Chatbots As A Mean To Motivate Behavior Change

How To Inspire Pro-Environmental Attitude with Chatbot Interfaces

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In loving memory of my dear parents, Katarina and Göran Åberg.
You are deeply missed.

Abstract

With an expanding access of decision supporting technologies and a growing demand for lowered carbon dioxide emissions, sustainable development with the help of modern interfaces has become a subject for discussion. There are different opinions on how to motivate users to live more pro-environmentally and to lower their carbon dioxide emissions with modern technology. This paper analyses the use of chatbots as a mean to motivate people to live more sustainable lives.

To evaluate the field, a literature study was conducted covering eco-feedback technology, recommender systems, conversational user interfaces, and motivation for pro-environmental behavior. The effect of motivational factors from behavioral psychology were tested, and their impact on peoples food consumption habits. The findings of this paper were based on three chatbot prototypes; one that is built on the motivational factor of information, a second one that is implemented on the motivational factor of goal-setting, and a third one that follows the motivational factor of comparison.

Twenty-seven persons participated in the study, seven people at the early stages of the project, and twenty people that used the chatbots. The user experience of the chatbots was evaluated, resulting in guidelines on how to design for chatbot interfaces and behavior change. The result from the user interviews indicates that chatbots can affect and motivate people to consume food in a more sustainable way.

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Chapter 1

Introduction

Ever since the beginning of civilization, human existence have been defined by the choices people make. Every second of every day people have been making choices [1]. The supermarket has always been a place where people tend to make many decisions and the choices made there can have a big impact on the environment. The food system today is undermining the environment and contributes to 20-30 percent of greenhouse-gas emissions [2, 3]. Thus, what people decide to have for dinner can affect the climate more, than if they choose to take the car instead of a bike to the store. Various technological advances have contributed to the ability of supporting and motivating these decisions in a completely new way [4, 5, 6]. Technologies such as artificial intelligence, conversational user interfaces, speech recognition accuracy, and the developments of smart-phones and other intelligent devices.

With an expanding access of decision supporting technologies and a growing demand for lowered carbon dioxide emissions, sustainable development with the help of modern interfaces has become a subject for discussion [4, 5, 7]. According to earlier work by Blevis [7] sustainability should be a central focus of interaction design. He defines design as an act of informing choices of future ways of being, and discusses the importance of invention, disposal, renewal and reuse. Froelich, J., et al. [8] explores the use of ambient displays on mobile phones to give users feedback about sensed and self-reported transportation behaviors. They developed and tested a system called UbiGreen Transportation Display, a mobile application prototype that semi-automatically senses and reveals information about transportation behavior. Their result show that feedback from ambient displays can change user behavior [8]. Steg, L., et al. [9] states that hedonic values are highly related to environmentally relevant behaviours as well and that these need to be considered when talking about sustainable decisions [9]. Woodruff, A., et al. [10] discusses that the efforts to be environmentally responsible require significant dedication of time and attention from people, and that interactive technologies can be an influential factor in order to facilitate

environmental believes [10].

It is challenging to help people live more sustainable lives by changing their habits and the way they consume food. Several studies have been conducted on topics such as pro-environmental[1] decision making and eco-feedback technology [5, 7, 10, 11], but none of these have focused actively on motivating people to take sustainable decisions with conversational user interfaces today. This topic deserves our attention as it becomes more urgent for us to take action against climate change [12, 13].

1.1 Goals & Objectives

The overall goal of this study is to get a better understanding on how to motivate behavior change with the help of modern user interfaces. To achieve this, research is going to be conducted to explore different methods and possibilities to motivate people in taking more sustainable decisions with the help of conversational user interfaces. This includes a literature study, interviews, prototyping, testing and developing. The literature study and the interviews will be carried out to gain a deeper understanding of fields such as eco-feedback technology, motivation, conversational user interfaces, and sustainable development. Prototypes will then be developed in order to apply the knowledge that has been gathered to a real situation. These prototypes will be user tested and evaluated with the help of background research to see if they can be used to motivate people to live more sustainable lives and consume food in a pro-environmental way. In the end of this thesis, the following question is going to be answered: can people's pro-environmental motivation be increased with conversational user interfaces?

The aim of this study is to explore new ways that people can interact with decision supporting and motivating technology. In the end of this study, guidelines are going to be presented. These guidelines can help designers build interfaces that motivate people to consume environmentally friendly food and thus, live more sustainable lives.

1.2 Outline

The remainder of this report consists of 7 chapters and they are structured as follows. In the next section the background theory behind this paper is described; a review of earlier studies and their results will be given. Afterwards the method of this thesis will be reviewed, followed by the result and a discussion. In the discussion proposed design guidelines for chatbot interfaces and behavior change will be given. The paper ends with a conclusion, an outlook

[1] The act of consciously seeking to minimize the negative impact on the environment.

on future work, and an acknowledgement to all of those who have helped in the development of this study.

1.3 Daresay

This study is conducted in collaboration with Daresay. Daresay is an award winning design and innovation agency with more than 70 employees in Umeå and Stockholm. They are working with leading global companies to create compelling experiences that bridge digital and physical domains. Daresay operates at the intersection of technology, design and business with a vision to improve the quality of life for people around the world through the digital services they use.

Daresay is a company were sustainability and sustainable development is vital. They work with the United Nation's 17 Global Goals for sustainable development in everything they do and the goals are a big part of both their working process and company culture. Thus, the sustainability aspect is an important part of this master thesis as well.

Chapter 2

Background

The following chapter consists of five sections: 2.1 Sustainability & Food Consumption, 2.2 Eco-Feedback Technology, 2.3 Recommender System, 2.4 Motivation, and 2.5 Conversational User Interfaces. Here the background theory is introduced, which is useful to understand the rest of this thesis.

2.1 Sustainability & Food Consumption

Sustainable development is defined as the process when human development meets the needs of the present without compromising the ability of future generations to meet their needs [14]. In September 2015, world leaders agreed to 17 Global Goals for sustainable development [12]. One of these goals were to fight climate change and to take action against its impacts. In a report by Naturvårdsverket [15], they state that carbon dioxide emissions need to decrease with 50 percent until 2050. If the world cannot meet these goals the global temperature is expected to increase with more than 2 degrees, which will have severe impacts on the climate [15]. The European Union believes that innovation and technology are keys to achieve these goals and to lower carbon dioxide emissions [13].

According to Naturvårdsverket [15], households are responsible for almost half of the carbon dioxide emissions. This means that decisions such as what to eat for dinner, how to travel, and how to use electricity, plays major roles for climate change. A big problem is that people only have a vague idea of how big impact their actions and choices actually have on the environment. Thus, they do not know what sort of difference they could make by changing their day-to-day behavior [16]. In a study by Pierce et al. [16], participants showed little knowledge in how energy consumption and carbon dioxide emissions were distributed at home. Thus, making it hard for inhabitants to know where and

how to make a change in order to actively reduce their climate impact. Åström et al. [17] conclude that policy makers need to discuss how to influence people's consumption habits. According to them it is more important to focus the problem on what people eat rather than if it is locally grown, or how the food was produced and transported.

2.2 Eco-Feedback Technology

According to Froehlich et al. [5] eco-feedback technology is a field of Human Computer Interaction (HCI) that primarily seeks to fulfill human needs while causing minimal environmental disruption. It can be defined as technology that provides feedback on individual or group behaviors with a goal of reducing environmental impact [5]. Eco-feedback technology is based on the assumption that most people lack awareness and understanding of how their everyday habits affect the environment [5, 16]. The goal of eco-feedback technology is to bridge the environmental literacy gap, and thus influence peoples environmental behavior.

Eco-feedback technology may be seen as a modern field of research, but it actually extends back to more than forty years of environmental psychology studies [5]. Studies from the 1970's have shown that eco-feedback technology can affect people's energy consumption and carbon dioxide emissions [18]. Kohlenberg et al. [18] showed that a light bulb, which switched on when a household reached their peak energy levels, actually changed energy usage behaviors. Today HCI and ubiquitous computing[1] researchers have done studies in a wide variety of domains such as energy consumption, carbon dioxide emissions, water usage, transportation and waste disposal practices [5].

2.3 Recommender System

Recommender systems are IT-based support systems. They act as personalized decision guides for users and aids them in decisions that has to do with personal preferences [19]. User interaction with a recommender system typically involves some input to the system, which the system then processes, and gives suggestions to the user based up on [19]. Most people have been in contact with recommender systems through the web [19], but with a wider expansion of context-aware technologies, they are probably going to be more common in everyday lives [4].

Most work in recommendation and recommender systems falls into two broad classes: content-based recommender systems and collaborative filtering recom-

[1] Ubiquitous computing is a concept in software engineering and computer science where computing is made to appear anytime and everywhere

mender systems. Content based recommendations are based on the activities of the active user [4, 20]. For example, it models users by the characteristics of the items they like or dislike and compares the description of an item to the profile of a user and recommends based upon that [20]. Collaborative filtering helps people make decisions that are based on the opinions of other people, who share the same interests [4, 21]. It assumes that two users who agree about one item are more likely to agree about another item. Collaborative filtering can also give recommendations based on items that a user has shown interest for in the past [21].

There are previous studies that have focused on methods for conversational recommendations. Christakopoulou et al. [22] discuss recommender systems that can converse with new users to quickly learn their preferences. They propose a framework that can make very effective use of user feedback and improve personalized recommendations. In a study by Lindén et al. [23] a conversational travel agent is proposed that helps users find an optimal trip, and through conversation allows them to express and modify it to their requirements.

2.4 Motivation

Motivation is commonly known as the driving force that enables certain behaviors [24]. It can be defined as people's direction to behavior and is many times the reason for human actions, desires and needs. Studying motivation has always led to one important question [24], how to measure it? Fishbach and Tillery [25] tries to answer this question. They distinguish between two types of motivation; process-focused motivation and outcome-focused motivation. Process-focused motivation refers to the dimensions of motivation that relates to the process of pursuing a goal, with less consideration on the goal completion itself. This could be factors such as enjoyment, boost or an enhanced self-image [25]. Process-focused motivation can for example be measured by the time an individual spends on a task. If a person spends more time on a project because they find it fulfilling, it is often a proof of high process-focused motivation [25]. Outcome-focused motivation describes the motivation to attain the desired end-state of a process, such as passing an exam or make money [25]. Outcome-focused motivation can be measured in many ways. For example by examining how a person considers taking a walk instead of driving a car to work. In this case an environmentally friendly person would probably consider taking a walk more positively than a less environmentally friendly person.

