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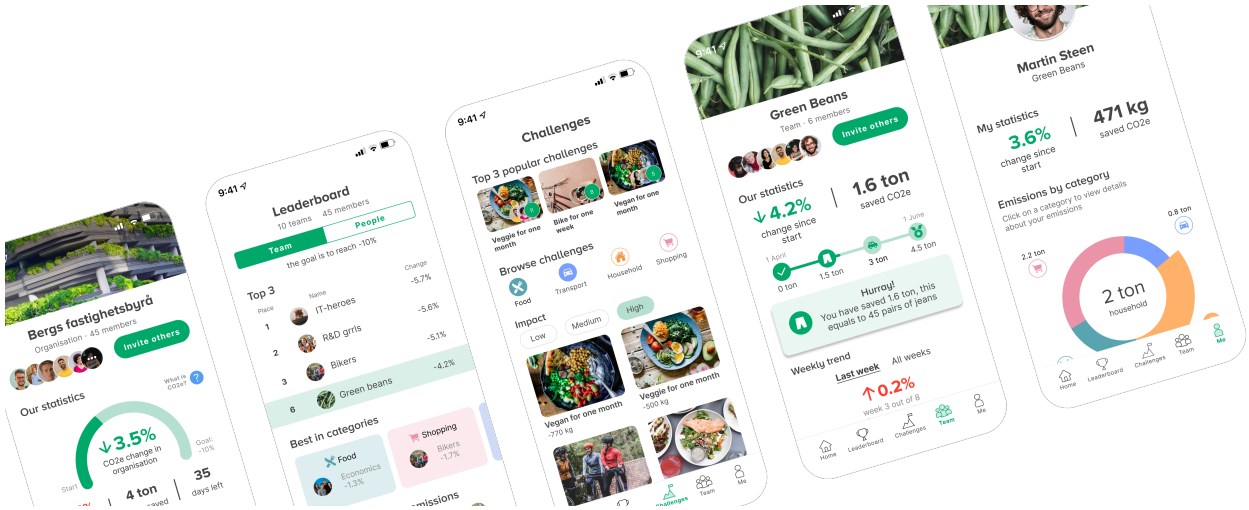

Kallna

A study to explore how to encourage people to lower their CO2 emissions in a climate competition

Master's thesis in Interaction Design & Technologies

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Gothenburg, Sweden 2022

Master's thesis 2022

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Abstract

As a result of climate change and increasing temperatures the future of humans and eco-systems is threatened. In order to reduce carbon emissions and limit impact there is a need for both policy-makers as well as individuals to take action. This has led to the introduction of eco-feedback in the form of carbon calculators to support individuals and groups in limiting their impact on the environment through reduced carbon emissions. Taking base in above mentioned matter as well as a literature study and formative research, this master thesis resulted in 12 guidelines for how to design to encourage people to lower their CO2 emissions in a climate competition. In addition to this, the prototype Kallna was created to suggest improvements on Svalna AB's climate step competition.

Keywords: Carbon calculator, Sustainability, Pro-environmental behavior, Nudging, Gamification, User-Centered Design

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Kassandra Bley and Sophie Gimströmer, Gothenburg, June 2022

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1
Introduction

The increasing temperatures as a result of greenhouse gas emissions are expected to threaten the future of humans and ecosystems, leading to to consequences such as extreme weather and loss of biodiversity [4]. It is clear that human actions have caused these changes but also that there is still a chance to work towards reducing the emissions and avoiding some of the climate impact [73]. In order to limit global warming to 1.5 degrees Celsius, emissions of carbon dioxide (CO2) would have to decrease by 45% by 2030 and be at net zero by 2050. In addition to reaching net zero, the remaining CO2 emissions would have to be removed from the air [4].

Carbon dioxide (CO2) is a greenhouse gas that is commonly referred to when discussing the impact of human activities on the climate [16]. However, CO2 only refers to one greenhouse gas which means that it sometimes understates the actual impact emissions can have. This has led to the term CO2e, carbon dioxide equivalents, being used instead. CO2e takes into account other greenhouse gases and refers to their combined effect as if they had the impact potential of CO2 [16]. In this thesis, both units will be used. In cases where it has been unclear whether the measure refers to CO2 or CO2e, CO2 will be used.

In Sweden, the climate goal is to reach net zero emissions by 2045 [77]. Out of the current emissions in Sweden, around 60% are a result of household consumption, and the rest derives from public service and investments [78]. In total, the consumption emissions are 9 tons per capita, which can be put in comparison to the 1 ton CO2 emissions that would be the limit in order to reach the goal of net zero emissions by 2050. The majority of emission in Sweden is a result of personal transportation, followed by household food consumption and household living [77].

In light of these statistics, there is a need for both policymakers to take action to lower emissions, but also for individuals to reduce their personal impact on the climate. This has led to the introduction of eco-feedback technology, such as carbon footprint calculators that calculate individuals' greenhouse gas emissions based on their lifestyle choices, for example their consumption [94]. The carbon calculators have been shown to be important tools in creating awareness for people about their choices and lifestyles and how they affect the climate [20].

However, it can be challenging to engage people to change their lifestyle or make choices that are more environmentally aware [7]. While people are aware of today's critical climate threats they are not always able to relate to them [23]. Furthermore,

factors such as conflicting goals, values and social norms may influence how people take on these issues [39].

Different strategies can be used to mitigate these barriers and to motivate people to change their behavior. For example, nudging is a technique which aims to influence people's behavior through the way information is presented [107, pp. 1-2]. Another way to motivate people is through the use of gamification which involves applying game design elements to applications, websites or information systems [29].

This master thesis is done in collaboration with the company *Svalna AB*, who provides individuals and companies with insights into their carbon footprint through their carbon footprint calculator called *Svalna* [104]. The thesis will cover a time-limited challenge that has been arranged by Svalna AB where employees of one of their customers will participate to compete with the goal to lower their carbon emissions. The competition is a pilot study for a project that is planned to be held later in 2022 together with municipalities in Sweden.

1.1 Aim and research question

The aim of this thesis is to study people that participate in a six-week challenge that Svalna AB provides with the ambition that people gain more awareness and lower their CO2 emissions with the use of the carbon footprint calculator, Svalna. The following research question aims at being answered:

> *What should be considered when designing a time-limited competition for an application intended to encourage people to lower their CO2 emissions?*

The expected outcome for this master thesis is guidelines for engaging people to lower their carbon emissions through a carbon footprint calculator along with a high-fidelity mockup that gives suggestions on how the application can look and behave. The result will especially be useful for Svalna AB since their product is being evaluated but it might also be of interest for designers, researchers who study environmental questions in relation to design, and people who are interested in a sustainable future. The result could also be useful for decision-makers, or in designing interventions.

1.2 Stakeholders

One group of stakeholders in this project are the users of the application. The users in this case are employees of a company that will partake in the carbon footprint challenge. The company will be provided by Svalna AB and will also be the subject of the interview studies.

Next, Svalna AB is the company with which the authors collaborate. Svalna AB is a research based company located in Gothenburg. They will be providing the

application tool and hosting the climate challenge.

Thirdly, Chalmers University of Technology and specifically the department of Computer Science and Engineering who will provide requirements and a supervisor to guide the master thesis. An examination will also determine whether the project work results in a master's degree.

Finally, as the authors of the thesis, Kassandra Bley and Sophie Gimströmer will be stakeholders in this project.

2
Background

2.1 Svalna

Svalna AB [104] is a small research-based company located in Gothenburg, Sweden. They are passionate about creating sustainable lifestyles and have created a unique technology that calculates greenhouse gas emissions based on financial data. The two tools they have developed help people, organizations and companies calculate and reduce their carbon emissions.

The company offers the climate service Carbon Intelligence System™ for organizations and companies that wish to keep track of their emissions. The system visualizes the consumed emissions based on accounting data, gives suggestions on actions to reduce emissions, and can create long-term climate goals [104].

Svalna AB's application Svalna has over 18 000 users and the number is growing rapidly. The application allows private persons to calculate their CO2 emissions based on financial data from their banks. Users can explore their emissions, set goals and compare themselves to others. There is also a group feature where people can get together to reach a common goal and inspire each other [104].

2.2 Eco-feedback technology

Eco-feedback is aimed at helping people learn about their consumption behaviors [3] in order to make them act more environmentally sustainable [38]. According to Froehlich et al. [38], it is proposed that people are not aware of what effect their behaviors have on the environment, and this is an area in which eco-feedback can help by providing them with the information needed to adopt pro-environmental behavior. Examples of areas in which eco-feedback can be used are driving or showering [38], water usage, recycling behaviors as well as purchases [3].

2.2.1 Quantified self

Diaries and journaling have been a major part of human lives for a long time where their everyday lives habits and emotions have been recorded. The quantified self is when people use technology to gather data about themselves, also referred to as self-tracking. It includes monitoring, calculating, and documenting signs of one's behavior, physical body [70], or environmental data [105]. These self-trackers can

be for example smartphones, watches, or weight scales that collect, interpret and make connections of the collected data and present it to the user [69]. The gathered data is often used for self-reflection and results in self-improvement [70].

2.2.2 Carbon footprint calculators

Carbon footprint calculators is a technology for calculating greenhouse gas emissions and provide people with information regarding their emissions that seeks to change their behavior and also to change policy-making [17]. It has been shown to be an important tool in creating awareness for people about how their choices and lifestyle affect the climate and how to reduce emissions [6]. Carbon footprint calculators, which hereby will be called carbon calculators, exist as websites [84], [59] and applications [104], [27], [52] where the majority of carbon calculators require the user to manually input data about their lives such as their household and transportation and gives the user a measure of their consumed emissions annually [84].

Five examples of how carbon calculators can be used will be presented below. The examples include three applications, one website and a feature of a bank application.

Svalna
Svalna [104] allows people to calculate and reduce their carbon footprint. Users enter individual information about their lifestyles according to the four categories transportation, household, shopping and food, in order to get an estimate of their yearly emissions. The application also allows users to connect their bank and use their bank transactions to keep track of emissions from bought items, set emission goals, and compare these against other people. In addition to individual tracking of emissions, the app also has a group function. The group function is based on the members' emissions and provides progress for the group as well individual comparison to the average of the group.

