus, it could be advantageous to implement game elements in the Food Saver app to enhance interest and motivation for using the app, and promote behavior change.

The interview informants commonly mentioned notifications with a reminder to use the product, and what to use it for, as a desired function. This function did not work properly in the app due to technical issues. A notification feature was also among the most important features mentioned in the study by Teo et al. (2017), which assessed what men wanted from a health screening app. In that study, a reminder was mentioned as an attention allocation, to ensure the continuous use of the app. However, this is not directly transferable to an app that targets food waste behavior change, which is not targeting health related behavior.

Several of the participants experienced technical issues with the app, such as the app crashing when using different functions. Tips and recipes was the most commonly reported function that was inaccessible due to technical difficulties. Taking into consideration that this was the most desired function, as seen by the interview results, the technical difficulties might have altered the results. However, it cannot be predicted whether the participants would find the app more useful without the technical issues. That there was no interaction between age and technical issues indicate that technical issues occurred in the app and not due to the participants, as people of higher age tend to be the group with most technical difficulties (Gatto & Tak 2008). The app was tested prior to distribution to the participants and no technical issues was identified. More rigorous testing and more robustness in the app may be required for future research.

User friendliness was an important aspect mentioned in interviews, and also by Teo et al. (2017) which looked at what men want from a health screening mobile app. Some participants mentioned lack of user friendliness in the comment field, while more than half of respondents reported that the app was user friendly to some degree or large degree (not shown in results). It can be that the scale chosen was not the best suited for this question, as it is not the best predictor of the real usefulness.

The app in this study showed limited effect on food waste behavior. However, some studies have found evidence that support apps' effect on behavior change. As far as known by the author, no other study exists that assesses the effects of an app that aims to help reduce food waste. However, apps targeting health behavior also incorporate behavior theory constructs, which makes the results transferable to the topic of interest. Payne et al. (2015) investigated 24 studies considering the effect of mobile apps in health interventions. They concluded that apps may be feasible for administering health interventions. De Cock et al. (2017) and Wang et al. (2016) found evidence that the use of diet and fitness apps had some association with healthier eating and activity behavior. Further, Flores Mateo et al. (2015) found that mobile apps can be used for promoting weight loss. Elbert et al. (2016) concluded that their app for increasing fruit and vegetable intake had the potential to change fruit and vegetable intake for some, but not all, groups. However, caution must be taken regarding the true effect of the apps as most of these studies did not include control groups. Other studies have showed that, even though there was an effect in the groups that received an intervention, there was no difference between the intervention groups and the control group. Knight-Agarwal et al. (2015) showed no difference between intervention and control group when testing the effect of an app on weight gain during pregnancy. The results from other studies indicate that, even though the Food Saver app had limited effect on behavior, there is potential for apps to support behavior change, and that doing an intervention often leads to increased awareness. However, solid evidence exist that people want health apps (Martínez-Pérez et al. 2013; Parizeau et al. 2015; Research2guidance 2013; Webb et al. 2010). The question remaining is if people want an app to help them reduce their household food waste.

All the authors from the studies described above emphasized the need for further exploration of the behavior changing effect of apps or options to increase the effect. The number of studies that explore the effect of apps on behavior are limited, and further research must be conducted to add to the empirical evidence of the effect of app interventions.

5.2. Why is it so difficult to help people to waste less?

The results in this study support the assertion that it is challenging to help people reduce their household food waste (Aschemann-Witzel et al. 2015; Koester et al. 2013). The reasons for food

waste generation are complex, and household food waste is not a result of a single action (Schmidt 2016). Rather, it is a result of a combination of multiple actions. One of the reasons for that is that the situations of purchase, utilization, and sometimes disposal, are separated in time, location and reasoning. Abrahamse et al. (2005) concluded that it is important to determine which behaviors and behavioral determinants that should be targeted by an intervention. The behavior of interest in this current thesis was wasting of sub-optimal products past the best before date, with a special focus on dairy products. However, as portrayed by Abrahamse et al., multiple actions lead to the actual behavior of wasting food. That multiple actions lead to food waste was considered when designing the app, as the app presented information on skills in utilizing and assessing the products, and tips for how to improve routines related to cooking and shopping. However, Schmidt et al. (2016) argued against the approach of providing broad ranged information. They believed that food waste reducing initiatives often lack an individual focus in their interventions. Consequently, the authors argued that the recipients receive an overflow of information, and thus feel overcharged and lose motivation. Therefore, Schmidt et al. performed an intervention on food waste reduction in the households targeting single behaviors based on information acquired from the participants at baseline. Examples of behaviors included impulsive purchasing or immediate discarding of expired foods. The intervention group showed an increase in perceived ability to prevent food waste, as well as self-recorded food waste-preventing behaviors, compared to the control group. The results can be considered as evidence supporting the benefit of personalized interventions targeting specific behaviors. However, the limitation of response bias might have influenced the results. Also, Dennison et al. (2013) found that many participants in their study expressed an interest apps were interesting if they provided advice and information that they could access “on the go”, which support the idea of an app with a variety of information.