In a study by Intille [26], he suggests that there are five components of presenting messages to motivate behavior change effectively:

1. Present a simple, tailored message that is easy to understand.
2. The message should be presented at an appropriate time.

3. The message should be presented at an appropriate place.
4. It should also be presented using a nonirritating, engaging and tailored strategy.
5. It should be presented repeatedly and consistently.

Intille [26] concludes that presenting information repeatedly and consistently may be the greatest ubiquitous computing challenge. To prevent a message becoming annoying is to ensure that the message has a high value for its user and that the message does not appear judgemental [26].

According to Noy et al. [27] it is very difficult to say how much would be gained if people were motivated to adopt a sustainable lifestyle [27]. According to them there are many reasons for people to not be environmentally motivated. Such as lack of time, lack of assertiveness, and the challenge in having to change habits [27]. In a study by Steg et al. [9] they address the issue that hedonic values often get in the way of environmental motivation, for example long showers and car use. They also show that it is very important to include both egoistic and hedonic values in environmental studies to better understand individual attitudes, choices and motivations. Possible hedonic consequences can stand as big barriers for behavior change [9].

2.4.1 Models of Pro-Environmental Behavior

Understanding what engages people to be pro-environmental is a question yet to be answered. It is a very abstract topic that spans across many disciplines. Kollmuss and Agyeman [28] describes a few of the most commonly used frameworks that tries to explain the path from a persons possession of environmental knowledge to pro-environmental behavior. According to them pro-environmental behavior can be divided into two main categories; the rational choice models and the norm-activation models. The rational choice models includes a basic assumption that people act rationally in accordance with their self-interest, in the norm-activation models focus is on a pro-social model that explains altruistic and environmentally friendly behavior [28].

Rational Choice Models

The earliest models of pro-environmental behavior can be categorized as rational choice models [28]. These were based on a linear progression of environmental knowledge leading to environmental awareness, which in turn was thought to lead to pro-environmental behavior [28]. The oldest and simplest of these models are often referred to as attitude models [5]. A key issue with attitude models is that any other number of factors may also influence pro-environmental behavior. Research has shown that an increase in knowledge and awareness does not necessarily mean an increase in pro-environmental behavior [28, 29].

One of the more recent models is one called the model of responsible environmental behavior [30], which tries to account for more factors. Hines et al. [30] developed this model based on earlier pro-environmental studies. Their model brought attention to the fact that both knowledge of issues and of appropriate action were important factors in whether attitudes actually could form pro-environmental behavior.

There is also a rational choice model called the rational-economic model which assumes that people act primarily to maximize rewards and minimize costs [5]. Froehlich et al [5] discuss the issues with this model. They conclude that the pit-falls of this model is that it assumes that people understand whether or not a behavior or a device is pro-environmental, which is not always the case. Another issue with the rational-economic model is that it discounts the effect of non-economic factors, such as altruistic and social values [5].

Norm-Activation Models

Norm-activation models differ from rational choice models in two ways [5]; they recognize that behavior may be rooted in altruistic values and that personal norm can change the perception of individual utility. Norm-activation models are also built upon the belief that personal or moral norms are determinants of pro-environmental behavior [31]. Schwartz [31] discuss that environmental action often involve social and collective norms, and how personal behaviors can affect others. He suggests that pro-environmental behavior can be simulated if a person is told the effects their behavior and responsibility can have on others [31].

2.4.2 Motivation for Pro-Environmental Behavior

There are many motivational factors that affect pro-environmental behavior. The following section summarizes the most commonly used motivational factors in the scientific community, and aims to find answers to the question of what motivates people to care for the environment.

Information

The most common way of motivating pro-environmental behavior is through information [32]. Climate change and its impacts is a problem that requires signaling, illustrating, and explaining by those who are experts [33]. Knowledge of issues and of action strategies can inspire people to be more environmentally friendly [28]. Information needs to be communicated with direct experiences, these have a stronger influence on people's behavior than indirect experiences [28]. It is also important that the information is easy to understand, trusted and presented as close as possible to the relevant choices [34].

Goal-Setting

Goal-setting is another well studied source of motivation. Goal-setting operates through a comparison of the present and the desirable future [35]. Locke and Latham [36] concluded that goal-setting theory focus on the core properties of an effective goal. These four properties are:

1. Goals serve a directive function. They direct attention and effort toward a goal.
2. Goals have an energizing function. They motivate people to do more. Goals that are set high often leads to greater effort.
3. Goals affect persistence. Difficult goals often prolong the effort.
4. Goals affect behavior indirectly. As individuals use, apply, and learn strategies to best accomplish the goal at hand.

Comparison

People are highly motivated by one another, and the actions of individuals are strongly shaped by surrounding people such as friends, colleagues and family [37]. They shape the way people think and how they ought to act, which can have an important role in reinforcing good [28]. If the surrounding culture and people propagates a sustainable lifestyle, pro-environmental behavior is more likely to occur [38]. A comparison between individuals or groups can be very useful in motivating action, especially when combined with feedback about performance [5].

Commitment

A commitment is a pledge or promise to behave in a specific way or attain a certain goal [5]. Gonzales et al. [39] showed that a person that expresses commitment towards a certain goal is more likely to pursue that behavior. There are three factors that impact behavior; the type of commitment that a person makes, the person or group to whom the commitment is made, and whether the commitment is public or private can play an important role [5].

Incentives

According to Geller et al. [40] incentives and disincentives are antecedent motivation techniques that come before a behavior, and rewards and penalties are consequence motivation techniques that come after a behavior. Incentives and rewards does not always have to be economical; status or convenience may also have important effects on pro-environmental behavior [5]. These factors can also

be necessary for people to think beyond themselves and to act pro-environmental [28, 41].

Relatable Experiences

Experiences that people can relate to motivates them more to pro-environmental behavior than experiences that they can not relate to [28]. Relatable experiences can in turn affect people's locus of control. The locus of control represents an individuals perception that their actions actually can make a difference [28]. To motivate people to live more pro-environmentally, certain techniques need to be adopted that puts them in bigger and more relatable pictures. For example by increasing identification with future generations to focus the problem on an identifiable future [42]. When doing so, research has shown that individuals are significantly more concerned when they are told about the burdens that future generations can be exposed to rather than the benefits [28, 38].

Feedback

One of the most important factors to motivate pro-environmental behavior is feedback. Feedback is needed to communicate some of the previously mentioned motivation techniques [5]. For example, goal-setting requires feedback to communicate performance towards a goal. Feedback can be divided into two main categories; low-level feedback and high-level feedback. Low-level feedback can provide direct and precise details about how to change specific behavior. High-level feedback is summative and can help improve performance towards a goal [8].

2.4.3 Barriers for Pro-Environmental Behavior

This section discusses the barriers between environmental concern and action, and the factors that stands in the way for people to act pro-environmental.

Comfort

Comfort can influence even the most environmentally concerned person. If stronger desires and needs are necessary they can conflict with pro-environmental actions [28]. For example, people's need to visit their family every Christmas overrides their environmental concerns in keeping traveling to a minimum.

Interest

Lack of interest or even laziness prevents some people from prioritizing the environment in their behavior [43]. Others just do not see themselves as the kind of person who would act upon the environment and therefore decide to not care [43].

Insignificance

Some people believe they cannot influence or affect the climate situation, which results in them not feeling any obligations to take responsibility for the environment [28].

Availability

Availability and infrastructure can be barriers for people to act pro-environmentally [33]. For example, few recycling bins and too little information stands in the way for people to act pro-environmentally. If people have to plan and travel far to sort their waste, it is less likely that they will do it [43]. Thus, making it an activity that can be perceived as stressful and sometimes time consuming.

2.5 Conversational User Interfaces

Before discussing conversational user interfaces a brief definition of conversation is needed. In the Oxford English Dictionary a conversation is defined as *a talk, especially an informal one, between two or more people, in which news and ideas are exchanged*. This definition suggests that initiative belongs to both sides of the conversation, Radlinski and Craswell [44] calls this mixed initiative.

Even though it is in the most recent years that conversational interfaces have gained widespread usage, they have been around for many years. Starting in the 1960's with text-based dialogue systems for questions and answers, and chatbots that simulated natural conversations [6]. Voice-based systems began to appear in the late 1980's and spoken dialog technology became a key area of research within the speech and language communities [6]. At the same time Voice User Interface (VUI) started to emerge and social robots that could mimic human expressions were developed. These human-like systems were developed in order to provide a more engaging interaction [6]. According to Radlinski and Craswell [44] a conversational system is an information retrieval system that permits a mixed-initiative between an agent and user, where the agent's actions are based on the conversation, using both short- and long-term knowledge of the user. They further discuss that a conversational system needs to have at least five properties:

- **User Revealment** - the system helps the user to express their needs.
- **System Revealment** - the system is clear with its capabilities to form user expectation of the system.
- **Mixed Initiative** - both system and user can take initiative for conversation.
- **Memory** - the user can reference past statements and the system understands.
- **Set Retrieval** - The system can reason about the utility of sets of complementary items.

2.5.1 Voice User Interfaces

A VUI is what a user interacts with when communicating with a device or system using their voice [6, 45]. Even though it is in the most recent years that speech recognition technology has gained wide spread usage, it has been around for almost a century [45]. The first success story was actually a children's toy, called Radio Rex in the beginning of the 20th century. Radio Rex could react and run upon its owner's call [45]. Today the technology has come a long way, and VUIs are often coupled with Intelligent Personal Assistants (IPA). An IPA is a software agent that can perform tasks or services for an individual. These tasks or services are based on user input, location awareness and the ability to access information from a variety of online sources. The user often interacts with an IPA through a VUI and today companies such as Google[2], Apple[3], Microsoft[4] and Amazon[5] have developed their own IPAs based on VUIs.

2.5.2 Chatbots

Chatbots produce natural responses to human user text inputs [6]. Chatbots are developed to trick the user into believing that they are conversing with another human [6]. To date most chatbots have been text based, but as new speech recognition technology has evolved more chatbots make use of speech as input and output [6]. It is most common that the chatbot responds to user input rather then being the initiator of the conversation [6].

Chatbots were first developed in the 1960's. Weizenbaum [46] developed a system called ELIZA, which simulates a psychotherapist. ELIZA was mainly created to demonstrate the superficiality of communication between man and machine [6]. Today chatbots are increasingly being used in areas such as education, information retrieval, business and e-commerce.