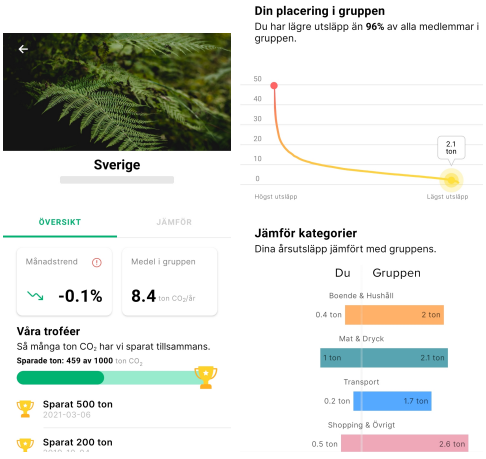

Figure 2.1: Print screens of Svalna [104]

Deedster

Deedster [27] is an application that calculates users' CO2 emissions based on input about their lifestyle such as household, transportation, food preferences, and consumption. Users can compare their own footprint against predefined personas from across the world, for example, "a typical Russian" or sign up to participate in a challenge. Deedster provides predefined challenges that users can participate in through joining an existing team or creating a new one. The team has a high score with the person who has the most "deeds", referring to the most actions done for the climate. The challenge also provides a high score for the highest-performing teams.

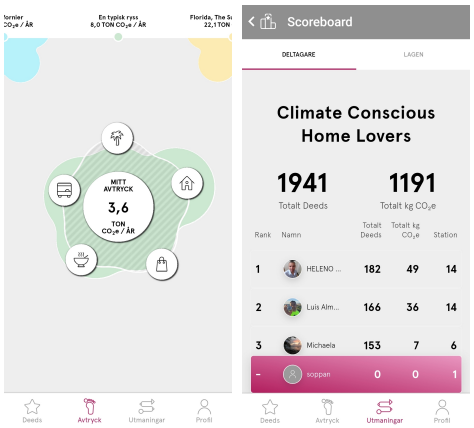

Figure 2.2: Print screens of Deedster [27]

Klarna

Klarna [58] is a bank application that automatically calculates CO2 impact for purchased items bought through Klarna. Users are provided with a monthly overview over their consumption behaviors which results in an amount of CO2. Users can also see their emissions in relation to something else, for example that 15 kg CO2 approximately corresponds to a flight with a distance of 81 km.

Figure 2.3: Print screen of Klarna [58]

Earth Hero

Earth Hero [52] is a carbon calculator that calculates people's annual tonnes of CO2 emissions based on input from the user's lifestyle. The emissions are organized according to seven categories: home, vehicle travel, air travel, food, energy, new items, and waste. The user can participate in a selection of predefined individual challenges and earn so-called earth points. The challenges vary in difficulty, such as "stop receiving junk mail" which is measured to be easy and "talk about the climate" more difficult.

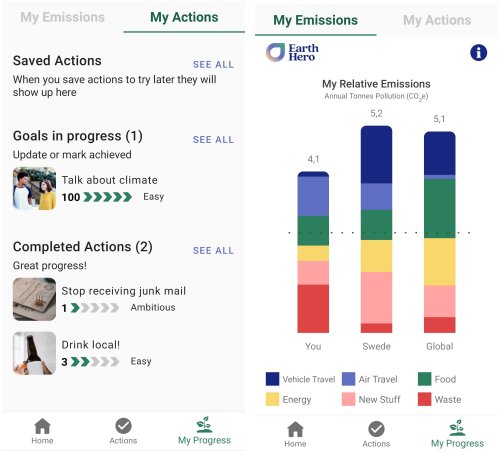

Figure 2.4: Print screens of Earth Hero [52]

Klimatkalkylatorn

Klimatkalkylatorn [59] is an example of a website that estimates an individual's CO2 emissions annually. The calculator requires a person to answer several questions within the four categories: household, food, transportation, and consumption. The output is a pie-chart of how much each category takes up along with the amount of CO2.

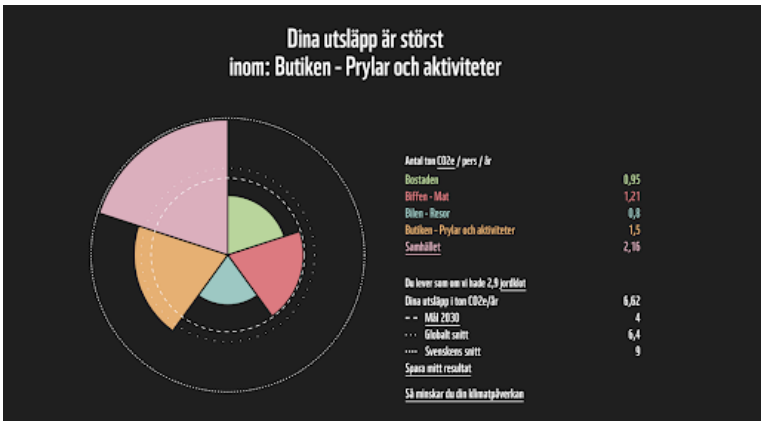

Figure 2.5: Print screen from Klimatkalkylatorn [59]

3
Theory

This chapter will present relevant theory for this thesis, including pro-environmental behavior, nudging, carbon calculators and gamification

3.1 Pro-environmental behavior

Pro-environmental behavior has been an increasingly popular topic of research in recent years [68]. Apart from the term *pro-environmental behavior*, it has been researched under different labels, for example environmentally significant behavior [99] and green behavior [65], all referring to the same type of behavior [68]. In this master thesis, the term pro-environmental behavior will be used.

Kollmuss and Agyeman [61] define pro-environmental behavior as:

> *"Behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world"* [p. 240]

This type of behavior could for example involve decreasing energy use or reducing waste [61]. Stern [99] discusses this behavior using the term *environmental significant behavior*, and describes it as behavior that is intentional and directed towards changing the environment while adding that there is also a focus on individuals' motives and beliefs.

Different models have been proposed to describe this type of behavior [61], [39], and why there appears to be a disconnect between environmental knowledge and carrying out pro-environmental actions. Among the attempts that have been made to explain these complex behavior patterns is model of pro-environmental behavior that differentiates between demographic, external and internal factors [61]. A few examples of the components listed by these authors will be discussed below.

3.1.1 External factors contributing to pro-environmental behavior

Kollmuss and Agyeman [61] list external factors that can influence pro-environmental behavior such as institutional, economic, social and cultural factors which will be described more in detail below.

Institutional and economic
Examples of external factors can include structural factors such as the climate in the region a person is living in [39] or giving people the opportunity to recycle. Another factor is infrastructure in the form of public transport or structure that supports people cycling, that would both allow people to make more environmentally friendly decisions regarding their mode of transportation [61].

Social and cultural
Social and cultural factors can contribute to both positive and negative behavior [61]. An example of how this can take form is brought up by Bouman and Steg [13]. These authors discuss how lack of pro-environmental behavior on a societal level can stem from people misjudging how much other people care about the environment, and not wanting to carry out such behaviors from fear of not being supported. For instance, people who are choosing a vegetarian diet because of environmental reasons may feel the need to come up with different explanations for doing so.

A study by Aicholzer et al. [3] showed how social factors can contribute to behavior change. They found that found that combining collaborative action with eco-feedback technology led to higher effects in pro-environmental efforts, and thus proposed that sustainable citizenship requires collaborative action.

3.1.2 Internal factors contributing to pro-environmental behavior

Internal factors that influence pro-environmental behavior can include motivation, environmental knowledge, values, attitudes, environmental awareness, emotional involvement, locus of control, responsibility, priorities [61], and worry about the environment [14]. Three of these factors will be presented in more detail below.

Motivation
Motivation is one factor that can contribute to pro-environmental behavior [61]. This psychological force can be divided into intrinsic and extrinsic. Intrinsic motivation means doing something to reach internal rewards or satisfaction in itself [91] and can be made up from our values [61]. Extrinsic motivation involves doing something to gain a separate outcome [91] for example to win something [24, p. 30]. Motivation can also be divided into primary motives and selective motives. Primary motives, such as pro-environmental values, can be overtaken by selective motives that affect activities and are more guided by a person's needs, for example being comfortable or saving time [61]. For an alternative definition of motivation, see Fogg's behavior model [35].

Values
Values can also affect pro-environmental behavior [61]. Dietz et al. [31] introduce different definitions of values and how they are used in everyday language: "what something is worth, opinions about that worth and moral principles" [p. 339]. Val-

ues contribute to our intrinsic motivations [61] and can affect environmental concern and behavior [31, p. 366]. In cases when a decision has to be made swiftly however, other forces than our values may influence the behavioral outcome [31, p. 339].

Environmental knowledge
Studies have yielded different results when it comes to examining the relationship between environmental knowledge and pro-environmental behavior [61]. Liu et al. [67], found that while environmental knowledge did not have a direct effect on pro-environmental behavior, it was still an important variable when mediated by attitudes and intentions regarding pro-environmental behavior. In light of this result, the authors suggest not only to focus on teaching about sustainability but also to tap into environmental emotions and attitudes, for example by connecting the impact of climate to people's personal lives. While acknowledging that most previous studies had yielded conflicting results, Díaz-Siefer et al. [30] found a direct link between environmental knowledge and pro-environmental behavior.

3.1.3 Psychological barriers to pro-environmental behavior

Researchers have set out to explain the barriers that hinder people from taking sufficient action to reduce climate change. For example, Gifford [39] has analysed literature on pro-environmental behavior and developed a list of seven psychological barriers - "Dragons of inaction" - to explain why people do not engage themselves in pro-environmental behavior even though they are aware of their contribution to the negative impact on the environment. In contrast to Kollmuss and Agyeman [61] who list "motivation" as one factor that influences pro-environmental behavior, Gifford [39] views motivation as being a collective result of all the below listed "dragons". While many people are already engaged in pro-environmental behavior, others are hindered by these barriers. Examples of the seven dragons are the Sunk cost dragon and the Limited behavior dragon. The Sunk costs dragon describes that people can have different goals and values, such as time and money, and that these can compete with each other but also with the goal of acting environmentally-friendly [39, p. 294]. The Limited behavior dragon deals with rebound effects. Even if people do engage in pro-environmental behavior to lower their emissions, it can be Limited and be affected by a rebound effect that means that the profit of the changed behavior declines as other behavior reverses it [39, p. 296].