A barrier against attaining a sustainable lifestyle is the pro-consumption systems in society that lead to unsustainable production and consumption (Aschemann-Witzel et al. 2015; UN Environment 2016). In addition, there are immediate benefits related to unsustainable behavior, such as buying too much food out of pleasure, that seems more important than the long-term benefit of saving money or care about the environment (Madden & Bickel 2010). Further, attitudes do not always turn into behavior. Similarly, sustainable attitude and behavior do not always lead to a reduction in environmental impact (Csutora 2012). The barriers can be described as (respectively) the awareness-attitude gap, attitude-behavior gap and behavior-impact gap.

5.2.1. “I am aware, but...” (awareness-attitude gap)

The results from this study indicate that the app might increase awareness among a sub group of people. However, awareness does not necessarily turn into behavior, or even attitude (Neff et al. 2015). People might not care about the topic, have other interests or simply disagree with the message presented (Filho & Kovaleva 2015; Höjgård & Jansson 2013; Neff et al. 2015). That some people do not have an interest in reducing food waste can be illustrated by a statement from a British newsreader in Stuart (2009, p. 203):“I paid for it. I can do what I want with it after that”.

5.2.2. “I do not like it, but...” (attitude-behavior gap)

However, many people do report concerning about environmental matters, such as food waste (Evans 2011; Graham-Rowe et al. 2014; Quested et al. 2011). Yet, though they are concerned, they often lack the willingness or ability to perform the necessary behaviors that promote change (Sheeran 2002; Vermeir & Verbeke 2006). Part of the solution involves providing knowledge, but not all (Kollmuss & Agyeman 2002). Providing knowledge will not make people sacrifice being a good provider, or their social identity, for the sake of reducing food waste. Qualitative studies have found that people perceive their own food waste generation as low and perceive themselves as resource conscious consumers (Jenssen 2016; Mejdahl et al. 2011). This self-perception can perhaps make the consumers feel like their small contribution to food waste reduction is insignificant. The perception of their own behavior as being insignificant can be a barrier against change because, if they do not perceive their behavior as a problem, the message in food waste reduction campaigns will be irrelevant to them. Others think that the responsibility of reducing food waste does not lie with the consumer, but rather the government, retailers and food industry (Kollmuss & Agyeman 2002). There is also the importance of habit and routines that affect peoples’ unconscious behavior (Stancu et al. 2016).

5.2.3. “I do something about it, but...” (behaviour-impact gap)

Even when consumers do make an effort to reduce their food waste, it might not necessarily have an impact (Csutora 2012; UN Environment 2016). Csutora (2012) described this issue as the behavior-impact gap. The study suggested that when people reduce one type of unsustainable behavior, they tend to do more of another unsustainable behavior, summing the impact to zero. The author also suggested that some of the reason for the gap might be that the sustainable actions communicated to the consumers are too marginal. Also, consumers might overestimate the impact of their behavior (overconfidence effect) (Dunning et al. 1990).

Despite the challenges associated with food waste reduction, some initiatives have had success in reducing people’s household food waste. In Norway, the ForMat project aimed to reduce food waste in the whole FSC (Stensgård & Hanssen 2016). During the project period, household food wasted

was reduced by 9 %. Among the strategies approaching consumers were reduced packaging sizes, extended shelf life of products and providing knowledge and awareness to consumers in-store and in social media.

Love Food Hate Waste is a campaign administered by WRAP with the aim to help people reduce their food waste behaviour by raising awareness and providing simple solutions for how to avoid food waste (WRAP 2013). The campaign included a broad variety of activities, from radio adverts to cooking classes. During a six-month period, avoidable food waste was reduced by 16 %.

The results from the two initiatives, together with evidence from Neff et al. (2015), indicate that it might be easier to see the impact of multiple actions as a whole, rather than from singular actions. In addition to the initiatives there are studies that have focused on single initiatives. Only two studies investigating the effect of a single initiative have been obtained while working with this thesis. One was a study by Young et al. (2017), which targeted consumers in retail through a social media and e-news intervention. The authors found no difference between the intervention groups and the control group. The other study targeting household food waste was performed by Schmidt et al. (2016) (described previously in this chapter). The study concluded that environmental psychological based strategies can be useful for changing behavior, including food waste prevention.

There is a great variety in methodology between the two intervention studies, as well as between the studies and this current study. The differences make it inappropriate to compare the studies against each other. More intervention studies must be conducted to build empirical evidence on food waste reduction interventions. The challenges associated with changing intentional behavior might call for the necessity of exploring alternative strategies, such as nudging (described in chapter 2.5) (Dreibelbis et al. 2016).

5.3. Limitations to the study

There are certain limitations to this study. First, some of the participants were eliminated from the results due to answering questions for the wrong intervention. P-value was significantly altered for one result due to the elimination, resulting in no significant effect of group on the usefulness for wasting less meat, fish and eggs. It has not been examined whether the excluded participants differed from the included participants regarding sociodemographic or attitudinal variables.

Most of the participants in the light version group rated the usefulness of the registration function, even though they did not have this function. It was not possible to limit the participants from downloading the other app (both were available in App Store/Google Play), which raises a question of whether some of the participants in the light app group incorrectly downloaded the full app.