[2]For more information, see https://assistant.google.com/
[3]http://www.apple.com/se/ios/siri/
[4]https://www.microsoft.com/en-us/mobile/experiences/cortana/
[5]https://developer.amazon.com/alexa

According to McTear et al. [6] a conversational chatbot interface should operate as follows:

- Recognize the text that was sent by the user.
- Interpret the words and discover what the user meant with this input
- Formulate a response, or if the message was unclear, interact with the user to find clarification.
- Construct the response, which may be in the form of words or, as in the examples above, accompanied by visual and other types of information
- Display the response

2.5.3 Messenger Bots

In April 2016, Facebook released their chatbot feature in Messenger[6]. The main purpose was to increase people's experience with the platform and to let businesses reach out to their customers in a completely new way [47]. To make it easier for developers and designers to build beautiful and consistent messenger bots that allows for a unified experience, Facebook released design guidelines to follow [48]. The messenger bot design guidelines are organized under three main headings:

Design Principles

Facebook [48] suggest that bots should **be brief**. Since most people use messenger on their phone, interruptions should be expected. The easiest way to address this according to Facebook [48] is to keep interactions short and concise. When that is not possible, developers and designers should consider how to maintain and reestablish context. Facebook [48] also advice to **avoid modality**; modality can create confusion and frustration for the users if they are interrupted in the middle of a task. Furthermore, **conversations and graphical user interfaces (GUIs) should be mixed** in the bots; Facebook offers a range of components, and these should be used depending on the bots functionalities and capabilities. It is also important to **observe conversational norms** and Facebook highlights the relevance to be deliberate about language, editorial voice, length of messages, and even speed of response. **Embracing structure** is also important when building a messenger bot. Making use of buttons, quick replies, and the persistent menu to structure user interactions while clearly communicating expectations. Moreover, Facebooks highlights the importance of developing a bot that **notifies with care**, **fails gracefully**, and is **predictable** in its interactions [48].

[6]For more information, see https://www.messenger.com/

Language & Editorial Voice

Because bot interactions take place on Messenger, a messaging platform, the words used are important in explaining the experience a bot provides and why people should use it. Thus, Facebook suggest methods for writing interactions and best practices [48]. As writing best practices they suggest that it is important to **preserve a voice**, **set user expectations**, and to **provide context**. The bots voice or way of communication reflects its personality; it is essential to be consistent with it, in a tone that feels natural and human. It should also be easy for users to know what the bot can, or can not do, in order to set the correct user expectations. Further, bots should be as descriptive as possible to communicate core functionality; to build an understanding of the experience the bot creates, content should guide users every step of the way.

Facebook [48] also suggest designers and developers to design conversations before launching a chatbot. This can be done by starting to build a library of prompts and responses. According to them it is important to think about the goals and possible outcomes of a conversation, they also emphasis on creating a list of keywords to really get an overview of terms associated with the bot. Facebook [48] also believe that mapping out interactions is a good idea, mapping gives a good overview of the tasks, expectations and contexts to establish with the bot. User responses can later be used to expand functionalities and capabilities [48].

Tips for Sounding More Conversational

In the end of their guidelines, Facebook gives tips on how to sound more conversational in writing [48]. They emphasize on the importance of the chatbots style of writing; it has to converse in a way that its utility is not misrepresented or core capabilities are misunderstood. Furthermore, Facebook state that a conversational tone should support an experience, not define it [48]. They give some simple suggestions in how to implement a conversational tone in a chatbot by using an active voice, contractions of words, write in first and second person, to be careful with grammar and punctuation, and lastly the usage of a certain tone. The chatbots voice is its personality and the tone is how that personality is expressed [48].

Chapter 3

Method

The Method chapter consists of six main sections: 3.1 Introduction, 3.2 Design Process, 3.3 Analyze & Idea Generation, 3.4 Conversational Design, 3.5 Chatbot Prototypes, and 3.6 User Testing & Evaluation.

3.1 Introduction

In order to answer the thesis question, this project was divided into several stages. The project started with a literature analysis on previous work and interviews were conducted to get a better understanding of people's thoughts about sustainability and environmental care. A target group was then identified, and a design process was formed. Last of all the findings were summarized, analysed and concluded.

This chapter covers the design process that was used during the project. It will cover the work-flow, where it was executed, and how the results were retrieved. These results were later used as a method to create guidelines on how to motivate people with the help of conversational user interfaces.

3.2 Design Process

The design process was constructed towards the scope of this project. The process was based on methods proposed by Hartson and Pyla [49], and especially their lifecycle template *The Wheel* [49]. The Wheel is an iterative design process which consists of 4 main steps: analyze, design, prototype and evaluation. Before The Wheel starts, research is usually conducted in order to identify user needs and preferences. Research can be done through articles and qualitative semi-structured interviews. Then the qualitative data can be analysed, and

the requirements pinpointed. Once that is established the process continues with designing, prototyping and evaluating through every iteration [49]. For an illustration of the process used in this study, see figure 3.1.

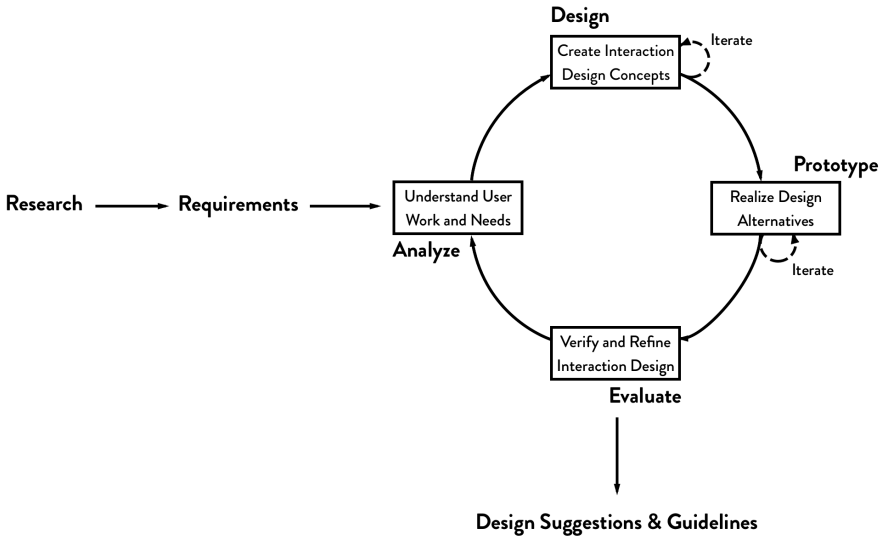

Figure 3.1: The Wheel; a life-cycle template illustrating the design process used in this study.

3.3 Analyze & Idea Generation

To find a suitable direction for the Master Thesis and to pinpoint specific problems with pro-environmental behavior. Multiple articles were read and analyzed, idea generating interviews were conducted and a scenario decisive workshop was held.

3.3.1 Literature Analysis

To gain more knowledge about pro-environmental behavior and motivation, numerous scientific articles and master theses were read and analyzed. When models for pro-environmental behavior and design principles for motivation were pinpointed, articles about eco-feedback technology, recommender system, conversational user interfaces and chatbots were examined. The literature was found by searching Google Scholar, the Umeå University library database, and through other search engines providing scientific material.

3.3.2 Interviews & Scenarios

Interviews were conducted at an early stage of the thesis to define the project. The goal of the interviews was to gain further understanding on how to design for pro-environmental behavior, thus a semi-structured interview method was chosen [50]. A semi-structured interview allows the interviewer to ask follow-up questions in order to go to the depths of the interviewees answers. This structure was chosen since it opens up for discussion and a better understanding of the interviewees answers [50].

The overall structure of the interview was inspired by the one proposed by Hall [51]. She suggests that an interview of users should be built up by three loosely joined boxes; an introduction, a body and a conclusion. The introduction is a warm-up that makes the interviewee feel comfortable. In the introduction the purpose of the conversation is stated and it is clarified how the information will be used and shared [51]. The body is where the semi-structured interview was conducted. Follow-up questions such as "Why?" and "Tell me more about that" were used. The conclusion is where the interview was wrapped up and finished by asking if the interviewee wanted to add something. They were then thanked for their time and help.

In the end of the body of the interviews, a small introduction to conversational user interfaces was made and four scenarios[1] were read to the interviewees. The goal of these scenarios was to engage the users [52] and to get a quick understanding of how they would perceive conversational user interfaces at home.

The interviews were audio recorded in order to eliminate any risk of missing important information while taking notes. This was done with the permission of the interviewees.

3.3.3 Workshop

A workshop was held with another master thesis student at Daresay. The objective of the workshop was to identify what pro-environmental scenario the chatbot would target. The workshop lasted for one hour and discussed which scenario that was most suitable for a pro-environmental chatbot service. The workshop also discussed which motivational factors that could be implemented into the service, how it was going to be implemented, and how the tests were going to be performed. Different scenarios were written on a whiteboard, one by one, where advantages and disadvantages were discussed. The scenarios were then compared, and the less suitable ones were erased until there was only one left.

[1] Scenarios describe the stories and context of how a specific technology is used. They note the goals and questions to be achieved and define the possibilities of how a user can achieve them.

3.3.4 Target Group

To narrow down the research and provide a higher level of detail, people between 20 and 30 years of age have been targeted in this study. People in this age group are more positive to behavior change [53], and experienced with modern technology such as smart-phones. This age group also forms the largest user group of Facebook Messenger[2] [54], which the chatbot was developed for.

3.4 Conversational Design

When the research and requirements were analysed and drawn. Inputs, observations and notes were compiled to get an overview of potential challenges and possibilities in developing a pro-environmental chatbot. In this way a clear definition of what was going to be designed and how it was going to be designed was created.

Since designing for conversational interfaces is a relatively new field of User Experience (UX) design, there were no certain standards to follow. The design phase was inspired by the guidelines provided by Facebook [48] and two articles written by Mariansky [55, 56]. He proposes a way of beginning to write the bots script and behavior. When the conversation flows started to get more complex the web-tool Twinery[3] was used. In this way a clear overview of possible outcomes, user behaviors and needs of the conversation were given.