3.1.4 External and internal factors working together

Mitigating climate change will require that individual processes and contextual factors are connected and work together [53]. Similarly, Kollmuss and Agyeman [61] and Gifford [39] mean that internal and external factors working together will increase the chance of people taking part in behavior that benefits the environment. Kollmuss and Agyeman [61] suggest there is a "pro-environmental consciousness", which is made up of a combination of the factors of values, attitudes, emotional involvement and knowledge about the environment. This consciousness is then affected by other factors such as personality and the social and cultural context.

Furthermore, different disciplines and areas of research will have to work together to pin down a complex issue such as environmental behavior [99].

3.1.5 Effects of Carbon calculators

Studies have been undertaken to measure the effectiveness of carbon calculators when it comes to influencing behavioral change [3], [60]. Mulrows [76] study shows that 8.9% of their participants could remember their carbon emissions and 15.9% thought that carbon calculations have given them increased sustainable behaviors. Participants were asked to rank categories according to the degree of footprint it had on the climate, where participants ranked transports as having a high effect and home energy consumption as low. The impact of household energy is misunderstood and in reality higher, where the low ranking of energy consumption can be a consequence of 75% of the participants reporting that they had low insights into their personal energy use.

Aichholzer et al.'s [3] long-term study showed that the majority of participants had reduced their carbon emissions after a period of two years, however some participants had no behavior change or had even increased emissions where energy usage and transportation were the biggest issues to non-improvement. In a separate study, participants claimed that they were unable to reduce their home energy consumption further since they already had optimized their energy consumption as a result of financial incentives [19].

To improve the possibility of pro-environmental behavior and a positive outcome, Mallett et al. [71] discuss that carbon calculators should provide people with information of social comparison and present how to increase their pro-environmental behaviors. Another important consideration is to make data relatable and tangible. For example, in an interview study on carbon calculators, "five thousand kg of CO2" was not tangible enough to be interpreted by the participants [60].

Reports on Challenges
Researchers have reported on some challenges regarding the use of carbon calculators. One challenge is to engage people since the tool is often used only once, even though carbon calculators try to invite people to use it more frequently [94]. Another challenge is to do with the willingness and ability to change behavior. It has been found that people are less likely to change their behaviors when it could affect their lifestyles, such as traveling less by car or airplane or changing diets from meat consumption. However, people could consider changing their behavior when it came to smaller tasks, for example, turning off devices to stand-by mode when not using them [19].

People's tendency to feel guilt when being compared to others is another consideration to take into account. Researchers [26] have found that people who are confronted with behaviors that oppose the social norm can experience that it has a negative effect on them and lead to guilt and self-criticism. In relation to this,

Mallett et al. 's [71] study showed that people gained eco-guilt when receiving information about their carbon footprint or a group that they belong to, especially when their footprint was larger than the average. In contrast, Barendregt [60] suggests that offering social comparison could foster engagement and motivation.

Additionally, it can be challenging to get users to trust the host of the carbon calculator [60] or the correctness of the data presented [7]. In order to get people to engage with and adopt a carbon calculator these are important factors to consider.

Finally, a challenge when it comes to the design of carbon calculators is to accommodate different types of users. For example, Barendregt and Kok [60] found two different types of users of carbon calculators - explorers and environmentalists, where the former are more novice to the concept of environmental issues and the latter have more experience. While both groups reported to be interested in knowing their own footprint and being able to compare it to others, their motivations to do so differed. The explorers were interested in more basal information and what they could do better, the environmentalists were more interested in detailed information. The explorers were also found to have a greater need for quick feedback, such as a quick-version calculator, and motivational language to retain their engagement. Similarly to Barendregt and Kok's [60] different user types it is also important to consider users differing expertise in the system. Experienced users may be more knowledgeable and need functionality that allows them to perform tasks quicker while novice users may need step-to-step instructions [85, p. 207].

3.2 Nudging

The concept of Nudging has been used widely since it was founded in 2008 by Thaler and Sunstein [107]. They describe it as the following:

> *"... any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives."* [p. 6]

The aim of using nudges is to lead people into a desired choice and behavior by making subtle changes in the way that choices and information are presented [107, pp. 1-2]. Hausman and Welch [50] broaden their definition of nudging focuses on other incentives than economics and describe it as follows:

> *"Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth."* [p. 126]

In its simplest form nudging can mean rearranging healthy and unhealthy food (e.g. snacks) in a store where the healthy food is more in the focus of a customer, and the unhealthy is placed behind the counter which leads the customer to choose the healthy alternative. The one who is responsible for choosing how to present choices

is called a *choice architect*. Nudges allow the customer freedom of choice since the customer can choose the unhealthy snacks if desired. This behavior change technique has been used among others by governments as well as in the private sector [107, pp. 1-5].

Another term which the authors refer to as *Libertarian Paternalism* [107, pp. 4-6] proposes that people should have the freedom to choose whatever option they wish which means that the nudge is done without steering people towards a certain choice.

3.2.1 Different types of Nudges

Thaler and Sunstein [107, pp. 19-21] distinguish nudging into two categories of thinking: *automatic system* and *reflective system*, where the automatic system is fast and unconscious and the reflective system is slower and controlled consciously. Automatic thinking can take place when a person experiences turbulence while flying and thinking that the plane will crash and reflective thinking can be to choose which program to study at a university. A study by Adam et al. [2] shows that people make decisions automatically (95%) rather than reflectively. Even so, systems tend to be designed for people to use their reflective minds which requires them to put in effort and awareness when making decisions.

Hansen and Jespersen [49] have developed the model further by adding the categories of *transparent* and *non-transparent nudges*. Transparent nudges make their intentions clear to people being exposed to them, while non-transparent do not make the intentions of intended behavior apparent. These four types of nudges can be combined. For example a reflective-non-transparent nudge can manipulate choice by adding items that are of no value in order for a specific item to seem more attractive. By providing more information, the nudge becomes more transparent.

3.2.2 Nudging in HCI

Nudges can be used for interaction with digital environments. Weinmann et al. [112] has labelled it as *digital nudging*. Digital nudging is an approach that uses user-interfaces design elements to direct people's behaviors and choices in digital choice environments, for example on websites, applications and systems [112]. For example, the application Square nudges people into tipping by making their payment "no tipping" checked in by default which requires the user to manually select it [21]. Weinmann et al. [112] present six nudging principles, based on Thaler et al. [108] that can be applied when designing digital contexts. Examples include the importance of providing users with feedback on their actions or predicting when users make errors through interaction with a system.

Six categories of Nudging

Caraban et al. [6] conducted a systematic review of articles on nudging theory within Human-Computer Interaction that were published between 2008 and 2017. The authors identified 23 strategies of behavior change, grouped into the following six categories:

- **Facilitate [6, p. 4].** Facilitate refers to making it easier for the individual to make decisions. These nudges aim at bringing a positive outcome for the individual because they can for example position or hide unhealthy items.

- **Confront [6, p. 4].** Confront nudges aim to decrease unwanted action by making a person reflect and doubt their decisions. A user can when uploading a picture of a child for example receive a prompt to consider changing accounts so that the picture is not publicly visible.

- **Deceive [6, p. 6].** Nudges in this category aim at resulting in a particular outcome by for example changing the way that alternatives are presented. This was done on a website that encourages people to choose healthier alternatives where a big shiny apple was placed beside a rotten one which made people choose the shiny one.

- **Social influences [6, p. 7].** Social influence nudges refer to trying to get people to do what is expected of them. People who received a mint candy along with the bill were more likely to give a tip than those who didn't get any mint.

- **Fear [6, p. 8].** Nudges in this category take advantage of people who are feeling fear or loss. It could for instance be the fear of missing out as a result of a time-limited opportunity.

- **Reinforce [6, p. 8].** This category of nudges tries to reinforce people's behaviors by raising people's presence in their minds. It can for example help the user when they have lost their focus by prompting about taking a walk or eating their food at a slower pace.

3.2.3 Fogg's behavior model

Caraban and colleagues [6] used Fogg's [35] behavior model to map different categories of nudging. Fogg's behavior model will be presented before it is discussed in relation to the concept of nudging.

Fogg's behavior model aims to understand underlying patterns in behavior. The model proposes that in order for a behavior to occur, three components must be met: the person must be motivated to carry out the behavior, they must have the ability to do so and there must be something to trigger the behavior. All of these components must be met simultaneously in order for the behavior to occur. Knowing this can be useful when designing persuasive technologies or when analyzing

systems that do not accomplish the behavior change they intend to [35]. Persuasive technologies in this case refers to techniques aimed at reframing behavior [66].

- **Motivation.** Fogg [35] defines three different pairs of motivators that make up motivation: pleasure and pain, hope and fear and social acceptance and rejection. The first pair is primitive and immediate, the second has to do with anticipation while the third can be expressed through motivation to be socially accepted.

- **Ability.** When designing persuasive technology, designers must focus on making it easier for the user to carry out a certain behavior. Simplicity is divided into six parts that connect to each other. These are time, money, physical effort, brain cycles, social deviance and non-routine. For example, the latter part tells that people will often stick to their routines and new behaviors that are not routine can be difficult to carry out [35].

- **Triggers.** Triggers, also called prompts or cues, tell a person to perform a behavior. Different types of triggers can be needed depending on whether the individual lacks more of motivation or of ability. If both ability and motivation are equal, the trigger can consist of a signal that reminds them to perform the behavior. An example of this is a traffic light. Today's technology allows for immediate triggers, for example a notification on the phone or a link in an email. Different contexts can lead to triggers being perceived differently [35].

Fogg [35] discusses that the different components of motivation and ability can be exchanged. For example, if a person has low motivation to carry out a behavior, they can still do it if the task is simple enough. The same is also true inverted, meaning if a person has low ability to perform a task but is highly motivated they may still succeed in performing the behavior. However, the final part, trigger, must be present for the behavior to occur. The trigger must be noticed, it must be associated with the behavior and it must happen simultaneously with motivation and ability. By taking into account these three sub-parts, there is a good foundation for designing for behavior change.

Finally, the model also looks at how to prevent certain behaviors, even though this is more difficult to achieve than making behaviors take place. By removing either motivation, ability or triggers it can be possible to prevent a behavior from occurring [35].