Another option is that some participants misinterpreted the question regarding functions. It is not possible to figure out whether the former or latter is the actual case. So, one must keep in mind that the results might not be valid. In the evaluation survey, there was no option saying, 'I did not see this function'. Instead it asked, 'I did not look at this function', which did not say anything about whether they had the function or not. One person in the paper group responded that she downloaded the app. The participant was not excluded from the results, and there is no way of controlling whether other participants in the paper group downloaded the app on their own initiative. For future research, there should be barriers that prevent participants from downloading the wrong app, as well as preventing the paper group from downloading the app. These barriers would help to some extent to address the issue in consumer research that it is not possible to fully control people's perceptions, interpretations and actions (Lietz 2010).

Presenting an app on paper was not a good predictor for how people really perceived the app. For future research, it might be beneficial to replace the paper group with a control group, which only answer the two surveys. This was done by Elbert et al. (2016) in their intervention targeting increased fruit and vegetable consumption, and by Young et al. (2017) in a food waste reducing intervention targeted against retailers. Young et al. found a significant reduction in food waste in all groups, including the control group. Elbert et al. found an increase in fruit intake compare to control, but not in vegetable intake. The two studies illustrate the benefits of having a control group, as the observed effects are not necessarily caused by the actual intervention.

In addition to limitations to this study, there are limitations that apply to consumer research in general. Consumer research is prone to memory biases. Over- and underreporting is a common issue. The phenomenon of over- and underreporting behavior is referred to as social desirability bias, and occur due wanting to present oneself in a positive manner to others. (Edwards 1957) Another common bias is telescoping, which is the tendency to recall distant past event as occurring more recently, and recent events as occurring further back in time (Morwitz 1997). Telescoping is an issue in consumer research as it might influence how the respondents answer the questionnaires. In this study, telescoping might have affected the response to the behavior questions, as it might be hard to recall whether an event happened within the last three weeks or earlier. Additionally, habitual behavior, such as everyday food related behavior, can be hard to recall as it does not stand out (Quested et al. 2011).

The Food Saver app that was distributed to the participants can be said to be an early stage app. This is confirmed by comments from participants. If the app was more finished by distribution to the participants, the results might have predicted the true effect of a food waste preventing app more accurately. The participants' feedback should, together with interview statements, assist in refining

the current prototype before publishing the app to the public. The social aspect of apps was mentioned in the interviews and proven important for environmental behavior change in a study by Abrahamse and Steg (2013). Thus, a social aspect can be beneficial for achieving behavior change in the Food Saver app. Abrahamse and Steg mentioned the effect of social norms for behavior change, which is consistent with TPB. With more resources (time and money) it would be possible to make an app with more of the desired functions.

The strengths of this study include a good sample size and a high response rate for this type of study. The high response rate might be due to the short intervention period. However, the short follow-up time (3 weeks) is not adequate to measure long term behavior change (Dwyer et al. 1993; Schultz et al. 1995). Another strength of this study is that the three intervention groups were balanced with regards to participant characteristics. However, the sample was not necessarily representative for all Norwegian consumers, as no information of the participants' residency was provided and old people were excluded.

5.3.1. Further research on the effect of apps on food waste prevention

The limitations to the current study can be utilized to make recommendations for further research. Further research on the effects of apps on food waste should have barriers that limit participants from engaging in the wrong intervention. Second, it could be beneficial to have a control group which only answered the surveys. Further, the app should be more finished at the time of distribution to the participants. Comments from interview informants and participants in this study should be considered in further designing the app. Additionally, the intervention period should be longer or possibly include a third effect measurement a few months after the intervention.

Other suggestions:

To make people waste less, it is beneficial to organize several actions simultaneously in different parts of the value chain and collaborate with different actors (Aschemann-Witzel et al. 2016b). It is also easier to observe the effects of a cluster of multiple actions than of single, isolated actions (Stensgård & Hanssen 2016; WRAP 2013). Hence, it would be of interest to launch a food preventing app in collaboration with businesses or other organizations such as Matvett (Matvett 2017).

Another topic of interest is that the interview informants frequently mentioned that they would like the app to have an overview of discounted food with short shelf life in the grocery store. It would be interesting to implement that sort of function in an app. Such app already exists, but rely solely on reports from consumers, which is not systematic and thus provide an unpredictable information flow (Foodlist 2016). Hence, there is potential for improvements, perhaps by collaborating with retailers.

Also, worth noting is the importance of appealing marketing to attract and keep the consumers' interest. In some cases, the sexiness of an app is more important than the content for people to adopt the app (Christensen et al. 2007; Yin et al. 2013).

6. Concluding remarks and implications

Food waste is one of today's major threats against sustainability. Consumers are the main contributors to food waste in developed countries, so actions must be taken to support people in wasting less food. This study is, to the best of knowledge by the author, the first study to investigate the effect of an app on food waste reduction in households.

The findings in the current study suggest that there was no evidence that an app can support people in reducing household food waste. There was no difference in effect between people receiving a full app with special focus on dairy products, and people receiving a light, more general version of the app, which implies that there is no benefit of having a special focus on dairy products. Based on the results, there is reason to believe that an evaluation on paper will not predict the real appreciation of an app.