3.5 Chatbot Prototypes

To be able to evaluate and determine the potential of conversational user interfaces as a motivational factor for pro-environmental behavior, prototypes were developed and tested in parallel with the design of the conversational flows. A prototype is often a draft version of the final product, which is great for rapid development and to early detect if an idea is worth spending time on [57]. At an early stage in the development phase it was decided that the chatbot was going to be launched on the Facebook Messenger platform. This platform was chosen because of the massive reach that it has; over 1.2 billion users since April 2017 [58]. Thus, launching the chatbots there made it easier to test the prototypes.

[2]For more information, see https://www.messenger.com/
[3]http://twinery.org/

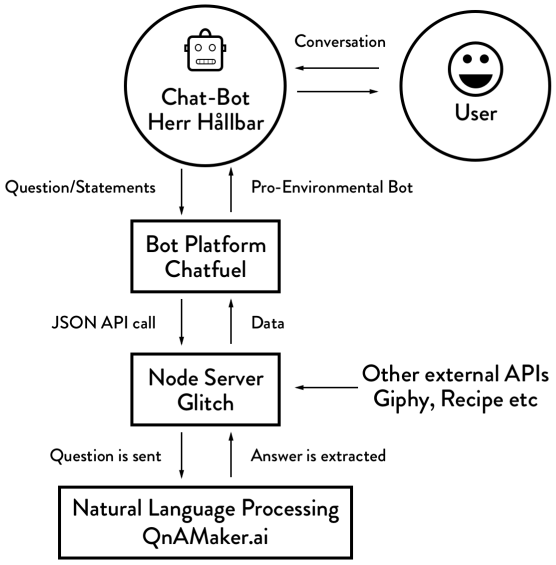

Figure 3.2: System context diagram of the different interacting tools and their role in the prototypes.

3.5.1 Tools

The tools that were used for the chatbot prototypes were Chatfuel[4], Glitch[5], and QnAMaker[6]. These services provide technology for quick chatbot prototyping. Chatfuel is great for all simple user flows, it is a graphical programming language that provides its users with a clear graphical user interface. Glitch is a NodeJS[7] environment hosted in a cloud where users can edit each file online. QnAMaker was used to build more complex interactions with natural language understanding. User input can be complex and sometimes the chatbot needs a better understanding of it. See figure 3.2 for a system context diagram.

3.5.2 Chatbots

This section discusses the different iterations of the chatbot prototyping. Three chatbot prototypes were developed following the motivational aspects mentioned in section 2.4.2.

[4]For more information, see https://chatfuel.com/
[5]https://glitch.com/
[6]https://qnamaker.ai/
[7]https://nodejs.org/

Informative Chatbot

The first iteration of the chatbot prototypes was the informative chatbot. The informative chatbot was developed by following the informational factor mentioned in section 2.4.2. This chatbot started a daily conversation with its users and gave them tips about how to consume food in a more sustainable way. The informative chatbot would for instance start a conversation about the positive aspect of eating vegetables instead of meat. Users were also given the chance to take initiative and give the bot feedback based on the information that it gave. The idea was to motivate people to pro-environmental food consumption by pushing information about different products to them.

Goal-Setting and Rewarding Chatbot

The second chatbot was the goal-setting chatbot. The goal-setting chatbot was mainly inspired by the motivational factor of goal-setting mentioned in section 2.4.2. But also had some influences from the factors of commitment and reward. The goal-setting chatbot set up weekly goals for its users, in order to commit them to consume food in a more pro-environmental way. It was decided that the chatbot would set up goals in order to make people eat more vegetarian food and thus, reduce their environmental impact.

Comparative Chatbot

The third and last iteration of the motivational chatbot prototypes were the comparative chatbot. The comparative chatbot compares its users to each other in order to shape user actions by surrounding people and to motivate behavior change. The comparative chatbot was designed to make comparisons on what the users ate, and the products they bought. The chatbot also communicated feedback about individual performance to increase motivation.

3.6 User Testing & Evaluation

Before the users were given access to the chatbot they were informed about the objectives of the chatbots and the tests. They were told that the chatbot was a pro-environmental food consumption bot that gives information on how to eat more sustainable. Furthermore, they were asked to focus primarily on the interface of the chatbot and how it expressed itself. The users were also informed that their conversation with the bot was going to be visible for the administrator, but that this information was not going to be shared with others. In the end of the introduction they were told that an interview was going to be conducted at the end of the week. At last they were asked if they agreed on these terms.

3.6.1 Interviews

As in the idea generating interviews a semi-structured method was chosen [50]. The interviews were performed to get a feeling for the test persons general thoughts about sustainable food consumption and their feelings towards the chatbot interface. The interviews were audio recorded in order to eliminate any risk of missing important information while taking notes, this was done with the permission of the interviewees. The interview questions are given under Appendix C.

Chapter 4

Results

The Results chapter consists of four main sections: 4.1 Analyze & Idea generation, 4.2 Informative Chatbot, 4.3 Goal-Setting Chatbot, and 4.4 Comparative Chatbot.

4.1 Analyze & Idea Generation

This section summarizes the result from the idea generating interviews and workshop.

4.1.1 Interviews & Scenarios

In total seven one hour interviews were conducted, all in Swedish (see Appendix A for the questions and Appendix B for the scenarios). Three interviews were conducted over Google Hangouts, while the other four was conducted at Sliperiet in Umeå.

Interviews

The idea generating interviews resulted in a broader understanding of people's definition of sustainability and what they saw as the most challenging factors for pro-environmental behavior. These challenges were summarized and generated four keywords that became a base for the project:

1. **Availability** - Acting pro-environmentally requires planning and research. The interviewees thought it was more difficult to act pro-environmentally than the other way around, thus leading to actions with a negative impact on the environment. For example the interviewees thought it was more

difficult to find environmentally friendly products at the grocery store. Which in turn makes it harder for people to buy groceries with a low impact on the environment.

2. **Adaption** - The interviewees found this to be one of the biggest challenges. They thought it was hard to constantly stay updated on what was considered to be pro-environmental, to be prepared for the ongoing changes, and to always adapt. For instance what was believed to be an environmentally friendly car five years ago is not environmentally friendly anymore. Another example that was discussed was that of milk; a couple of years ago people were told to drink milk, but today it has been proven to be bad for the climate. The interviewees thought it was hard to constantly be ready to break patterns and change habits in everyday life.
3. **Insignificance** - The interviewees thought it was hard to put themselves in a bigger picture. That their everyday actions actually had an impact on the environment as a whole. Sometimes they could get a feeling of powerlessness.
4. **Knowledge** - They also thought that they needed knowledge and information that they could trust. They thought it was hard to actually know that their actions was pro-environmental. This keyword correlates with the others in many ways.

Furthermore, the interviews showed the importance of surrounding people and friends. Most of the interviewees concluded that the social factor affected them the most when it comes to pro-environmental behavior. They discussed that their friends inspired them to act pro-environmentally. It was also noted from the interviews that people's feeling towards future generation was strong, they wanted their kids to be able to enjoy nature just as themselves today.

Scenarios

The scenarios conducted after each interview gave some useful insights in how a conversational user interface need to communicate information to its users. The scenarios showed that information need to be communicated at the right time, preferably in advance of action, so that people feel in control of making pro-environmental decisions or not. It was important for the interviewees that the conversational user interface did not tell them what to do, instead they wanted to be inspired. Furthermore, it was observed that the information needs to be communicated in a positive and engaging manner, and that it is of great benefit if the information put the user in a bigger, more relatable picture.

4.1.2 Workshop

Several ideas came up during the workshop, but in the end it was decided that food consumption was the most appropriate scenario for this thesis. Food is something that everyone consumes and the supermarket is a place that people tend to go several times a week. Thus, an area where there is great possibility to affect peoples pro-environmental decisions. It was decided that a chatbot was going to be prototyped in order to change peoples food consumption behavior.

4.1.3 Personality

From the idea generating interviews it was observed that many people wanted the information to be communicated in a positive and inspiring manner. The chatbots way of talking was therefore designed to be as positive and engaging as possible. The chatbot uses both emojis and GIFs to express its emotions. The chatbot also got a graphical appearance. Since its name was "Herr Hållbar" which translates to Sir Sustainable, it was designed to be a Sir with earthy colors of green and brown. The chatbots graphical appearance can be seen in figure 4.1.

Figure 4.1: First graphical appearance of the chatbot prototype. The chatbot was designed with earthy color and as a Sir since its name was Sir Sustainable.

4.2 Informative Chatbot

The following section summarizes the result from the design phase, prototyping phase and user tests of the informative chatbot. The informative chatbot was tested by six people, two women and four men with an average age of 25.5 years (ranging from 23 - 29). The tests were conducted in Swedish, since all the subjects understood written and spoken Swedish fluently. Three interviews were conducted over Google Hangouts[1] and three interviews at Umeå University.

4.2.1 Conversational Design

The informative chatbot was designed through iterations of writing and sketching conversational flows, the results obtained can be seen in figure 4.2 and 4.3. Figure 4.2 shows the welcoming flow of the chatbot. This flow was then used daily, but with different phrasing, to start a conversation with the users. Figure 4.3 shows the external features of the informative chatbot, for example "Find store" which helps the user to find the closest supermarket, "Help" which has some information about how the user can communicate with the bot and "Alternatives" which gives the users a set of alternatives on different subjects.

4.2.2 Prototype

The informative chatbot prototype was used as the first iteration to develop a sustainable food consumption chatbot. In figure 4.4 the welcoming flow, a conversational flow and the find store functionality of the chatbot is shown. All examples are given in Swedish, but gives an overview of how the chatbot interface looked like.

4.2.3 User Testing

People saw information and knowledge as the biggest challenges in consuming food sustainable today. They thought of the globalization of products as a big barrier in consuming products that had a low impact on the environment. The interviewees thought it was hard to know which products that are good for the environment, and how to retrieve this knowledge. To learn, people had to change their behavior, which as in the idea generating interviews was perceived as a big challenge.