Fogg's behavior model to understand nudging
Caraban et al. [6] argue that their 23 nudges can be mapped into three types of trigger of Fogg's behavior model where designers can get an understanding of when a nudge can be used in different situations. The three categories are:

- **Facilitator.** Facilitator nudges are designed to make a task or behavior easier. They're useful in circumstances where the user desires to do something but

doesn't have the skills to do it.

- **Spark.** Spark nudges consist of motivational elements where the individual has the ability but not enough motivation to the behavior.

- **Signal.** Signal nudges refers to individuals where both motivation and ability is present where the nudges trigger the user into a certain behavior, such as reminding them of a task.

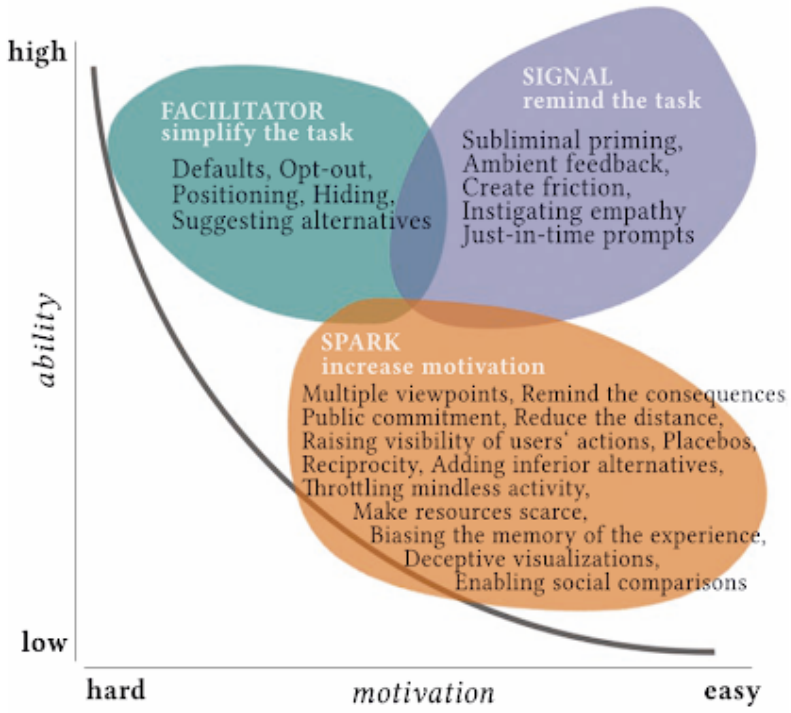

Figure 3.1: Three types of nudges [6]

3.2.4 Criticism of nudging

Using nudging as a behavior change method in policy-making has been criticized due to people's behaviors being influenced without them being aware of it [49]. One issue is that people can come to rely on nudges guiding them when making decisions when in fact nudges require people to take more individual responsibility [15].

Bovens [15] claims that nudges work best "in the dark" since it is likely that the more transparent the nudges are the less effective they will be. Transparency refers to if people can interpret the aim behind a nudge [6]. In contrast to Bovens claim [15], Sunstein [103] discusses that nudges are transparent and not in the dark and that transparency about nudging will mostly not decrease the effect of the nudge.

Caraban et al. [6] study shows that the criticism of nudging being manipulative

is not all true. The 23 nudges which are placed on two axes present that most of the nudges prompt a reflective choice, however, 22% of the nudges occur manipulation of behaviors, which may be of an unethical consideration [6]. It is important for designers to take nudging and the effect it has on people into consideration when designing since user interfaces will always, to varying degrees, lead people in a direction [112].

3.3 Gamification

The term *gamification* originally emerged from the media industry, and it started to spread during the latter half of 2010 [29]. It is a concept that involves applying game design into a non-game area, for example, applications, websites or information systems [29]. Different definitions have emerged to attempt to describe what the concept entails [29], [113]. A commonly used definition in the field of gamification research is that of Deterding and colleagues [29] who defines gamification as:

> *"the use of game design elements in non-game contexts"* [p. 10]

"Game design elements" refers to attributes that are characteristic to, and can be found in most games. It can for example include leaderboards, levels, constraints, or taking turns. While "full-fledged" games and gamified applications both consist of game design elements, Deterding et al. [29] make the distinction that gamified applications only need to have some of these elements.

A second, similar definition comes from Zichermann and Cunningham [113] who define gamification as:

> *"The process of game-thinking and game mechanics to engage users and solve problems"* [XIV Introduction]

Since its introduction, gamification has grown in popularity and as a topic of research [64]. For example, gamification within applications is used in a range of different contexts such as motivating health [29], [8] as well as for teaching [113, p. 1].

3.3.1 Octalysis - a gamification design framework

The Octalysis framework, created by Yu-Kai Chou ([24, p.23-28] suggests that there are eight core drives making up the motivation to carry out behavior. These drives form a guide for how to make use of the engaging strategies used in games. For example, Core drive 5: "Social influence and relatedness" discusses elements such as social acceptance and competition and how these can be a source of motivation by helping to draw people towards other people, places or events that they themselves can relate to. A second example is Core drive 1: Epic meaning and calling, stating that people do things when they perceive there is a reason larger than themselves. The Octalysis framework gets its name from the eight drives being positioned in the shape of an octagon, where different drives are arranged according to their "nature", for example whether they are extrinsically or intrinsically focused.

The framework can be used to analyze existing applications or systems by examining how it makes use of each of the eight drives and what techniques and elements are being used to achieve these motivations.

3.3.2 Gamification for behavior change

AlMarshedi et al. [5] also discuss gamification as a means to change people's behavior. The authors mean that it is important to consider and develop factors such as motivation when designing gamification services or applications. An example of when gamification is used to change behavior is Stepbet [98]. Stepbet encourages motivation through challenges. In this app, users are able to set up a challenge (for example walk 14k steps every day for 6 weeks) where money is invested in order to engage in a certain goal. In return, they can earn or lose money, depending on if they fail or accomplish the challenge.

Gamification can also help with solving complex, large-scale problems with the use of relatively simple designs [113, p. 1] and is today used in many different areas [29] where engaging people in environmental and sustainable questions is one of them [86]. JouleBug [56] is an example of an application that uses gamification and social elements to encourage users towards a sustainable lifestyle. The application contains challenges that users can create and participate in, as well as predefined categories of smaller actions (for example meatless Monday, save a flush, etc) that the users can take part in. All actions that a user does lead to a reward and a summary of the total impact that a user has contributed to.

Studies have been undertaken to investigate how gamification can lead to pro-environmental behavior. For example, Nockur and Pfattheicher [81] conducted a study to examine whether sustainable behavior could be fostered through a group competition. Their study shows that competition on a group level can lead to increased sustainability behaviors, whereas individuals competing for the same goal can lead to unsustainable behaviors. Their findings also showed that individuals with high competitiveness could decrease their sustainability behaviors when other group members acted unsustainable, whereas individuals' degree of competition was not affected by group members that acted sustainably. In relation to this, Aicholzers et al.'s [3] study showed that less than a majority (41%) of their participants experienced reduced efforts when comparing their own carbon footprints with others.

3.3.3 Criticism of gamification

Some critique has been raised toward gamification and a few of the game elements that are being used. One point of critique comes from Robertson [89] who discusses that it is common to use a few design elements from games, usually points and badges, and thereafter call it gamification. Whereas, those game elements are one of the least important parts of a game and yet they become the center of the experience. Robertson [89] suggests to instead calling it gamifiifation call it *pointsification*.

Robertson [89] is not alone to criticize gamification. Bogost [11] claims that the word "game" takes too much attention, which in itself is a complexity to succeed with. The "ify" suffix of gamification is also problematic since it usually points to making something into a specific state. He proposes to call gamification *exploitationware*. Bogost [11] also criticizes that the key design elements from games that other researchers claim to be points, levels and badges are in fact wrong, where he means that key game elements are what makes a game an experience such as excitement, interest and hope.

In relation to this, [24] points out that while the elements of points and badges that are often used tap into short-term extrinsic motivation, it is important to also consider the intrinsic motivation that can give a more sustainable outcome.

In addition to the above mentioned critique, Landers [64] makes a distinction between "legitimate" and "rhetorical" gamification, where the latter is about creating a game-like product only to increase sales for the organization, for example through adding some badges, points and leaderboards. The problem with this, says Landers [64], is that it does not take into account the psychology behind the game elements and how they can help change behaviors. Building on the Hamari and colleagues' [48] theory of gamification, Landers [64] suggests attempting to recognize the desired behavior change, then look at what psychological processes lie behind this behavior and as a final step identify what game elements can help bring about this behavior [64], [63].

3.4 Pro-environmental behavior, Nudge, and gamification

Both nudging and gamification have been used to influence pro-environmental behavior. Schultz et al. [96] studied how social nudges affected people's behavior in regards to household energy consumption. Almost 300 households in California (US) participated in a study where all households were informed about their household's energy consumption as well as that of their neighbors'. Half of the households were informed by text and the rest with text along with a visual emotion in the form of a smiley-face or a sad face. The result after one week showed an undesired behavior where households that got feedback in text format and who had lower than average energy use to start with increased their energy use, a so-called boomerang effect. However, households who also had lower than average energy use and who were provided with the information along with a positive smiley-icon indicating that they were doing well did not increase their usage.

As for gamification, studies have shown that gamification is effective in aspects such as engaging different groups, enabling learning and changing behavior in regards to climate change, to name a few [86]. For example, in order to lower people's energy use through the use of applications, game mechanisms such as progress tracking,

reporting goals for sustainability and the option to compare oneself to others can be effective. Gamified applications can also help with overcoming barriers of pro-environmental behavior, for example by informing users on how to act sustainably or help lower perceived risk about such behaviors [32]. The use of gamification has also been shown to be able to lead to psychological impact in participants, as it has been shown to help drive their intentions [66].

Gamification has also been linked to long-term environmental behavior change [66], [88]. When comparing the techniques of nudging, gamification and reframing of motivations and travel behavior, Lieberoth [66] found that gamification led to a larger psychological impact where people who were in the gamification group had higher intentions of renewing their bus travel card. This was done through the use of points, badges and combining online and offline behavior. A study by Ro et al. [88] strengthens that gamification can result in long-term effects in a sustainable domain. They designed and tested a gamified application where teams compete against each other to reduce energy consumption which resulted in behavior change for individuals.