To this date, there exists no household food waste targeting app on the Norwegian market. Based on results from the surveys and interviews, along with the former successes of apps targeting other behaviors, there is reason to believe that a household food waste reduction app can be welcomed and utilized by Norwegian consumers.

It is necessary to conduct further intervention studies to build empirical evidence of food waste reduction interventions. The interventions should be communicated both through apps and other channels to be able to compare the effect of different types of interventions. Future app interventions should take the comments of the participants in this study into account, regarding the content and design. Efforts must be made to reduce technical issues to a minimum.

6.1. Implications

There is great potential in educating consumers about food safety in the mission to increase their acceptability of sub-optimal foods. This study has provided new insights on what people want from an app that aims to help them waste less food. and can hopefully inspire the testing and development of evidence based mobile phone apps that support food waste preventing behavior.

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Appendix 1: Summary of brain storming session

Contributors: Helen Hoem and Marije Oostindjer

The purpose of the brain storming was to get ideas for the content of the app.

Outline

1. Why is it bad to waste food? Fact sheet. Why milk?
2. What's in it for me to waste less? Calculation of money/CO2 saved etc
3. What does best før mean? Quiz
4. Tips and tricks/recipes
5. Registration of milk bought. With option of typing manually

There will be notifications with tips and tricks, and reminders to use the registered milk.

Name and front page picture

Name

The ideas for the names could be divided into four categories:

1. Names based on theme (negative focus)
Typically names with the word waste.
2. Names based on theme (positive focus)
Typically names with the words food.
3. Names based on action (negative focus)
Typically names related to either Save/Smart konsum
4. Names based on action (positive focus)

We finally landed on the category names based on theme (positive focus). We want the app to have a positive focus, and the names in this group was more specific compared to the names in the category names based on action (positive focus).

We made "Foodsaver" the working title.

Picture

The pictures could be divided in three categories: Environment (e.g. a tree, food cycle); literally save (bank safe with plate, save button, battery); abstract food (COSUS logo, fridge).

The picture should somehow be related to the name. We agreed that the environment focus is for the specially interested. The picture should be easy to make the way we want it (e.g. a man holding a lot of food is more complicated).

There isn't any room in the budget for someone to be payed to make the picture. Unless someone with their own company can do it for 500,- they can send us a bill.

Fact sheet

Category 1

- There is enough food to feed the world's population, but it's unevenly distributed.
- Mention UN development goals

Category 2:

- Much of the food we dispose is still good.
 - Quality + safety
 - Particularly easy for milk/yoghurt etc

Category 3: Loss

- Waste of resources
- Emissions from food production and infrastructure
 - Climate change not necessary, but clear why it is bad.
- Waste of money.
- How much food is wasted, nationally and globally. And in different parts of the value chain.
- We need to make sure we use the words: Environment, protect, sustainability
- Link to the quiz at the end of the fact sheet
- Not too much information. Easy to read. Possibility to click on the subject to read more.
- Include illustrations/pictures.
 - Tree- environment picture? Can pick one from the environment category on name/picture sheet.

What's in it for me to waste less? (includes calculation)

- Should fit on one screen (no rolling)
- Nice to add “save” picture here too

Content:

- Personal calculation on what is to gain.
 - With explanation/illustration: “This is equivalent to..”
- Interactive: Enter units of milk/month (milk or yoghurt, need to decide). Do you end up throwing some of this?
 - Compare to average? If possible.
- Provides information of assumption (what calculation is based on)
 - Include source of information
- Provides link to tips/tricks/recipes
 - Insert “link”

Quiz: Quality of safety (tentative name)

1. General introduction

- “Most people don’t know what the best before date really means. If the date has passed, is it still good to eat? Is it quality or safety?” or something more educational
- Very short. 3 sentences + start button

2. Quiz: 7 questions

- a. If the date on these products has passed, which one may still be good to eat?
 - Best før on milk vs bruk før on fish.
 - Pictures of each
- b. What products may have a «best før» dato?
- c. How can you decide if a product with best før dato is still good to eat?

Four alternatives. Correct alternative: Look, smell, taste

- At least 2 more.
- One “fun” question. E.g. a fun fact.

3. Score: 3 categories.

- E.g. Supersaver, foodsaver, saverstudent. With test to accompany.
- Decide on the score categories after we know the number of questions.

4. With link to tips/tricks/recipes
5. Try again-button

Recipes/tips and tricks

Category 1: Storing/planning/shopping

- Tips for grocery shopping/planning
- Use your senses before throwing. Look at Matvett site, but don't copy.