The interviews of the informative chatbot showed that the information communicated by the bot was straight and clear. Emojis and GIFs clearly made the interface and the conversation feel more natural, and the bot more alive. An

[1] For more information, see https://hangouts.google.com/

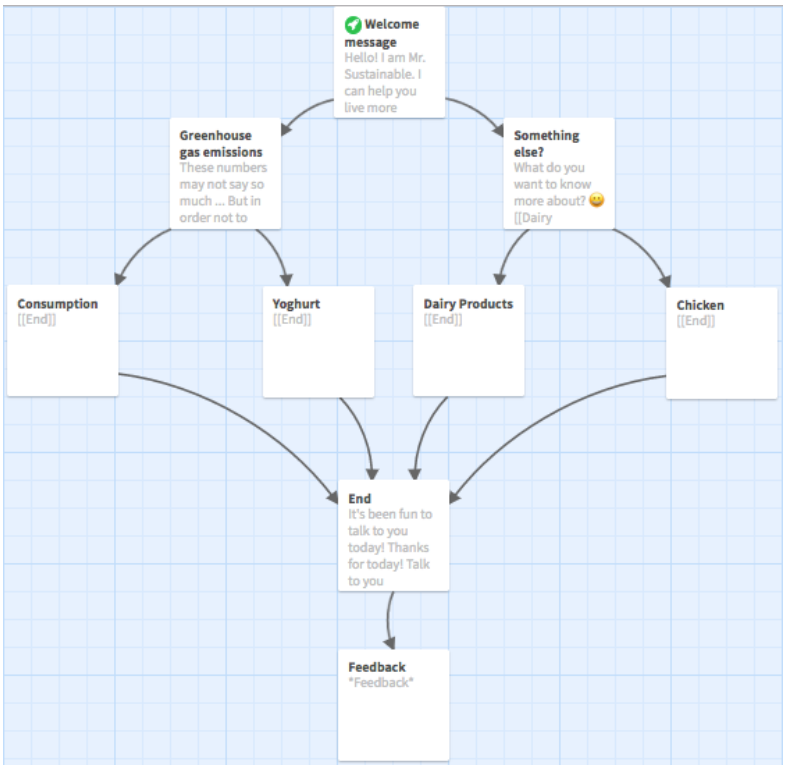

Figure 4.2: Welcome conversation flow. The chatbot introduces itself, its features, and starts a conversation with its users.

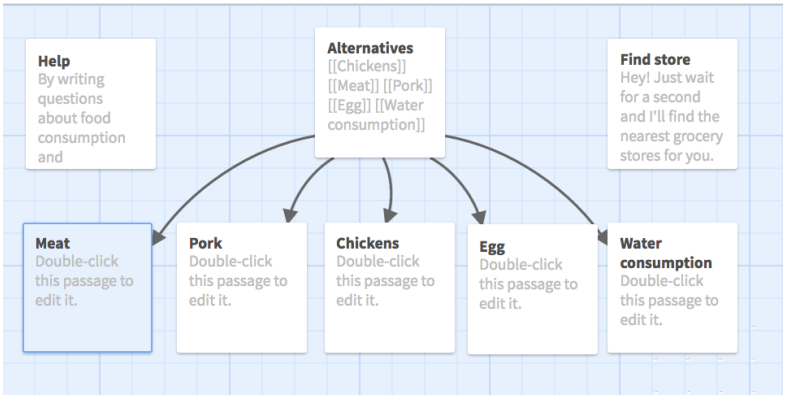

Figure 4.3: External functionality of the informative chatbot. "Help", "Find store", and "Alternatives".

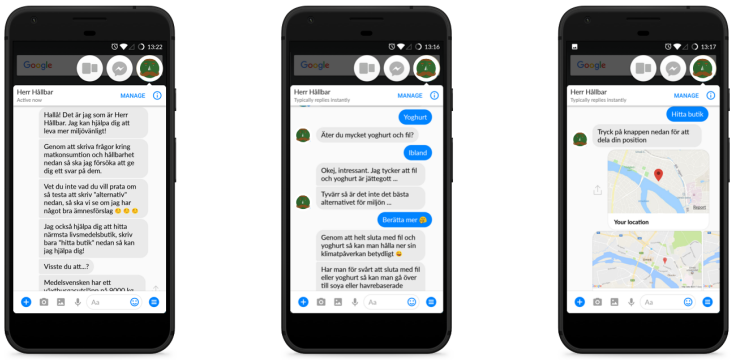

Figure 4.4: Overview of the informative chatbot interface. To the left, the welcome flow is shown. The screen in the middle shows a conversational flow. And to the right, the find store functionality of the chatbot is displayed.

interesting note was that people did not think of the bot as too human-like, this was perceived as positive since it lowered the user expectations of the chatbots functionalities and capabilities. The fact that the chatbot was aimed at a certain subject, in this case food consumption, was an aspect that increased user trust in the information communicated by the chatbot.

It was also observed from the interviews that it was important that the users did not feel locked to the interface. The test persons felt like it was important that they could steer the conversations just as much as the bot did. Mixed initiative was perceived to be important in order for the conversation to feel natural. It was also noted that it is important that the information communicated by the bot is short and concise, with more graphical elements. Users felt motivated by the information that the bot presented, but they also stated that the information need to be presented at a time when they are open for it. Users need to be receptive of the information in order for it to have an impact.

The main points taken to the next iteration of the chatbot prototypes were:

- **Trustworthy** - People felt like the information from the bot was well communicated and trustworthy. This was good as the informative part on how to consume food more sustainable was perceived as one of the biggest challenges.
- **Concise information** - Short and concise information. The bot should be more graphical with diagrams, infographics, GIFs and videos.
- **Mixed initiative** - Important to steer users, but at the same time make

them feel in control as well.

- **Follow-up questions** - People wanted the bot to dig deeper in some subjects. Follow up questions always make a conversation feel more natural.
- **Sustainable consciousness** - The chatbot should write more and at unexpected occasions. It should be more of a consciousness to its users.
- **Motivation** - People felt motivated by the informative chatbot, but it was observed that they needed additional triggers to change their behavior.

4.3 Goal-Setting Chatbot

The following section summarizes the result from the design phase, prototyping phase and user tests of the goal-setting chatbot. The goal-setting chatbot was tested by six new people, two women and four men with an average age of 25.66 years (ranging from 23 - 29). Interviews were conducted in Swedish, three interviews were conducted over Google Hangouts and three interviews at Umeå University.

4.3.1 Conversational Design

The goal-setting chatbot was designed based on the informative one. The informational part was not pushed up on the user, but only shown when users actually wanted to talk about sustainable food consumption. As in the informative chatbot the goal-setting bot also began by welcoming its users. The bot introduced itself and its features to set the right user expectations. Furthermore, the bot set up the goal of cooking at least four vegetarian dinners that week. The welcoming flow is shown in figure 4.5.

The goal-setting chatbot was designed to be much more repetitive than the informative one. The bot wrote three messages to the users each day in order to remind them about the weeks pro-environmental task. In figure 4.6 the morning conversational flow is shown. Every morning the chatbot asked its users if they wanted to discuss some sustainable food consumption, if the users wanted to talk they were redirected to the informational part of the chatbot and the conversation began. In the afternoon the chatbot wrote once again to remind its users about some of its features and capabilities, and the possibility of getting suggestions on both vegetarian and vegan recipes. The design of the afternoon flow can be seen in figure 4.7. In figure 4.8 the design of the evening flow is shown. In this flow the bot asked its users about what they had eaten for dinner and if it was vegetarian or not. If it was vegetarian the bot told the user of how many vegetarian dished they had eaten and how many was left to reach the weekly goal, otherwise they were encouraged to try again the next day.

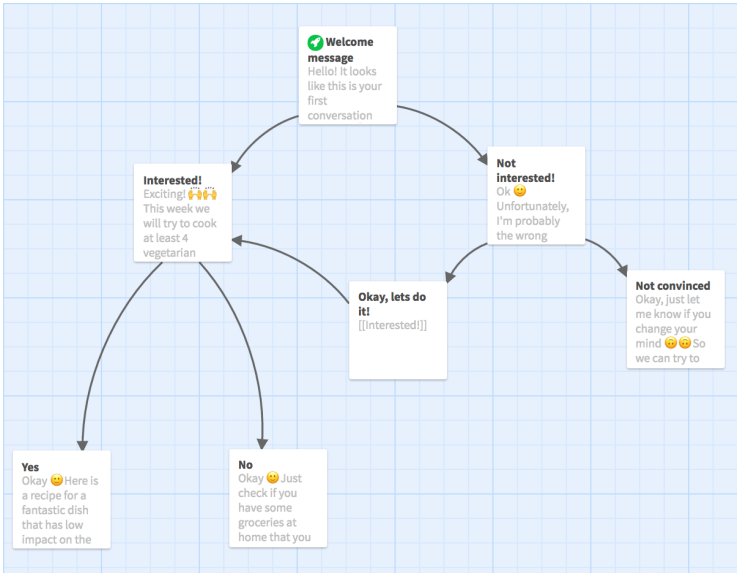

Figure 4.5: Welcome flow of goal-setting chatbot. The chatbot introduces itself, its features, the week's goal and how it was going to be obtained.

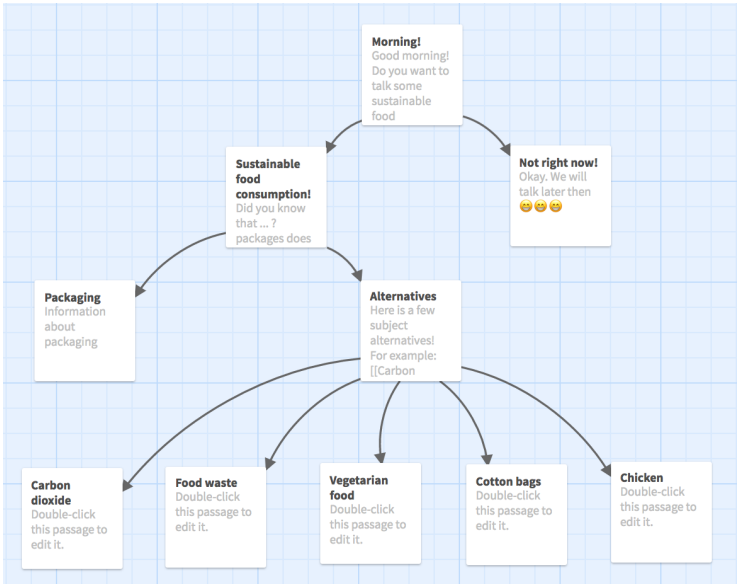

Figure 4.6: Morning conversational flow. The chatbot starts a conversation with its users and asks if they want to talk about sustainability.