As has been described, gamification has been used in a range of areas, including to influence pro-environmental behavior. This being said, Beck et al. [8] found that designers make minimal use of gamification elements when designing energy use applications, where the main elements used were feedback (91% of applications) and points (43% of applications). They suggest that designers include more components in order to create a more pleasant, engaging and rewarding experience for the users.

It has also been suggested that there is a need for more research on how climate change gamification works, especially in the long-term as this would show whether new knowledge learned is applied in the lives of the participants [86].

4
Methodology

This master thesis centers around a design challenge that is difficult to solve and where no solution is the correct one, which are defining characteristics of a wicked problem [87]. The term wicked problem was first introduced in 1960 by Horst Rittel and characteristics of these types of problems were later defined by Rittel and Webber [87], who defined wicked problems as being complex, difficult to define, often have unclear boundaries but can have multiple solutions.

Rittel and Webber [87] suggested that societal problems are inherently different from scientific problems. Problems found in nature - which they called "tame problems" are easily defined and have solutions whereas societal problems don't have solutions but are resolved through judgment of the designer.

Buchanan [18] connected wicked problems to design. He pointed out that design problems are often characterized by the difficulties Rittel and Webber [87] mentioned. He also suggests using design thinking for these types of problems. As wicked problems are not determinate or have definite conditions, they can not be dealt with a linear problem solution process, but have to be dealt with iteratively. Furthermore, the implication of the solutions of the problems being subjective, they cannot be true or false, like with scientific problems, but instead, they can be good or bad [18].

A common way to tackle wicked problems is with the help of an iterative design process where the designer can move back and forth between different steps [110, p. 9].

4.1 Design Processes

A user-centered approach is a method that involves having the real user throughout the process. It means to understand who the user is and what goals they have to create a desirable and usable product [85, pp. 285-286]. Nielsen [79] emphasizes the importance of involving users and discusses that designers are not users, even though only relying on designers' own expertise can be seen as an easy solution when it comes to designing.

There are several different design processes that one can choose from, such as Design sprint [43], double diamond [25], simple interaction design [85, p. 186], Jones'

model of design process [55] and the five-step design thinking process [83]. What these have in common is that they work in an iterative manner where the designer is able to go back and forth to a preferred step as often as it's needed in order to move forward in the design process. All of these processes also have a clear focus on the user at some point in the process, which is an important aspect of a design process according to Preece et al. [85, pp. 186-187].

The Double diamond [25], the Design Sprint [43] and Jones' model [55] support divergent and convergent thinking. This means that an issue can be explored in a broader sense (diverge) and then narrowed down and focused on one action (converge). While Jones' model [55] consists of one cycle of diverge-transform-converge, the double diamond method [25] indicates through two iterations and the design sprint [43] supports three iterations of broadening and narrowing down.

The three design processes [43], [25], [55] described all support iterative work however they do not have as clear visual indications of how this could be done as Simple interaction design [85, p. 186] and five steps of design thinking [83] have. They indicate this through arrows to represent that one can go back and forth between the different stages. The design sprint process [43] and five steps of design thinking [83] are quite similar in the way that they are structured. However, the design sprint [85, p. 186] contains one extra step which is to decide on a design after the designing stage.

Jones [55] claims that any design method that helps the designer in finding a solution for what they do not know but need an answer for is a good method to choose. The five-step design thinking method by d.school [83] is to-the-point, fits the phases we are planning to go through and has a clear focus on empathizing with the users. This, in combination with our previous experience using this method, has led us to choose this process as a basis for this thesis.

4.1.1 Design thinking

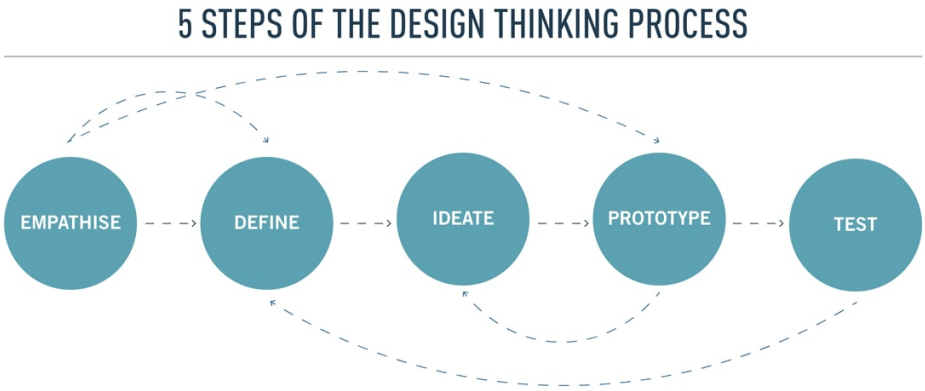

Figure 4.1: 5 Steps of the Design thinking process [100]

Design thinking [83] is a five-step method that can be used when solving complex problems [37]. The method contains five steps which can be gone through iteratively or be carried out in different orders [83]. The process contains the following steps:

1. **Empathize.** This step involves work towards understanding the users and what their needs are. It entails observing their actions and interactions, engaging in interacting with them and immersing yourself in the user's experiences. This step ends with sharing your findings with fellow designers and colleagues. Empathy is central when working with human-centered design.

2. **Define.** This step is where the designer attempts to create meaning with what they have learnt about the users and problem-space in the previous step. They create a problem statement, a "point-of view" to guide the process. It can be useful to create a How might we-list to use in the next step.

3. **Ideate.** The third step involves ideating ideas by using what has been identified to create solutions. It is preferable to try to come up with many ideas instead of a single solution. Examples of methods that can be used in this stage are mind mapping and sketching. At the end of this stage, it can be useful to select a few ideas to move forward with.

4. **Prototype.** The prototyping step entails creating artifacts that will help ideation and communicating the ideas. Examples of prototypes are designs of different fidelities, storyboards or a physical environment.

5. **Test.** The final step is where users get to test and give feedback on the prototypes generated in the previous step. This helps with further understanding and gives the opportunity to refine the design.

4.2 Empathize

The step Empathize involves working to understand the users. Qualitative research methods allow for collection of rich and meaningful data. A combination of qualitative and quantitative methods can yield a better understanding of the research subject [10]. In this project, both qualitative methods (interviews and diaries) will be combined with user data collected from an application.

4.2.1 Semi-structured interviews

Semi-structured interviews [85, p. 394] are a combination of structured and unstructured interviews that use both open and closed questions. Semi-structured interviews allow the interviewer to be flexible and adapt the set of predefined questions as the interview progresses [9, pp. 143-144]. Benyon [9, pp. 143-144] notes that the interviewer can come up with new follow-up questions based on the answer

that participants give which create a natural and alive conversation than for example structured interviews.

Preece et al. [85, pp. 229-230] discuss that questions should be formulated to be open and not angled in a direction that makes the participant change their natural answer. The interviewer should not assume that a participant likes a certain thing, but instead ask if the participant likes it. The questions should also be designed to be simple without compound sentences to confuse the participant [85, p. 234].

Benyon [9, p. 145] argues that it can be difficult to hold the interview and at the same time take notes since it requires multitasking, therefore it is recommended to separate the roles and have one facilitator and one note-taker.

4.2.2 Questionnaires

Questionnaires [51, p. 278-281], [9, p. 146] can be used to collect data about users' opinions as well as demographic data. Advantages of this method is that a large number of people can be reached, including people in different locations. According to Preece et al. [51, p. 278-281] it is important to consider the wording and the order of the questions when creating new questionnaires. Using this method to collect data is useful if people are motivated to answer. If people need more persuasion to respond to questions, it is better to use interviews. Background information such as gender and age are useful to put data into context.

4.2.3 Individual diary

Individual diary is a qualitative method that tracks individuals' daily activities and experiences. A benefit of diary writing is that it can capture a behavior or a routine that an individual has which can otherwise be unrecognized compared to other methods [40, p. 213]. This is due to the fact that the diaries are conducted in real-time which allows the user to write in present time compared to recalling something from the past which can be interpreted in a different way than how it actually was. Diaries or so-called user logs take place over a period of time and can last from a couple of days to several months or even years [93].

4.2.4 Design workshops

Design workshop [57] is a method where a design challenge is worked on with the aim to generate new ideas on how to solve it. The workshop often contains tasks of ideating, sketching and discussing. The method can be carried out after the research phase

4.3 Define

Define is the step where the team defines the problem based on the insights from the previous phase. Below are some methods that will be used in this step.

4.3.1 Thematic analysis

Thematic analysis [17] is a qualitative method for identifying and then analyzing patterns within a set of data. One approach is to go through the steps of 1) familiarizing yourself with the data, 2) generating initial codes, 3) search for themes, 4) review themes, 5) define and name themes and 6) produce a report.

4.3.2 Personas

Personas [72, p. 205] are characters made from information about the users. They are descriptions of characteristics and behavior patterns, often presented with a name and a picture as well as a scenario showing a typical situation of their life and behavior. Personas can be useful to understand the user throughout the design process and works well for communicating within the team.

4.3.3 Scenarios

Scenarios [72, p. 236] are created to convey the user's point of view around the use of technology. It is generally produced together with personas where each persona should get at least one scenario based on their perspective. A scenario starts with a trigger event and ends with showing how technology can help the persona in that situation.

4.4 Ideation

The ideation phase is where ideas will be generated which will be carried out with four methods.

4.4.1 Brainstorming

Brainstorming [28] is an ideation method aimed at generating as many ideas as possible during a set amount of time. A brainstorming session should be an open space for everyone to feel comfortable and think "out of the box" which means it is important to avoid criticism. "Wacky ideas" are encouraged, and people can preferably build off of each other's ideas. A session typically has a facilitator that can help keep the group on track.

4.4.2 Hierarchical task analysis

The Hierarchical Task Analysis (HTA) [9] was developed in the 1960s and has had multiple different ways of describing it since then. HTA can be described as a graphical representation of how tasks and sub tasks are related to each other which is shown in a hierarchy [9, pp. 243-244]. HTA is presented from the user's point of view and the tasks show what goal the user has [47].

4.4.3 Crazy 6

Crazy 6 [42] is an adaptation of the method Crazy 8 that's commonly used in the sketching phase. Each person in a team folds a paper into six segments. The timer is then set for six minutes, and the idea is to sketch one idea in each of the six rectangles spending one minute on each. This method aims at generating many ideas in a short period of time, while helping push the team to move on from sketches that are not perfect.