Category 2: Recipes

- Dinner: Casserole, soups etc
- What can you make from milk
 - Both milk that's gone sour and not
- Fruit/vegetables: Smoothie, cut in pieces and freeze

Category 3: Initiatives

- Link to how you can make your own milk by adding cultural milk. (safety issues)
- Link to both (inter)national and local initiatives
 - TGTG, Foodlist
- With pictures
- Must be simple
- Suitable for all levels, including 'experts'

Appendix 2: Interview guide (in Norwegian)

Spørsmål og introduksjon	Materiale/kommentarer, ting å huske på
<p><u>1. Oppstart (2-3 min)</u></p> <p>Moderator ønsker velkommen, presenterer seg selv, og de andre i rommet.</p> <p>Deltakerne presenterer seg selv kort. Navn og hvor de kommer fra? (ikke hva de studerer når det er noen som studerer matvitenskap)</p> <p>Husk, det er ingen rette eller gale svar. Bare si det første dere tenker på.</p>	<p>Deltakerne blir bedt om å sette mobilen på lydløs</p> <p>Forklare hva som skjer.</p> <p>Si at det blir tatt lydopptak og at resultatene blir holdt anonyme! «Er dette ok?»</p> <p>Start av lydopptaker</p> <p>Presentasjon <u>etter</u> start av båndopptaker, så de blir raskere vant med å snakke mens den er på.</p> <p>Det kommer til å ta 30 min, så vi er ferdig her klokken-.</p>
<p>2. Spørsmål om melk (5 min)</p> <p>Warm up question: Hva bruker du melk til?</p> <p>Oppfølging: Bruker du andre meieriprodukter?</p> <p>Hvis du tenker på en gang du måtte tømme ut melk eller kaste andre meieriprodukter. Hvilket produkt var det? Hva var årsaken til at du kastet den?</p> <p>Probe: Hvorfor..</p> <p>Probe: Var det noen følelser knyttet til dette?</p> <p>Forklar. (Eksempler på følelser hvis de synes det er vanskelig: Lettet, dårlig samvittighet, glad, følelsen av å få ting gjort, irritert, ingen spesiell følelse...)</p>	<p>Oppvarmingsspørsmål for å gjøre de vant til å svare på spørsmål og komme inn i temaet.</p>

<p><u>Hvis ikke de kommer på noe:</u> Hva tror du er hovedgrunnen til at folk kaster melk/meieriprodukter?</p>	
<p><u>3. Spørsmål knyttet til appen (20 min)</u></p> <p>Kan du fortelle om en gang du brukte noe som var utgått på dato, i stedet for å kaste det? Hva var det og hva brukte du det til</p> <ul style="list-style-type: none"> - Hva fikk deg til å ønske å bruke det? - Hvordan kunne du være sikker på at det var trygt/godt å bruke/spise? 	<p>Dra nytte av at det er et gruppeintervju</p> <p>«Var det det samme for deg?»</p> <p>«Ville du gjort det samme?»</p> <p>Hensikt: Samle data om hvilken informasjon som kan være i appen, som bidrar til at man ønsker/tør å bruke produkter som har gått ut på dato.</p>
<p>Info: Det kastes mye mat/melk. Som et tiltak har vi tenkt å lage en app som kan hjelpe folk i hverdagen til å kaste mindre mat/melk hjemme. Grunnen til at vi har valgt å fokusere på melk og meieriprodukter er at dette er produkter som ofte er like gode å bruke etter utløpt dato.</p>	
<p>Hvem kan denne appen kunne være nyttig for tror du?</p> <ul style="list-style-type: none"> - Hvorfor... hvorfor... - Hvem tror du den ikke er nyttig for/hvem tror du ikke vil bruke den? - Tror du en sånn app ville være gøy å bruke? <ul style="list-style-type: none"> Hvorfor/hvorfor ikke? Hva ville gjort appen ekstra gøy for deg? 	<p>Venne de på tanken om appen</p>
<p>Hvis du selv skulle hatt nytte av en slik app, hva er det første du tenker på at den måtte den inneholdt/kunne gjøre? Nevn 3 ting.</p> <ul style="list-style-type: none"> - (Hvorfor.... Hvorfor....) - (Kan du nevne 1-3 apper du bruker mest/likes å bruke (Ikke instagram, FB, snapchat?) - Matvaregruppen vi skal fokusere mest på i appen er melk og meieriprodukter. Hvordan kan en app hjelpe deg (eller andre) å kaste mindre melk? <ul style="list-style-type: none"> o Hvilke ting skulle du ønske du kunne vite mer om? 	<p>Hensikt: Finne ut hva som gjør en app interessant å bruke.</p>

<p>(eksempler hvis de er blanke: hvordan vite om maten er trygg å spise/fakta om matsvinn/hvordan bruke melk som er gått ut på dato/hvordan bruke rester/effekter av (å redusere) matsvinn..)</p>	<p>Hensikt: Finne ut hvilken informasjon som burde være med</p>
<p>Kan du nevne noen personlige fordeler for deg ved å kaste mindre mat/melk?</p> <ul style="list-style-type: none"> • Evt: Hva tenker du om det/vil du utdype det? (Hvis det passer) • Til slutt: Tror du en app kan hjelpe deg med å oppnå de fordelene du har nevnt/som har blitt nevnt. Evt. hvordan? <ul style="list-style-type: none"> ○ Evt spørre: Hva er argumenter for at den ikke skal hjelpe? ○ Eller: Er det noen grunner til at du eventuelt ikke ville bruke appen? (f.eks. slitsomt, kjedelig, unødvendig, liten gevinst..) 	<p>Hensikt: Input til «what's in it for me». Hva anser de som viktig</p> <p>Hjelpeord: Økonomi, måltider, syn på seg selv, føle seg viktig/nyttig..</p>
<p>4. Avslutning (2-3 min)</p> <p>Er det noe dere har lyst å tilføye?</p> <p>Takk for at dere hadde lyst til å komme. Det har vært til stor hjelp. Håper dere synes det har vært interessant.</p>	<p>Stopp båndopptaker.</p>