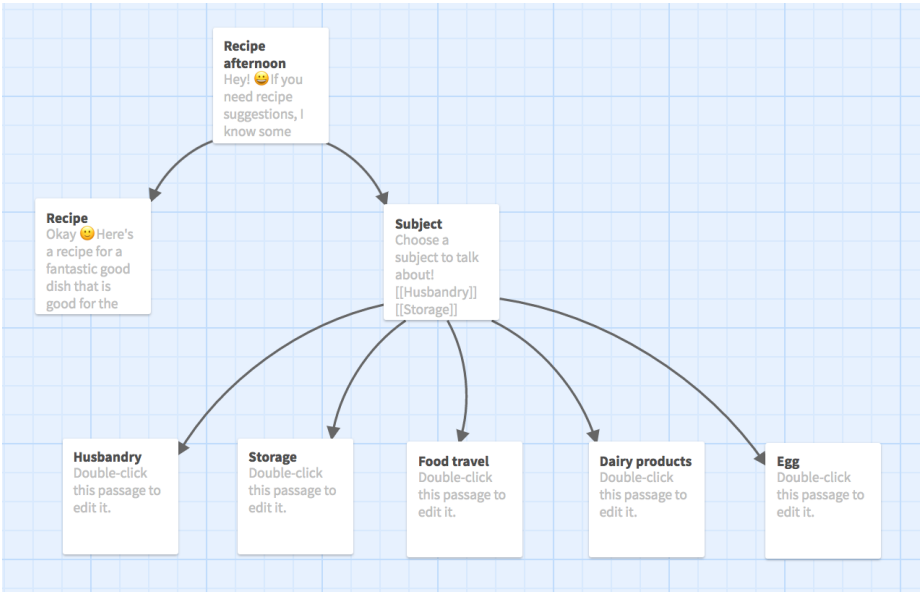

Figure 4.7: Afternoon conversational flow of goal-setting chatbot. The chatbot reminds the users about its features.

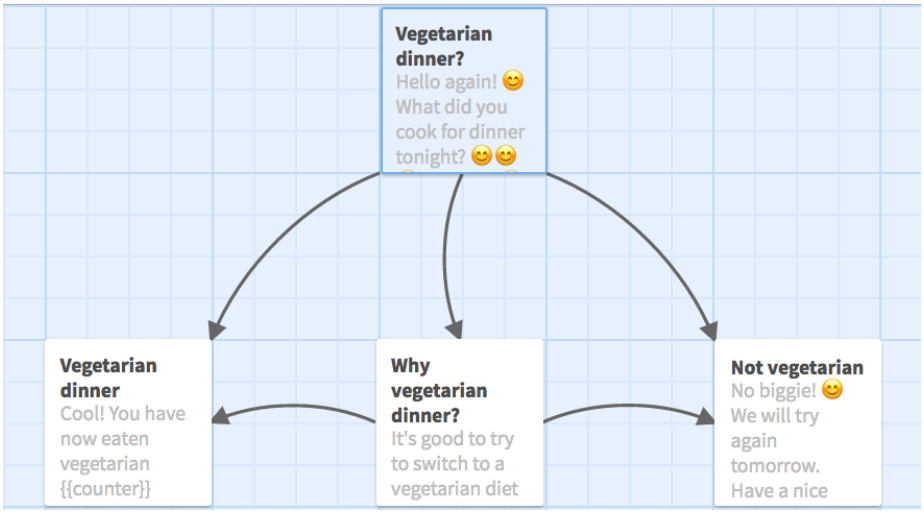

Figure 4.8: Evening conversational flow. The chatbot checks whether the user has eaten vegetarian or not.

4.3.2 Prototype

The goal-setting chatbot was used as the second iteration in the pro-environmental chatbot development. Figure 4.9 show different conversational scenarios. Fur-

thest to the left of figure 4.9 a print screen of the welcoming conversation from the chatbot is shown. Next to that the daily morning contact is displayed, where the bot asks the user if they want to talk about sustainability or not. The third screen shows the recipe functionality of the chatbot and the screen furthest to the right shows the daily ending flow. In the ending flow the bot asks its user if they had eaten vegetarian food or not; if they had the bot congratulated the user, if not they were encouraged to try again the next day.

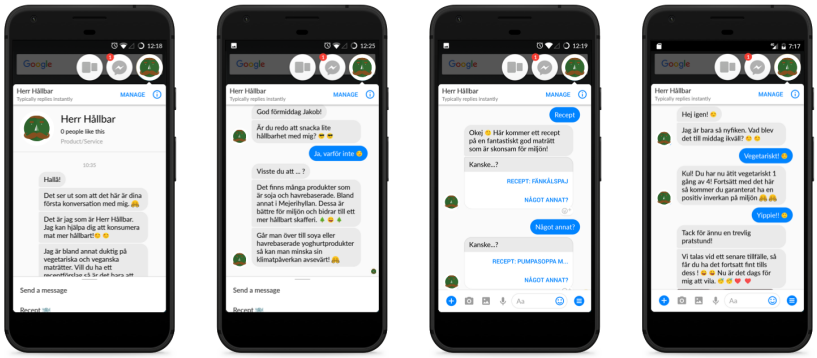

Figure 4.9: Print screens from conversational flows of the goal-setting chatbot. From left to right; welcoming -, morning -, recipe -, and evening flow.

4.3.3 User Testing

As in the informative chatbot interviews, people pinpointed information, knowledge and the need for behavior change as the main barriers in consuming sustainable food. They thought it was hard to find inspiration that led them to eat food with a lower impact on the environment. It was also noted that people would buy better products if information was more easily accessible, and if they were put in the bigger picture. The interviewees also mentioned the social aspects of eating pro-environmental food and that their family, friends and relatives affect them when it comes to day-to-day behavior.

When discussing the interface of the chatbot people were very positive to the goal-setting functionality. Many had felt more motivated to buy better products and vegetarian food to lower their climate impact. People also liked the recipes and the general interaction possibilities of the chatbot. An interesting note was that people also wanted an ending to the conversation with the chatbot, especially in the informative flow. If there was an ending after a certain amount of facts, some users stated that they would feel more obligated to start and end

a conversation with the chatbot. Another interesting note was that some test persons felt like it was going to be useful if the users also had the opportunity to introduce themselves. The graphical appearance of the chatbot was also discussed and some users did not feel like the looks of it, coincided with its conversational tone.

The main points taken to the next iteration of the chatbot prototypes were:

- **User introductions** - Users should also be able to introduce themselves to increase the band between the user and chatbot.
- **More use of buttons** - More use of buttons as an interaction tool. People are more comfortable with buttons than writing their own text.
- **Recipe functionality** - Recipes are a great trigger that inspires and motivates people. Makes it more comfortable for them to change their behavior.
- **Conversational endings** - Conversations should have an ending so that users can expect how long a conversation is going to be.
- **Graphic representation** - Chatbots graphic identity must coincide with its conversational identity.
- **Points** - A more complex scoring system could be useful. A quiz on the shared information is conducted at the end of each day in order to motivate people to learn the facts.
- **Weekly shopping list** - Together with the user arrange a sustainable shopping list for that week.
- **Motivation** - People felt highly motivated by the goal-setting chatbot. Interviews showed that the bot had an impact on peoples food consumption habits.

4.4 Comparative Chatbot

The following section summarizes the result from the design phase, prototyping phase and user tests of the comparative chatbot. The comparative chatbot was tested by seven people, four women and three men with an average age of 25 years (ranging from 22 - 28). Interviews were conducted in Swedish, one interview was conducted over Google Hangouts and the other six at Umeå University.

4.4.1 Graphical Appearance

From the results of the goal-setting chatbot, it was decided that the graphical appearance was going to be updated. Since some users believed that the appear-

ance did not coincide with its tone of speaking, the chatbots face was designed to express more positivity than the previous one. The updated appearance can be seen in figure 4.10.

Figure 4.10: Updated graphical appearance of the chatbot prototype. This iteration was designed with brighter colors and a smiling face to express more positivity than the previous look.

4.4.2 Conversational Design

The comparative chatbot was designed with similar base functionality as the goal-setting chatbot, but instead of setting up goals for its users this bot was designed to compare its users to each other. The comparative chatbot made comparisons on what the users ate, the products they bought, and it also shared recipes between users in order to create more of a community. In figure 4.11 one of the comparative flows is shown.

Figure 4.11: Comparative after-noon conversational flow of the chatbot. The chatbot asks users if they usually think about buying seasonal food, and compares their responds.

4.4.3 Prototype

The comparative chatbot was used as the third and final iteration in the development of a pro-environmental chatbot. Figure 4.12 show print screens from different conversational flows of this chatbot. The print screen to the right show how a morning conversational flow could look like, in this example the bot sets user expectations by letting them know that it best understands keywords

when conversing. On the screen in the middle the bot gives examples on how to sort waste, and to the right the bot is comparing its users to each other. After it compares its users the conversation is ended and the chatbot says good night.

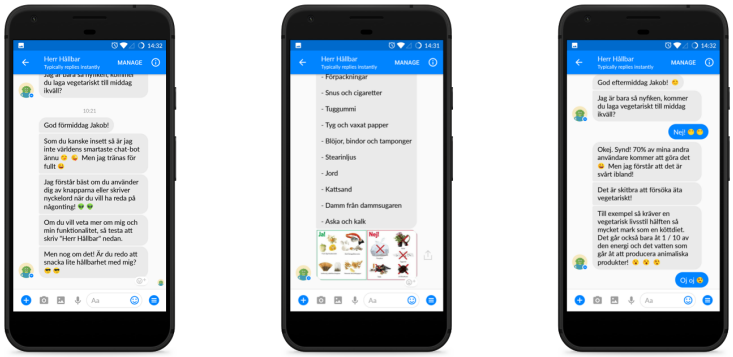

Figure 4.12: Print screens from conversational flows. From left to right; daily morning flow, waste sorting flow, and evening comparison flow.

4.4.4 User Testing

As in earlier interviews people defined eating sustainable food as making active choices when grocery shopping. Such as consuming vegetarian, ecological, locally produced, and seasonal food. The test persons also discussed planning, pricing, and information as major barriers for consuming sustainable food. They discussed that these barriers would be easier to break if prices were lower, information was presented in a more in-your-face kind of way, and that the information puts food consumption in relation to other activities.

When discussing the interface of the chatbot people were in general very positive. People thought that the recipe and waste sorting functionalities were great. The majority of users also enjoyed talking to the bot, because of its ease and fun personality. Emojis were discussed a lot; some of the users loved them and thought they added humanity to the bot, others believed that it was too much and that the chatbot could be perceived as childish. An interesting note was that some users felt an ethical obligation to tell the bot the truth and that they had a responsibility towards the chatbot. Phrases that was not related to the sustainable factors also increased the human characteristic of the chatbot according to some users.