4.4.4 Dot vote

Dot voting [44] is a method that allows everyone in the team to vote for an idea by placing a dot next to the idea of choice. Consensus in the group is reached through the idea with the most dots being chosen.

4.4.5 Reverse brainstorming

Reverse brainstorming [75] is a method that encourages the participants to think about problems instead of solutions. Through considering how the problem can be made worse and then reversing this into a solution it is possible to generate new ideas.

4.4.6 Parallel design

Parallel design [80] involves designers working independently but simultaneously on separate design solutions. This is in contrast to iterative design where design cycles are repeated and design is modified based on user feedback. The process starts out with a concept, then the designers split up and work on individual sketches before merging, sharing their designs and coming up with a shared version. This version is then iterated together. This method is useful when there is limited time to carry out a project as well as helps bring out diversity.

4.4.7 Ideation selection

In case it is difficult to reach consensus, ideation selection will be based on Dot voting [44].

4.5 Prototype

The two methods low-fidelity and high-fidelity prototypes are used in the prototype phase.

4.5.1 Low-fidelity prototypes

Low-fidelity prototypes are a cheap and fast way of exploring different design ideas [85, p. 243], [9, pp. 176-177]. Low-fidelity or so-called lo-fi prototypes are conducted

early in the design process and are usually not integrated into the final product, but rather are a step towards the finalization by exploring options [85, pp. 243].
A disadvantage with low-fidelity prototypes is that the details of the system can be poor which might give the user less feeling of how the system might look and feel [85, pp. 246].

4.5.2 High-fidelity prototypes

High-fidelity prototypes [85, pp. 244-245], [9, p. 176] are usually created in the material that the final product will have to give the correct look and feel. High-fidelity or high-fidelity prototypes are especially advantageous since they can be shown digitally as interactive prototypes which can give users or customers a better idea of how the system might work instead of showing low-fidelity prototypes [85, pp. 244-245].
However, one problem with high-fidelity prototypes is that they look like a finished product which might cause confusion when testing the prototype where people forget that it's still a prototype. Another challenge is that the high-fidelity prototype suggests that it is implementable when in fact it can be rather difficult [9, p. 176].

4.6 Test

To evaluate and test the prototype two methods have been chosen which are Cognitive walkthrough, Hierarchical task analysis, and Heuristic evaluation.

4.6.1 Cognitive walkthrough

Cognitive walkthrough [72, p. 46] is a systematic method that can be used to assess a system's usability. It helps find pain points in the interaction that may hinder the user to move forward. The method is useful especially for systems where the user will not have preexisting knowledge but must learn how the system works as they go along.

4.6.2 Heuristic Evaluation

Heuristic Evaluation [36] is a process developed by Jakob Nielsen and Rolf Molich, which contains 10 principles that determine the usability of a product. The method is a walkthrough of the product's user interface and often used early in the design process to gain insight for improvements. The evaluation includes for example to examine that the system's words and phrases match the user's language and that the user has the ability to undo or exit an unwanted action.

4.7 Design principles

The Gestalt laws [111] and Norman's 7 design principles [82] will be used in the design phase.

4.7.1 Gestalt principles

Gestalt laws (gestalt meaning "pattern" in German) were originally proposed by German psychologists at the beginning of the 1900s. The principles of gestalt can help in designing visual displays as they provide clear representations of humans' visual perception and how we perceive patterns [111, p.181]. Ware [111, pp. 181-197] discusses eight of the Gestalt laws, which for example include the principle of proximity that explains how elements that are close together are perceived to belong together and the principle of similarity that describes how similar shapes are perceptually grouped together.

4.7.2 Norman's 7 design principles

Don Norman's [82, pp. 7-25] seven principles can be of good support when designing a product in order to make it useful and in the best case even enjoyable. The principles require the designer to acquire a focus on the user as well as an understanding of the combination of technology and psychology. It includes for example to create a product that is easy for the user to understand without previous knowledge or that the user should receive feedback to gain confirmation that something works accordingly.

4.8 Tools

During this master thesis, four tools will be used internally for communication, organization, ideation, and designing. Due to Covid-19, the main communication will be conducted online through the video communication tool Zoom [114] and when it comes to conducting interviews Teams [106] will be used. Trello [109] will be used for organizing tasks and the online visual collaboration Miro [74] will be used for ideation.

Lastly, to create high-fidelity prototypes, Figma will be utilized. Figma is a digital cloud-based tool for designing and prototyping which allows users to create vector-based mock-ups while working in real-time in a collaborative manner [34].

4.9 Participants

The participants in the study are employees of a company that will partake in Svalna's climate step competition. When involving people as research subjects, it is important to respect them and make sure not to unintentionally cause harm [12]. With this in mind, care will be taken to make sure participants are well informed and that private information is dealt with properly.

5
Execution and Process

This chapter presents what activities have been carried out during the project. The project started with a pre-study followed by six iterations, which will be described below. Each iteration contained execution of methods from the Methodology chapter (chapter 4) and ended with an updated version of the Guidelines. All iterations were two weeks long except for the pre-study which was carried out over the course of four weeks. A total of ten interviews were held, six of which were with experts within fields relevant to the study and four with participants from Svalna's climate step competition.

A dialogue with Svalna AB was held throughout all iterations in order to get a better understanding of what challenges were to be explored during the practical design work.

Throughout this project the five-step design thinking process [83] was used. The phases Empathize and Define were applied in iteration 1-3 where questionnaires and interviews were conducted and analyzed. The phases Ideation and Prototype have been adopted through all iterations. Finally, Testing was carried out from iterations 3-6.

Three of the methods that were planned and described in the Methodology chapter (chapter 4) ended up not being used. We decided not to use the method Individual diary due to the pilot-study getting delayed which lead to us not fulfilling our original plan. Additionally, the two evaluation methods Heuristic Evaluation [36] and Cognitive walkthrough [72, p. 46] were not used during this project. Cognitive walk-through was not used as user testing conducted over the course of the iterations was perceived to provide enough data. Hierarchical task analysis was not used as we found that the scenarios created for the personas already covered some of the method's purpose as they showed the user's actions. Instead, we found that we rather needed a clear overview of the actual screens included in the design. This led us to instead create a sitemap [54] to show the relations between the different screens.

In addition to above mentioned changes, we did not make use of data from Svalna's application due to a change of focus towards expert interviews instead of following an existing climate step competition.

5.1 Pre-study

Before the project started in terms of user research, practical work and report writing, a four week long pre-study was carried out. The pre-study consisted of the activities of planning, conducting a literature study and benchmarking. The two latter activities were done in order to get an understanding of existing research in the area of interest and to see what solutions already were currently available on the market.

5.1.1 Planning

Our plan was to have an agile working process with inspiration from the scrum method were work would be done in two-week sprints. Evaluation and planning would be carried out at the end of each sprint in order to be flexible and to follow up on our work. A shared digital Kanban board would be used to divide and follow-up on work tasks.

The plan was to use either double diamond or design sprint for design process, however it would be decided upon once the project had started.

Contact with our mentor at Svalna AB and supervisor at Chalmers was planned to be held through email, where meetings would be held continuously throughout the project. The meetings would most likely be digital due to Covid-19.

The master thesis was planned to be based around Svalna AB's climate step competition where a company's employees would sign up to participate with the goal of lowering their CO2 emissions. The plan was to interview participants that took part in the competition as well as to collect data from Svalna's app.

The original timeplan was divided into different activities: research and planning, interviews, statistics, design, and report writing. These would be subject to change as the process moved forward.

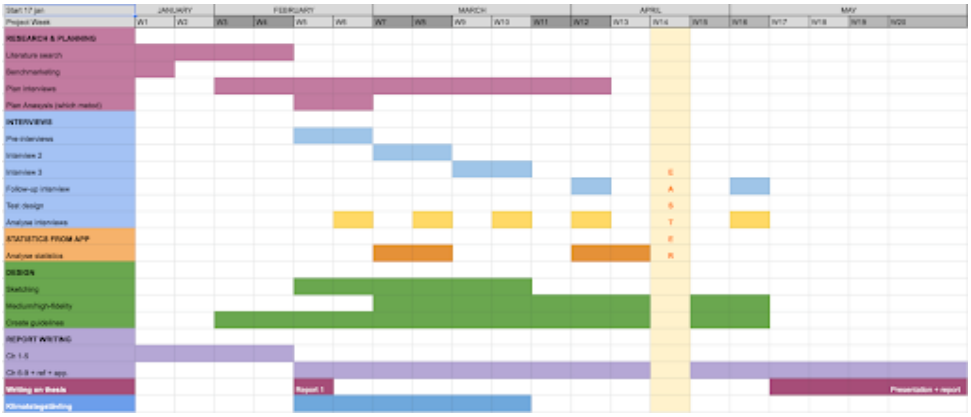

Figure 5.1: Timeplan

Ethical considerations
There were a few ethical issues that were thought to be able to arise in our project, for example that nudging aims at getting people to do a certain thing which is not always seen as ethically correct [112]. It has been criticized for being manipulative as users may be unaware of underlying intentions [66]. It is also possible that nudging leads to unplanned results. Lieberoth et al. [66] list a number of unexpected effects that nudging may have, leading to unplanned or negative results. One example is where people asked to make their commitments public led to them making less commitments [6].

Furthermore, we have no control of how the knowledge we are creating will be used, as a result it could be used to influence people's behavior in unethical ways. Interviews and collection of data will need to be considered to make sure it is done in a proper way with regards to issues such as handling of data and informed consent, to name a few. Our study needs to make sure that personal data from the interviews is anonymous and can not be tied together to an individual person.

5.1.2 Literature study

The literature study phase involved reading up on relevant concepts in connection to our research question. We started out looking at a broad range of topics, inspired by areas that previous research had pointed towards as being of interest. The initial focus was on carbon calculators, nudging, gamification and pro-environmental behavior. As the literature study progressed, we complemented these topics with other relevant topics.

Search engines such as Google scholar [45] and Chalmers university library [22] were used to search for relevant articles, using the keywords mentioned above. Google scholar provided an overview of the number of citations each article had, which was helpful in order to get a pathway to relevant research and to see which ones were used to support other articles. When we had found an article of interest the process most often was to look for more relevant literature in the article's list of references to find other articles that would help us broaden and deepen our understanding of the topic.