Appendix 3: Norwegian quotes

- 1) *«Også er det jo det at du glemmer at du har det. At det står eller sant ta smøreost da. Som er du åpner det også bruker du litt også setter du på plass også kjennes den kanskje full ut, eller og den er jo ikke gjennomsiktig så du vet, altså, så du tror kanskje at den er uåpnet og da holder den lenger også åja den var jo åpnet, også er den helt grønn.»* Informant 2F; Female, medium engaged in environment and food waste prevention.
- 2) *«Det er jo når rømmen blir grønn. Da slår jeg ut den. Også er det melk da, hvis den har stått lenge romtemperert eller sånn over natta eller hvis den er gått ut på dato sånn litt for lenge (..). Nei jeg synes det er ekkelt. Egentlig. Jeg er redd for å bli litt dårlig i magen, også synes jeg ikke det smaker så godt. Men det er kanskje psykisk, jeg vet ikke.»* Informant 4J; Male, below medium engaged.
- 3) *«Ja, det var vel litt sånn latskap da. Enkleste utvei. I stedet for å bruke den til retter ogsånn da. Bare bli kvitt den. Få den unna.»* Informant 1B; Male, medium engaged.
- 4) *«Så ja, både at du glemmer det men og at det liksom er ikke så nøye. Altså det går helt greit å kaste det. Hvis det er sånn at oi den var blitt grønn, så går du ikke og sørger over det. Du bare kaster det og tenker ikke mer på det egentlig.»* Informant 2F; Female, medium engaged.
- 5) *«Men melk synes jeg ikke nødvendigvis er ødelagt fordi den går ut på dato. Vi har hatt melk hjemme som er hvertfall kan ha vært helt opp i 14 dager uten å ha blitt ødelagt. Så noen ganger lenger enn andre. Når det begynner å skille seg og lukte veldig.. det er ikke så veldig ofte det skjer da, fordi det går som regel til etellerannet, blir brukt opp.»* Informant 1C; Female, medium engaged.
- 6) *«Og .. ja. Jeg synes også det burde være oppskrifter. At man kan for eksempel, hvis man har en melk da, så kan man trykke på melk og se hva man kan lage med det. Også hadde det også vært litt gøy å se .. fordi det er jo, for eksempel, når det gjelder kjøtt da. Så sier alle at hvis du reduserer med.. eller hvis du dropper å spise kjøtt en gang i uken så sparer du miljøet så å så mye.-Det hadde også vært litt gøy hvis man kan se.. hvis man reduserer sitt*

eget svinn, hva det vil gjøre med miljøet (..) Jeg tror det er lettere for folk å forholde seg til det i stedet for bare «Nå gjorde du noe bra for miljøet». Man vil gjerne vite hva man har gjort.» Informant 1A; Female, medium engaged.

- 7) *«Men kanskje også sånn at appen kan gi deg informasjon om de ulike meieriproduktene og hva som kan spises når. Hva som er farlig, hva som er helt innafor. Og hvordan man skal feks lukte eller se seg frem til om det er dårlig eller ikke da. Og sånn forslag til oppskrifter feks sånn. Ja litt sur melk kan du ha i vafler eller sånn gode gamle husmortips.» Informant 4K; Female, above medium engaged.*
- 8) *«Det må være enkelt. Det kan ikke være sånn at du å drive å bla deg gjennom.. at det tar for lang tid. Det ser jeg for meg.. sånn som du snakker om at det kommer opp en sånn melkekartong, også kommer det opp en okse også trykker du. Sånn at det er enkelt.» Informant 1C; Female, medium engaged.*
- 9) *«Det som er gøy med apper er jo at det er sosialt, for min del da. At det er en sosial bit i det å bruke appen. Men det som også gjør det gøy.. Eller, jeg vet ikke om det er riktig ord å bruke ordet gøy da. Er at appen er veldig sånn ryddig og enkel å forstå da. At det blir ikke noe sånn [sigh] liksom, når du skal bruke den. Blir sånn (munter stemme) "Åja, dette var jo lett og greit".» Informant 3H; Female, above medium engaged.*
- 10) *«Det er jo selvfølgelig økonomisk og eller ja. Man slipper å bruke penger på noe man egentlig allerede har i kjøleskapet. Også får man jo bedre samvittighet» Informant 1A; Female, medium engaged.*

Appendix 4: Evaluation survey

Vurdering av app Del 3

Hei! Her følger tredje og siste del av undersøkelsen om apper.

1

Hva er din epostadresse?

2

Nedenfor har vi satt opp en del utsagn om bærekraft. Oppgi i hvilken grad du er enig i utsagnene.