The comparative functionality of the chatbot was perceived as both positive and negative. The comparison was thought to increase the group feeling for some users; they felt like they were a part of something bigger and felt responsibility towards others. But it also made some users feel sceptical; they felt omitted and a bit insecure when the chatbot compared them. They were not sure who the other users were and how their information was going to be used.

Another interesting observation was that people felt a lot of trust in the chatbot and the information it communicated, some stated that this was because of it being very human-like. The majority of users felt that the chatbot had an impact on their consuming behavior.

The main points noted from the comparative chatbot were:

- **Ethical obligation** - People felt trust in the chatbot and the information that it shared, and thus felt an obligation to tell the truth back.
- **Responsibility** - People felt a responsibility towards the chatbot. Almost as they were going to try to eat more sustainable for the chatbots sake, rather than the climates.
- **Comparison** - People had both negative and positive comments about the comparative functionality of the chatbot.
- **Motivation** - People felt motivated by the comparative chatbot. But its comparative functions and phrases has to be carefully implemented.

Chapter 5

Discussion

This chapter consists of three main sections: 5.1 Introduction, 5.2 Result Analysis, and 5.3 Guidelines.

5.1 Introduction

As mentioned in section 1.1 the purpose of this thesis was to get a better understanding on how to motivate behavior change with the help of conversational user interfaces and answer if people's pro-environmental behavior can be increased with conversational user interfaces. To answer this question, three chatbot prototypes were designed and developed based on different motivational factors. This chapter will cover an analysis of the retrieved results, which then will be followed by proposed guidelines when designing chatbots for behavior change and motivation.

5.2 Result Analysis

The results from the user tests gave a clear representation on how chatbots can be used to increase pro-environmental motivation. The informative chatbot did not only function as the first iteration of the chatbot prototyping. It was also used to find topics that users wanted to talk about, in order to create more complex conversational flows. From the results of the informative chatbot it was observed that people needed more than just facts to feel motivated. This is a confirmation on what previous studies have shown; that an increase in knowledge and awareness does not necessarily mean an increase in pro-environmental behavior [28, 29]. It is obvious from the user interviews that people need more than just information to keep interest in the chatbot. This is a big challenge;

how to keep users interested in the informative part and to make the chatbots catch attention of those people who really need to hear the facts. Although the majority of users stated that they felt that the informative part was motivating, many also stated that they probably would get tired of using the chatbots after a few weeks. However, it was obvious that users actually embraced the information shared by the chatbot. For instance, users suddenly started to discuss seasonal food in the interviews after a seasonal food conversation was added to the comparative chatbot.

When the goal-setting functionality was built up on the informative chatbot, it was apparent that users perceived it differently. An increase in interest was shown, and it was clear that the goal-setting functionality had an attractive force. This is also clear from the interviews, where the majority of users stated that they were motivated by the bot and the goals that it set. It is hard to say if users lied about them eating vegetarian food or not. However, it can be perceived as positive; both cases might show that users felt an obligation to do good in front of the chatbot and a willingness to change food consumption habits. Throughout the tests users expressed that they felt a responsibility towards the chatbot, which is very interesting and shows the social implications that technology with human characteristics can have.

When the comparative chatbot was tested it was noted that the users first felt stressed when compared to other people. But as they got more used to the bot writing and comparing them to other people they showed more at ease with the bots comparative functions. Comparing users can be very sensitive if it is communicated in the wrong way. If users perceive the feedback to be negative or puts them in an awkward position, they can feel omitted. On the other hand, it can be perceived as very positive if it can enhance the feeling of belonging and responsibility towards others. The result from the interviews also show that people felt a big trust towards the chatbot at the end of the tests. Users felt more and more comfortable with it, some even saw the chatbot as a companion or a buddy.

This study can not show any statistical evidence that there is a difference in motivation between the different prototypes. However, the result from the user interviews indicates that the comparative and goal-setting chatbots were more appreciated than the informative one. From the comparative prototype it was observed that users felt a bigger social impact from the chatbot than the previous two. This could mean that as the conversations of the chatbot developed, so did its motivational affection. Although the comparative bot made people feel responsible, the goal-setting chatbot showed most results when it comes to motivating people to consume food more sustainable. This could be due to the fact that it was the best prototype to keep user interest for one week. There is also a possibility that the goal-setting chatbot was perceived as most motivational, since it was developed based on more motivational principles. When goal-setting was added to the chatbot, the motivational factors of commitment and rewards automatically followed. Users expressed commitment to the goal

of eating vegetarian food for four days and they were rewarded by the chatbot if they made it. If these factors made users feel more motivated by the goal-setting chatbot than the other two is difficult to say.

5.3 Proposed Guidelines

The key findings of the result analysis are presented and summarized as two separate guidelines in the following sections. First of all, proposed guidelines on how to design chatbots will be presented. Then, guidelines that describe how to design for pro-environmental motivation and behavior change will be given. These guidelines have two main purposes; providing a quick step by step guide to chatbot design, and to influence other people in working to increase pro-environmental awareness.

5.3.1 How To Design for Chatbot Interfaces

Getting started with designing for conversational user interfaces can be a bit overwhelming. What is the best way to design for chatbot interfaces? Where do you start, how do you start and in what way should a prototype be iterated? This is some of the questions that arose during the developments of this project. In this section a proposed process of designing for conversational user interfaces is presented and summarized.

Define Goals

As for any service the goals and intents of the chatbot and users has to be defined at an early stage in the project. What user needs and problems are going to be solved with the chatbot? And how is it going to be solved with a chatbot? People are going to use the chatbot for a particular reason, pinpoint the reasons and let them be a groundwork for the continuation of the development process. Introductional open ended interviews can be a great way to start.

Keywords

Write down a list of keywords that corresponds to the goals of the users and the chatbot. These are going to be of great help when creating the conversational flow and the personality of the chatbot in the following steps.

Platform

Early on in the design process decide which platform the chatbot is going to be hosted at. This step is more important than one would think. Developing chatbots for different platforms can differ significantly when it comes to interaction possibilities, input-styles, placing of text, and room for text. Chatbot goals and user intent are key factors of choosing the right platform. If the chatbot needs to reach its user at any time of the day, messenger could be the right platform since people use it frequently. But if the chatbot is intended to reach its users at work, slack could be the better choice.

Simulate Chatbot with Wizard of Oz

Based on the goals and the keywords from previous steps simulate the chatbot on the chosen platform. Since chatbots are conversational, what better way is there to define the interactions than through a real conversation? A suggestion is to use the Wizard of Oz method. Wizard of Oz is a rapid prototyping method for systems that are to costly to build [59]. According to Maulsby et al [59] a wizard of Oz experiment is a test where a human simulates a systems functionality and interacts with an user through the interface.

Ask a couple of potential users if they would like to talk to a chatbot that can help with the goals stated in previous steps. Then start the dialog and write down the dialog flows. This will give a good idea of what people want to talk about to this certain chatbot. This is a good way of getting started with the conversational flows that a chatbot possibly can have.

Conversational Flows

Once some key conversational triggers are found the conversational flows can be designed. A great way to start is with a text-editor to just write down potential flows. When the scenarios are evolving to more complex ones, use Twinery go get a good overview of how it all comes together. In this way it is easy to give constructive critique to the flows early on before they have been implemented.

Chatbot Personality

Once the conversational flow of the chatbots is decided, create a chatbot personality. This step is very important because the graphical appearance and the tone that the chatbot has is going to reflect its personality. Thus, can lead to user emotions such as trust, motivation, and decide if the users wants to communicate with the chatbot.

Write Scripts

Last but not least, the chatbots script can be written. Facebooks [48] design guidelines mentioned in section 2.5.3 are good to follow. Key scenarios to have in mind here is the on-boarding process, to always have a fallback scripts if the chatbot does not understand user input, to have reminders if the users could not talk with the bot at a certain point, and be clear at all times. It is important that the users understand what they can and cannot do when interacting with the chatbot.

Bring it all together

Once the scripts have been written, the chatbot is fully developed. It has a personality, a tone, a graphical structure, a home in the shape of a platform, and it knows how to answer user input. Now the bot is ready to talk to its target group. Be ready to constantly change and improve the bots structure and conversational skills.

5.3.2 How To Design for Pro-Environmental Behavior

The main goal of this thesis was to present guidelines on how to motivate pro-environmental behavior with chatbot interfaces. In the following section these guidelines will be presented based on the interviews and tests of the chatbot prototypes.

Catch Interest

How to catch user interest is an important factor to think about when designing for pro-environmental behavior. The primary goal is to show users that they can affect the climate situation. To do so, pinpointing activities where they need to make a change is a great idea. But getting users involved in the problem and interested in the facts of climate change is a big challenge. It is important that the facts are communicated in other ways than pure text, it needs to be illustrated, displayed, and explained in an intuitive way that people understands. When people describe things, they often support their claims visually and chatbots should too. Information should be presented repetitive to remind users about the issue, but using a nonirritating, engaging and tailored strategy as mentioned by Intille [26]. People will not write themselves to this kind of service, the chatbot needs to be the initiative taker for conversations in order to catch interest and affect motivation.

Model Conversation After Users Preferences

To affect peoples pro-environmental behavior and design for behavior change, it requires modeling of the user. It was obvious from the user interviews that peoples perception of the chatbot varied significantly. It is important that the chatbot gets acquainted with the users personality in order to communicate sustainable information in a way that suits the user. Users either liked or disliked the emojis and gifs used by the chatbot. People that frequently used emojis in their text messages stated that they liked the chatbots way of communicating. And the people who did not felt that the chatbot could be perceived as a bit childish. Fogg [60] discuss that similarity is one of the most powerful persuasion principles. He concludes that conversational systems are more motivational if they can match the personality of the target user.

Positive Personality

Personality is crucial when developing for a pro-environmental chatbot. From the user tests it was obvious that people felt at ease when talking to the positive chatbot, despite the severity of the climate situation. Information should be communicated in a positive manner by a positive being. It is more likely to drive individuals to take action that benefits the climate with positive and good emotions, rather than with negative ones [33]. It is important that the information is conducive to engagement, fear and guilt can make people withdraw from the issue and try to think about something else [33].

Praise

Another important aspect of personality, language and motivation when it comes to behavior change, is to use praise. As seen from the result of the goal-setting and comparative chatbot, users felt good about themselves when they were praised. People have to be praised or encouraged when they manage a task or not. In the comparative chatbot the users that did not receive any praise felt ashamed and insufficient. Fogg [60] conclude that praise from a system or a computer can generate positive effects similar to the one from people. His research show that, offered sincerely or not, praise can affect people's attitudes and their behavior.