In order to keep track of the literature we found we created a Google sheets [46] document including columns with title, author, description, keywords and a link to where the article. We initially divided the topics between us and did separate literature searches. Relevant literature was added to the document in order for the other person to be able to read up on the topic so that we had a similar understanding. Miro [74] was then used to draw connections between different theories and concepts in order to enhance our understanding.

The knowledge acquired during the literature study was summarized in the Theory chapter (chapter 3). After having carried out research we considered a qualitative research method suitable to gain a deeper understanding of people's feelings and attitudes towards engaging in a carbon calculator competition.

5.1.3 Benchmarking

Benchmarking was carried out in order to get an understanding of what similar apps and tools were available on the market. This was done through searches on Google [41] and App store [101] where we looked at carbon calculator apps and websites. We started out looking at different solutions and tools individually before discussing pros and cons with found solutions, and what insights we could bring to our own practical work. While benchmarking was carried out throughout the initial phase of the project we would come to revisit it during the execution process of the project, where we also looked at fitness and health apps that used a similar concept of competition such as the apps Sats [95] and Strava [102].

The findings from the benchmarking of carbon calulators were summarized in the Background chapter (chapter 2).

5.1.4 Personas and scenarios

Three personas were developed to get a better understanding of the user group of a climate competition. The personas were partly based on the literature study where Barendregt and Kok [60] had identified two different type of users: explorers and environmentalists.

One of the created personas had no prior interest of environmental activities while the second was an expert at environmental issues. The third persona was someone who is curious to learn more about the subject. The interest for competing varied among the three personas in order to provide us with different scenarios for how a competition could be approached.

Figure 5.2: Persona version 1

Scenarios [72, p. 236] were created to illustrate each persona's perspective of using the app. Figure 5.3 presents an example of one of the personas "Eva", in a scenarios where she has the motivation to win the climate competition.

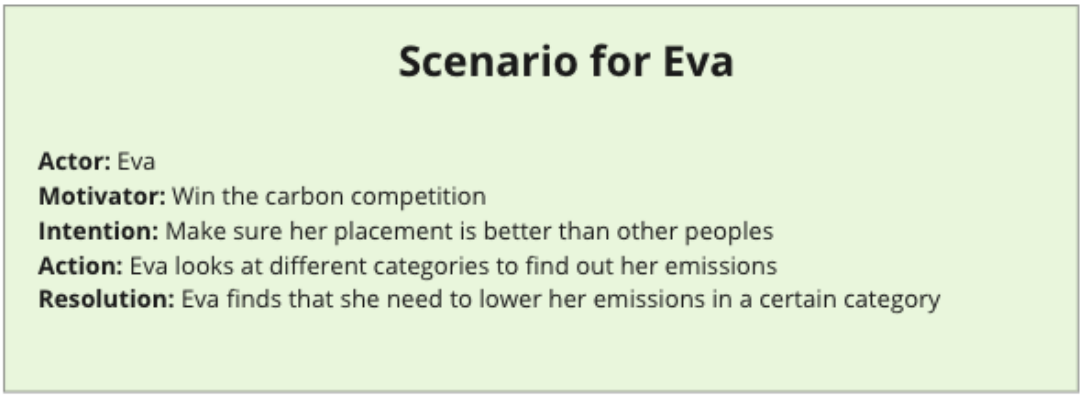

Figure 5.3: Scenarios version 1

5.1.5 Guidelines from literature

The first version of the guidelines was based on the literature study where interesting phrases and words were captured. The findings centered around topics such as nudging, pro-environmental behavior and gamification. The result of benchmarking was added to the guidelines to give a perspective of what similar tools was available on the market. At this point the guidelines were more in the form of overarching themes that we considered would be relevant to focus on in future iterations.

The following categories were created as a first version of the guidelines. References supporting the guidelines are shown in brackets.

TANGIBLE INFORMATION AND COMPARISONS
Offer people an option to see how their behaviour impact their emissions [60].

INFORMATION FOR PRO-ENVIRONMENTAL BEHAVIORS
Give people information on how they can lower their CO2 emissions [71].

OFFER TAILORED AND PERSONAL INFORMATION
Give tips and advice tailored to the user [60].

DIVIDE INTO SMALLER TASKS
It is easier for people to change their behavior when it comes to smaller tasks than life changing ones such as travelling by flight [19].

DON'T ECO-GUILT PEOPLE
When people received information about their carbon footprint, especially when it was higher than the average group they eco-guilt were gained [71].

GROUP LEVEL
Competition on a group level compared to on an individual level can lead to increased pro-environmental behavior [81].

GAME ELEMENTS
Offer people game elements that are not only extrinsic such as points and leaderboards but also intrinsic [24, p. 30].

SOCIAL CONTEXT
Allowing the user to compare their CO2 footprint to that of other people can motivate engagement [60].

TRANSPARENCY
If using transaction data as a means for calculating emissions, information about the calculation method and its accuracy should be provided to the user [7].

ADAPT TO THE INDIVIDUAL
Consider designing for different users needs, such as expertise or interest [60].

ALLOW TO MEASURE BEHAVIOR
For example, self-tracking can allow a person to get information about their behavior which can assist them in self-improvement and self-reflection [69].

NUDGING
Different types of nudges can be used to motivate people to carry out a behavior, for example by giving a reminder or to make a task easier to do [6].

5.2 Iteration 1

During the first iteration a questionnaire was sent out and four interviews were conducted. The first sketches were created based on brainstorming ideas and the guidelines from this iteration and in the previous one. This was followed by the creation of Guidelines version 1 which is presented at the end of the iteration.

No changes were made to the personas or scenarios during this iteration.

5.2.1 Updated time plan

The original timeplan for the project was changed due to delays of launching an update in Svalna's app. This resulted in some changes being made as to what activities would be carried out and when. The pilot study was planned to begin five weeks later than the original plan. This meant that interviews and analysis of the data would be moved according to the new timeplan. The time leading up to the climate step competition would be spent doing design work and creating guidelines. In addition to this, we saw an opportunity to conduct interviews with people who

had taken part in similar competitions as well as with experts within the fields of sustainability, gamification and carbon calculators. This could provide an additional perspective that would be able to add value to our study.

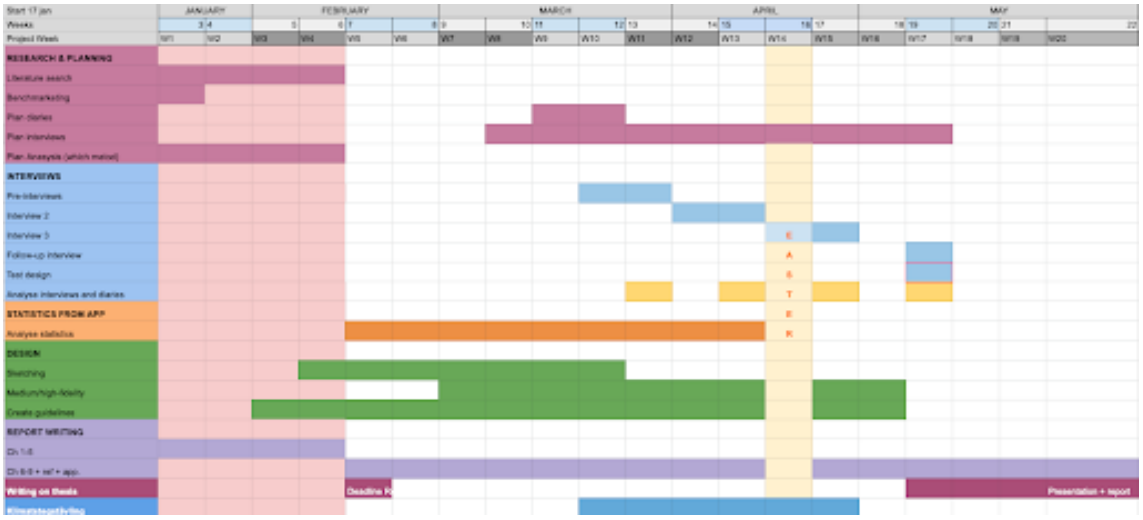

Figure 5.4: Updated timeplan version 1

5.2.2 Questionnaire

A questionnaire was distributed online and was answered by 43 participants, where the majority were aged between 19 and 30 and located in Europe. The reason for the questionnaire was to collect insights into people's experiences with carbon calculators and competitions.

A pilot-testing was done in order to collect feedback about the content and ordering of the questions, before submitting the questionnaire online. Some questions were adjusted and clarified as a result of this. One example was that a question aimed at finding out which of three options was equivalent to 900 kg CO2 emissions was difficult to interpret. The options were all related to the distance between two cities with flight (for example a flight between London and New York). This question was re-formulated because it could be a result of lack of knowledge regarding geographical estimates.

Analysis
Analysis was done through looking at frequency in responses and compare the two groups of people who had previously used respectively not previously used a carbon calculator to each other.

Takeaways
After analysing the data, some takeaways were that the majority of respondents were concerned about the environment, but they did not engaging in environmental activities to the same extent as their concern.

The majority of the respondents reported that they wanted to use carbon calculators to learn about the environment, followed by having fun. When it came to previous experience of carbon calculators, people who had used them before said that they would prefer to compete as part of a team in a competition, while respondents who had not used them before wanted to compete individually. The majority of respondents wanted to compete against friends or family. The questionnaire contained a question asking what "900 kg of CO2" corresponds to in terms of activities. This question received mixed responses. While it is not possible to draw any conclusions from this, we discussed that it could be that data presented in this way is difficult to interpret.

Bias
There are a few possible points of bias that could affect the result of the questionnaire. Firstly, since the questionnaire was partly distributed via an online group for survey exchanges, it can be assumed that the majority of the respondents were students who were expecting responses to their surveys in return. Secondly, while the term "Carbon Calculator" was explained several times, the concept of a competition in a carbon calculator could have been explained further. This might have affected the result as people with no prior experience might have misunderstood what a competition in a carbon calculator was. Finally, to reach more participants the survey was distributed via social media which meant that it reached people all over the world. The result might have been different if only people who live in Sweden would have participated.

5.2.3 Interviews

Four interviews were conducted during the first iteration. Three of these were with experts in their respective fields (gamification and climate-related topics) and one interview was with a former participant of a climate step competition.