	1 Helt uenig	2	3	4	5	6	7 Helt enig
Jeg er ofte bekymret for om noen av matvarene som jeg har i kjøleskapet kan bli utrygge å spise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jeg kaster heller en matvare fremfor å bruke den hvis jeg er usikker på om den fremdeles er bra.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jeg vurderer om en matvare fremdeles er spiselig ved å lukte, smake og se på den.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3

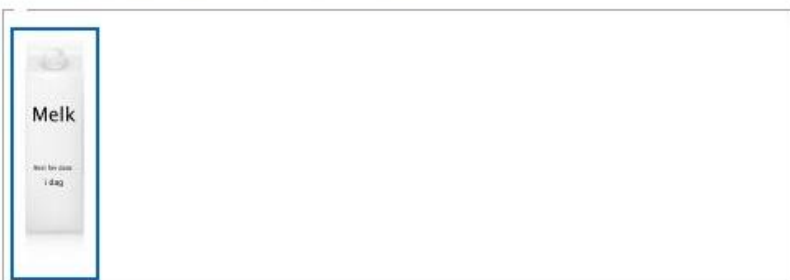
I hvilken grad er det viktig for deg å redusere mengden mat som blir kastet i hjemmet ditt?

- Ikke viktig i det hele tatt
- Lite viktig
- Ganske viktig
- Veldig viktig

4

Hvor sannsynlig er det at denne melken ville blitt kastet hjemme hos deg?

- Ville helt sikkert IKKE blitt kastet
- 10% sannsynlig at ville blitt kastet
- 20% sannsynlig at ville blitt kastet
- 30% sannsynlig at ville blitt kastet
- 40% sannsynlig at ville blitt kastet
- 50% sannsynlig at ville blitt kastet
- 60% sannsynlig at ville blitt kastet
- 70% sannsynlig at ville blitt kastet
- 80% sannsynlig at ville blitt kastet
- 90% sannsynlig at ville blitt kastet
- 100% sannsynlig at ville blitt kastet



5

Hvor sannsynlig i % er det at denne yoghurten ville blitt kastet hjemme hos deg?

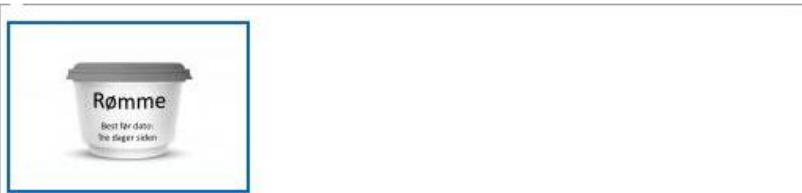
- Ville helt sikkert IKKE blitt kastet
- 10% sannsynlig at ville blitt kastet
- 20% sannsynlig at ville blitt kastet
- 30% sannsynlig at ville blitt kastet
- 40% sannsynlig at ville blitt kastet
- 50% sannsynlig at ville blitt kastet
- 60% sannsynlig at ville blitt kastet
- 70% sannsynlig at ville blitt kastet
- 80% sannsynlig at ville blitt kastet
- 90% sannsynlig at ville blitt kastet
- 100% sannsynlig at ville blitt kastet



6

Hvor sannsynlig i % er det at denne rømmen ville blitt kastet hjemme hos deg?

- Ville helt sikkert IKKE blitt kastet
- 10% sannsynlig at ville blitt kastet
- 20% sannsynlig at ville blitt kastet
- 30% sannsynlig at ville blitt kastet
- 40% sannsynlig at ville blitt kastet
- 50% sannsynlig at ville blitt kastet
- 60% sannsynlig at ville blitt kastet
- 70% sannsynlig at ville blitt kastet
- 80% sannsynlig at ville blitt kastet
- 90% sannsynlig at ville blitt kastet
- 100% sannsynlig at ville blitt kastet



7

Hvor mange ganger brukte/så du på appen?

- 1-2 ganger
- 3-4 ganger
- 5-6 ganger
- Mer enn 6 ganger

8

Ranger funksjonene etter hvor lang tid du brukte/så på dem. Ett tall mellom 1 og 5 på hver rad. 1: Brukte minst tid. 5: Brukte mest tid. Du kan bruke hvert av de 5 tallene bare én gang.

	1	2	3	4	5	Jeg så ikke på denne funksjonen
Fakta om matsvinn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hvor mye kan jeg spare? (kalkulator)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tips og oppskrifter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Min melk (registrering)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quiz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9

I hvilken grad synes du teksten var enkel å lese og forstå?

- Ikke i noen grad
- I liten grad
- I noen grad
- I stor grad

10

Hvilken karakter vil du gi...

	1 Svært dårlig	2	3	4	5	6 Svært god
Appens utseende?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Appen alt i alt?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11

Hvilken funksjon synes du var mest nyttig for å unngå matsvinn? Velg kun ett alternativ.