Graphical Appearence

It is important that the chatbots graphical appearance coincides with its personality. People are often drawn to things that they can relate to and for technology to have some kind of physical characteristic can be enough to convey social presence [60]. In the user interviews people stated the importance of

a good graphical appearance of the chatbot and how important is was for the user that the personality of the chatbot can be applied to a face. Attractive technology is believed to have an attractive force, people tend to like applications or services that they think are beautiful. Research has shown that it is easy to like, believe and follow attractive people [61]. This should therefore be applied to chatbot interfaces as well, in order to motivate and affect people's behaviors. Users may assume that a chatbot with an appearance that coincides with its personality, also is intelligent and reliable.

Spontaneous Messages

Even though climate change and sustainable development is a serious topic, it is important that there are spontaneous messages communicated by the chatbot. In the user interviews, people discussed how much more natural the chatbot felt when it used phrases such as *What a beautiful weather* or *How are you doing today?*. These small messages or psychological cues infer that the chatbot has emotion, and emotions can be used to motivate and persuade users to change behavior.

Responsibility

As seen in the interviews some people felt a responsibility towards the chatbot. This is interesting because it shows the strength and impact that chatbot and conversational user interfaces can have. Some people felt more responsible towards the chatbot then they did to the climate. The reason for this can be of the social rule of reciprocity, which is a social rule which states that after you receive a favor, you must pay it back [60]. Reciprocity may have occurred when users perceived that the chatbot was kind to them, and they felt a obligation to do "good back" for the chatbots sake. A great way to create reciprocity is through a kind tone and repetitive messages, in this way people feel responsible towards the chatbot.

Trigger Points

Trigger points was shown to have major impacts on the users. It is important to find features and functionality that is close to the goals of the chatbot and the behavior it is going to motivate. The recipe functionality of the sustainable food consumption chatbot was shown to be a big hit and a motivating factor for the users to eat pro-environmental food.

Chapter 6

Conclusions

The conclusions chapter consists of three main sections: 6.1 Chatbots As A Mean To Fight Climate Change, 6.2 Limitations, and 6.3 Future Work.

6.1 Chatbots As A Mean To Fight Climate Change

The guidelines found in this study can be used when developing chatbots for behavior change. The result show the social implications a chatbot interface can have on pro-environmental behavior and that these interfaces can be used as a mean to fight climate change. Simply having physical and emotional characteristic seems to be enough for technology to convey social presence. The impact of a chatbot or computer adopting a human role can surprise people, thus designing psychological and motivational cues into technology can raise many ethical questions. Is it wrong to trick users into believing that they are conversing with something that has human characteristics? Designers should be aware of the psychological impacts their products can have, and it is important that they implement appropriate psychological cues into their services. Users should not be persuaded or motivated in ways that can have negative consequences, or in ways that pressure users to do things that they actually do not want to.

Various technological advances in the most recent years have contributed to the rise of conversational interfaces and chatbots. Thus, designing for chatbots is a relatively new field of UX design and there are no certain standards to follow. When developing for chatbot interfaces designers have to rethink their process. Designing for Android, iOS or Web means that there is a lot of focus on style, fonts and colors. But in a chatbot interface these do not need to be taken into consideration at the same degree. The content is the style of the chatbot and the focus should be on how this content is communicated; with the personality and appearance of the chatbot. When testing a chatbot or conversational user

interfaces it is important that the users have the opportunity to get acquainted with the system in different ways. A chatbot has its own personality and just as humans it takes a while to get to know them. The first impression does not tell people how it behaves, how it communicates, what it knows and what it does not know. In this study it was therefore important that people had a chance to reflect over this kind of communication, and if they believed that it could have an impact on their pro-environmental behavior.

This study can not show any statistical evidence that people's pro-environmental behavior can be increased with conversational user interfaces or chatbots. However, the result from the user interviews indicates that chatbots can affect and motivate people to consume food in a more sustainable way. This research provides a base for future investigations about designing for sustainable development and behavior change with chatbot interfaces.

6.2 Limitations

Due to the 20-week time restriction of the thesis project there are some limitations in this study, the most significant is the length of the tests. They lasted for one week, which is too short to give a reliable answer to the thesis question. However, the user interviews gave reliable results and this project was also about the psychological implications that a chatbot interface can have.

The number of tests can also be increased to give more reliable guidelines. For example, the geographical and cultural factors has not been taken in consideration and it is therefore hard to say that these guidelines are applicable globally. As stated in section 5.2 there can also be a difference how different people and personalities perceive the chatbot. It could be a good idea to create a chatbot that gets to know the users and communicates based on their personality. But as stated above this was not done due to the time restriction.

The Chatfuel platform also proved to limit the development of the prototypes a little bit. Chatfuel made it easy to sort and arrange the conversational flows, it also made it possible to quickly host the prototypes. But using a third party program makes it harder to troubleshoot bugs when they occur, which led to some minor unresolved errors and limitations in the prototypes.

Another limitation of this thesis is the fact that the chatbot was designed to be Swedish. This was determined at an early stage of the thesis, since the test persons understood written Swedish fluently and it was believed that they would understand the sustainability information better if the chatbot communicated in Swedish as well. One major disadvantage with the chatbot being Swedish is that there are no natural language processing frameworks that has an artificial intelligence that reads Swedish and is well trained. Which lead to some minor bugs when users conversed with the chatbot.

6.3 Future Work

This study could be extended in many ways. A larger number of participants and longer tests might lead to more reliable guidelines. A chatbot designed in English instead of Swedish might give more stable conversations. And a chatbot that knows its users could result in a more personalized experience, which might lead to greater trust in the chatbot. A future approach for this study could also be to compare an already existing motivation application with a chatbot that have the same functionalities. In this way measurable data could be retrieved and clearer results if chatbot interfaces are more motivating than screen interfaces when it comes to pro-environmental behavior. The chatbots could also be tested based on different triggers; for example a shopping list with sustainable groceries or a quiz on the information shared by the chatbot at the end of the day. In this way it would be possible to see if the users actually embraced the facts that they were given each day. Since this thesis is about chatbots and conversational user interfaces a possible extension of this project is to see if voice control could have an impact on peoples pro-environmental behavior as well. The chatbot can also be extended with more deep and complex conversational flows.

Changing behavior in order to reach a sustainable future needs to happen. It can be a journey full of guilt, but people need to hear about their wins as well. To motivate and take full use of the competitive spirit inside of people, they need to be informed on how to make a difference. To find the right way to achieve this, different digital channels needs to be tested. Chatbots or conversational user interfaces have the potentiality to be behavior changing and inspirational services. Social influence has shown to have a big impact on people, if a chatbot can get into this social sphere it has the ability to motivate people's behavior on a completely different level than any other form of technology.

Chapter 7

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Appendix A

Idea Generating Interview Questions

- Tells us a bit about yourself:
  - How old are you?
  - What do you do for a living?
  - What is a typical day for you like?
- Give us your definition about what it means to be climate-smart.
- Do you see any challenges in being climate-smart today?
- How do you feel about your own part in the global climate challenge?
- How would you say you act to be more climate-smart today?
- Tell us a bit about what it is that makes you act climate-smart today.
- What is it that motivates your actions?
  - Friends?
  - News?
  - Social media?
  - Others?
- Tell us a bit about your view on motivation when it comes to make climate-friendly choices.

Appendix B

Scenarios and Questions

1. **Scenario 1 - Driving**
   It is Monday afternoon, and you come home after a long day at work. This day you drove your car to work. You walk through the front door and take of your coat. The smart assistant is quick to update you on the environmental impact that today's driving had:

   The smart assistant says: Welcome home *interviewees name*, how was your day? I noticed you took the car instead of your bike to work this morning. You have driven 2 miles and your carbon dioxide emissions amounted to 2.94 kg CO2 only on driving, which is about 23 percent of your daily emissions. If possible, try to take the bike to work tomorrow, for the climate sake.

   Questions based on scenario:

   (a) How would you feel to be treated in this way?

   (b) Would it motivate you to take the bike the next day?

2. **Scenario 2 - Showering**
   It is morning, you are newly awake and start the day by taking a shower. You think it is very nice and raise the temperature slowly as you are standing there. Time passes and you feel like you could stand there all day. After a few minutes, and while you are standing in the shower the smart assistant informs you about the environmental impact that the shower has:

   Excuse me *name*, you now have showered for 3 minutes and with that consumed 36 liters of water. Yesterday you showered for 10 minutes and thus consumed 120 liters of water. Try to be more effective and you save 2.2 kwh in energy.

   (a) Tell us how you would feel about this.

3. **Scenario 3 - Cooking**
   It is afternoon and you have just arrived home from work. You are unsure of what to cook for dinner today, so you decide to ask for suggestions from the smart assistant:

   The smart assistant responds: There are ingredients to cook pasta bolognese, but you could cook a sauce with mushrooms and onions instead. A vegetarian dinner saves you the carbon dioxide emission of 25 kg CO2 and some money too. Vegetarian pasta sauces can save you more than 1,000 sek per year.

   (a) Tell us how you would feel.

4. **Scenario 4 - Waste sorting**
   After dinner, there has been some empty packages, such as an aluminum-can and a pastabox in cardboard and plastic. You open the space you have for waste sorting and the smart assistant is aware of this.

   It says: Remember to put the packages in the right container and to remove the plastic from the pasta box. By being careful with recycling, you are not only economical but also climate smart. A recycled aluminum-can saves enough energy for a whole day in front of the computer.

   (a) Tell us how you would respond to this kind of message.

Appendix C

User Test Interview Questions

- Tells us a bit about yourself:
  - How old are you?
  - What do you do for a living?
  - What is a typical day for you like?
- Give us your definition about what it means to consume food sustainable
- Do you see any challenges in consuming food pro-environmentally today?
- What would engage you more in buying products that little impact on the environment?
- What is it that makes you eat what you eat today? Carnivore / vegetarian?
- How have you experienced "Herr Hållbar" and the chatbot interface that has been talking to you this week? What did you like / what did you not like?
- Do you think the chatbot could have express itself in a different way?
- Did the chatbot feel natural in the way it expressed itself?
- Did you feel more motivated to eat sustainable food this week then you usually do?
- Do you have any other comments?