- Fakta om matsvinn
- Hvor mye kan jeg spare? (kalkulator)
- Tips og oppskrifter
- Min melk (registrering)
- Quiz

12

	Ikke i det hele tatt	I liten grad	I noen grad	I stor grad	Vet ikke
Mener du faktasiden (Fakta om matsvinn) kan hjelpe deg å kaste mindre mat?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mener du kalkulatoren kan hjelpe deg å kaste mindre mat?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mener du tipsene kan hjelpe deg å kaste mindre mat?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13

Totalt sett; - Hvor nyttig mener du appen er for å hjelpe deg å kaste mindre av følgende produkter?

	1 Ikke nyttig i det hele tatt	2	3	4	5	6	7	8	9	10 Veldig nyttig
Frukt og grønt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brød	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meieriprodukter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kjøtt/fisk/egg	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mat generelt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14

Basert på innholdet, vil du anbefale denne appen til venner eller familie?

- Nei
- Ja
- Kanskje

15

I hvilken grad synes du appen lærte deg noe nytt?

- Ikke i det hele tatt
- I liten grad
- I noen grad
- I stor grad

16

I hvilken grad har du gjort følgende de siste 3 ukene?

	Jeg gjorde dette før, men ikke i løpet av de siste 3 ukene	Jeg gjorde dette før, og i løpet av de siste 3 ukene	Jeg gjorde ikke dette før, men har gjort det i løpet av de siste 3 ukene	Jeg gjorde ikke dette før, og heller ikke i løpet av de siste 3 ukene
Kastet mat som har gått ut på dato	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brukt mat som har gått ut på dato	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Luktet, sett på eller smakt på maten før du tok avgjørelse om du skulle kaste den eller ikke	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snakket med venner eller familie om matsvinn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17

Har mengden mat du kaster forandret seg de siste 3 ukene?

- Jeg kaster mye mer enn før
- Jeg kaster litt mer enn før
- Jeg kaster samme mengde som før
- Jeg kaster litt mindre enn før
- Jeg kaster mye mindre enn før
- Vet ikke

18

Synes du appen var....? Velg alle alternativer som gjelder for deg.

- Interessant
- Uinteressant
- Komplisert
- Enkel
- Irriterende
- Gøy
- Kjedelig
- Motiverende
- Nyttig
- Unyttig
- Lærerik
- Sosial
- En plikt å bruke
- Noe jeg ønsket å bruke
- Ingen av alternativene passer

19

Lastet du ned appen på telefonen eller fikk du den per post?

- Lastet ned på telefonen
- Fikk den per post

20

Opplevde du noen tekniske problemer da du brukte appen?

- Nei
- Ja
- Annet:

Hvis du krysset av for "ja": Hvilke problemer opplevde du? Noter under Annet

21

I hvilken grad synes du appen var brukervennlig?

- Ikke i det hele tatt
- I liten grad
- I noen grad
- I stor grad

22

Hvor godt likte du varslene?

- Ikke i det hele tatt
- I liten grad
- I noen grad
- I stor grad
- Jeg fikk ikke varsler

23

Synes du quizen var interessant?

- Nei
- Ja
- Vet ikke
- Jeg tok ikke quizen

24

Se for deg at appen hadde en sosial funksjon hvor du f.eks. kunne dele resultater og erfaringer med venner eller familie. Ville dette gjort appen mer eller mindre interessant for deg?

- Mye mindre interessant
- Litt mindre interessant
- Ingen forskjell
- Litt mer interessant
- Mye mer interessant

25

Hvor sannsynlig er det at du kommer til å fortsette å bruke appen?

- Veldig usannsynlig
- Ganske usannsynlig
- Hverken sannsynlig eller usannsynlig
- Ganske sannsynlig
- Veldig sannsynlig

26

Var det noe du savnet ved appen? Eller har du andre synspunkter eller kommentarer til den?

27

Hvor sannsynlig er det at du ville lastet ned denne appen dersom den ble tilgjengelig?

- Veldig usannsynlig
- Ganske usannsynlig
- Hverken sannsynlig eller usannsynlig
- Ganske sannsynlig
- Veldig sannsynlig

28

Var det noe du savnet ved appen? Eller har du andre synspunkter eller kommentarer til den?

Info

Mange takk for hjelpen og flott innsats!

Husk å klikke "Send inn svarene" når du er ferdig.

Mange takk for hjelpen! Hvis du har spørsmål eller kommentarer vil vi gjerne høre dem. Ring 90 91 24 72 eller send en epost til post@faktumanalyse.no

Appendix 5: Consumers' perceived household food waste

Table 1. Consumers' perceived household food waste (below is percentages). Source: De Hooge et al. (2017).

If you would try to estimate your own household, how much of the following food that you buy or cook ends up being thrown away at home?						
	All countries	Denmark	Germany	Norway	Sweden	The Netherlands
Fresh fruit and vegetables	15,5	15,1	15,7	14,7	14,1	17,9
Milk and dairy products	11,3	10,9	12,3	10,1	9,1	14,4
Bread and other bakery products	14,1	14,4	14,9	13,6	11,9	15,5
Meat and fish	9,3	8,6	10,2	8,6	6,7	12,4
Prepared meals / dishes (leftovers)	16,1	12,1	17,8	16,3	14,1	20,1



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