The interviews were all conducted online via Teams [106] and took place over the course of two weeks in February and March 2022. During the interviews one of us had the role of interviewer and one of us had the role of note taker. Before each interview, the interviewee was asked to sign a consent form explaining the purpose of the study and informing them of their rights as participants (see Appendix 2-5). The interviews were audio recorded in order to focus on what was being said. The note taker had their sound turned off in order to not distract from the conversation. Each interview started with warm-up questions and ended with a debrief and information about what would happen next.

In order to find suitable interview participants, we searched within areas that would be relevant and contribute to the study. One of the participants was provided through Svalna AB, which was someone that had participated in one of Svalna's previous climate step competitions.

We chose to include experts from a variety of fields in order to get a wide view

of the problem at hand: sustainability, carbon calculators and game research. We also selected experts because we thought that it could provide meaningful additions to the group of potential users.

The questions for the first interview were based on relevant themes from the literature research, results from the questionnaire and previous information that we had received from Svalna AB about the outcome from a previous competition. The three other interviews were based on our literature study and on previously conducted interviews because we estimated that further knowledge or support was needed within an area.

Analysis
Each interview was transcribed after it had been conducted. After the transcription was completed, we did a version of the method Thematic analysis [17] where each of us marked interesting word and sentences of each interview. The marked passages and terms were copied onto sticky-notes in Miro [74] where the analysis took place. The sticky-notes were sorted according to themes. Relations between the different categories were illustrated with arrows. The four interviews were analyzed separately due to that the interviews had different areas of focus.

The themes and problems that were identified in each interview were used as input for the subsequent interview when it came to choice of expert and questions.

Takeaways
Each interview participant is referred to by a letter and number combination, indicating if they are a previous participant of a climate competition (P) or if they are an expert within a relevant field (E). Below are the main findings from the first set of interviews conducted in this study, with P1, E1, E2 and E3. Quotes from P1, E2 and E3 have been translated from Swedish into English.

P1
P1 had taken part in a climate step competition at their workplace prior to this study. Hence, did the interview with P1 revolved mainly around the topic of previous experience in a climate step competition, but also touched on topics such as prior environmental knowledge. See Appendix 2.

1. **Comparing results to others**
   P1 reported that there was a worry about being judged by others at the workplace if one's score, meaning change in CO2 emissions, was perceived as being low. The respondent explains the feeling as:

   "What if I end up at the bottom, what if everyone can see how bad I am, how worthless I am behaving for the climate." - P1

   This caused a large portion of the participants opting to be anonymous on the leaderboard, which in turn meant that the leaderboard was not of much

use in the competition.

2. **Together we can make a difference**
   Even though it was a competition where teams and individuals were meant to compete against each other, P1 pointed out that the main goal for the colleagues was to do something together. Being able to see how much impact they could make together as a group turned out to be their intrinsic objective and the motivation from this inspired conversations in the lunchroom. P1 puts it as:

   "...it was important that it started a conversation about what is happening globally, it is not just 'me and my emissions' but the wider perspective." - P1

3. **Low emitters' motivation**
   During the competition, progress turned out to be faster for those participants who started the competition with high CO2 emissions. For people who already had low CO2 emissions, it was difficult to decrease their emissions further as they had already taken steps to reduce their emissions prior to the competition. This caused this group to suffer loss of motivation.

E1
E1, who was recruited for their expertise within the field games gave a mixture of expert advice and personal experiences. The interview was based around questions about games, gamification and prior personal experiences of competitions. For a full list of the interview questions, see Appendix 3.

1. **Motivating to compare result**
   E1 found it motivating to be able to see other players' scores and compare their own scores to them. They also wanted to learn from other players' success in order to improve their own score and said the following:

   "...I find someone.. They have a really good score. How have they been doing or how have they.. were they always this good?" - E1

2. **Need for information to learn**
   E1 felt that it would be interesting to see their own emission levels but pointed out that there is a need for it to be contextualized and explained, in order for them to be able to change their behavior. If presented with information that is difficult to interpret, then this could lead to a loss of motivation. E1 explains it as:

   "But if I don't know where that condition lies or why it's that bad then maybe I will lose motivation to try to figure it out." -E1

3. **Team spirit is motivating**
   E1 valued both individual competing and competing as a group, but pointed

out that competing as a group could help the player feel less alone in the competition which could be motivating and said:

"...as a team you have that competitive nature, as a team you cheer each other on and give each other motivation, make yourself work harder." - E1

E1 also brought up the opportunity to be able to compete within the team as well, to see how well you are doing compared to your teammates and others in the organization.

E2
E2 is an expert in sustainability and human-computer interaction. For a full list of the interview questions, see Appendix 4.

1. **The app needs to be considered in its context**
   E2 meant that a carbon calculator can be an effective way to get thought processes around sustainability going, but that for long-term change it is important to consider the context around the use of the tool.

   "You might start thinking about eating more vegetarian but it does not mean that you are doing it. Then suddenly your kid tells you that they want to do it too and suddenly something happens." - E2

2. **Follow-up to create engagement**
   E2 suggested having regular meetings or activities in order to see how the progress is going and maintain engagement and morale in the competing teams. E2 also suggested having a designated person (in Swedish "Eldsjäl") who is dedicated to the purpose and who can keep up engagement in the group.

   "It can be a self-appointed or self organized enthusiast who cheers people on and acts as a driving force. If there is not such a person, they it all might fail because there is no feeling of belonging." - E2

3. **Contextualizing is important for understanding**
   E2 meant that the concept of a ton of CO2e emissions is difficult for people to grasp. In order for people to gain understanding, CO2e emissions needs to be contextualized or put into comparison with things that are more tangible to people. The respondent suggested the following:

   "...'your climate footprint is 5 tons of CO2'. No one is going to understand what this means." - E2

E3
E3 was asked to participate because of their expertise within environmental activism. The full list of questions from the interview can be found in Appendix 5.

1. **People influence each other's motivation and behavior**

E3 pointed towards the strength in numbers, and that knowing that a person is not alone can be powerful and provide with opportunities for reflection with other people The respondent explained it as:

"There is strength in knowing that you are many people thinking the same way and to have a discussion group where you can share experiences and difficulties that arise..." - E3

2. **Lack of knowledge**
   E3 held the impression that there is a lack of knowledge both when it comes to how urgent the climate crisis is but also regarding how much emissions different habits contribute to.The respondent meant that some people get shocked when they see that their footprint is higher than they thought, and that this is the case even for some people who view themselves as environmentally conscious. E3 shared their impression of the situation:

   "People think... 'Yes but I sort trash and I buy organic foods and do everything well in my everyday life, I cycle to work and then you think you can take a long-haul flight once a year.'" - E3

   E3 also brought up that some people avoid exposing their concerns about the environment out of fear of being judged by others, and thought that feeling part of a group can allow people to share experiences and difficulties that arise when changing to a more sustainable lifestyle. The respondent explained:

   "It is a sensitive question for many people and I believe the more alone you feel the more difficult it gets. So I think it is important to create a sense of community." - E3

3. **Both fearful and hopeful information can be effective**
   E3 had the impression that people change their behavior as a result of realizing how urgent and serious the climate situation is but also pointed out that doomsday information can be discouraging and have a negative effect.

   "...pictures of flooding or fires or the doomsday picture.. Me myself feel like I don't have the energy for that, if I read such things in my flow (social media) I feel crestfallen." - E3

   In light of this, the respondent also pointed to the importance of instilling hope and encouragement that changing habits can have positive effects such as having more time over for friends and family.

Bias
All interview participants but one had either used the Svalna application or were familiar with the application before, which could have affected their responses.

Three of the interviews were expert interviews. However, the interview with E1

did yield the data expected and took a different direction. The focus of this interview instead turned in to that of a potential user of the application. The reason for this could have been a mismatch of expectations or that the questions used did not manage to bring out the desired result. The inductive approach [17] was used, meaning that the results would determine the themes. However the questions intended to cover certain areas of interest, and a reason for change of direction could be that they did not manage to cover these areas sufficiently.

One of the participants had previously worked at Svalna AB, which could influence their responses. Another potential issue could be that the participant who had previously taken part in a climate competition had done so a couple of years prior to this interview. As time had gone by it is possible that they could have misremembered how they felt at the time.

5.2.4 Sketch

Five sketching sessions were carried out during the iteration, all through individual sketching with the use of Crazy 6 [42]. The Gestalt Laws [111] were applied throughout out all sketches in the project. We kept in mind that similar elements are often perceived as grouped together and how close elements are to each other can be interpreted as relatable.

Note that the sketches are conducted based on guidelines from this iteration (guidelines version 1) since the work was done iteratively.

Show how other people have lowered their emissions
The first sketching session aimed at solving the issue "G2. Show how other people have lowered their emissions" (created in this iteration) regarding that it can be motivating for people to see how other people have successfully lowered their CO2e. A Crazy 6 was conducted with 12 ideas in total generated. A dot vote was conducted where four out of ten ideas got the most votes. The four ideas were carried out in the remaining sketching sessions in the iteration.

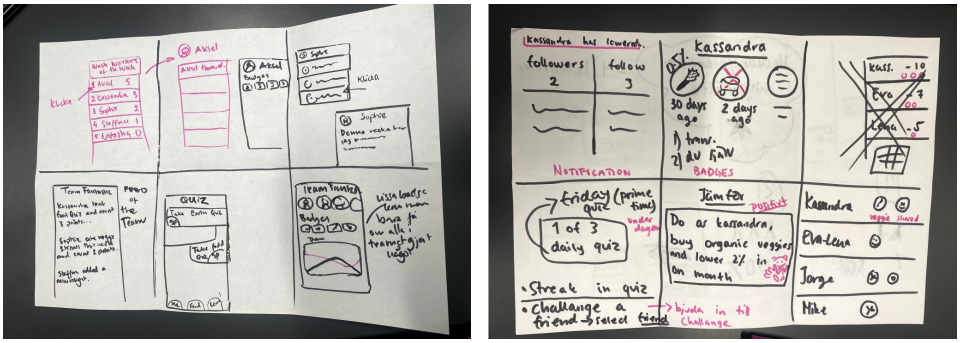

Figure 5.5: Crazy 6 on visualizing that other people have lowered their CO2 emissions

Option for people who do not want to share
The second sketching session aimed at sketching around a leaderboard based on "G17. Option for people who do not want to share" from this iteration. For this, Reverse brainstorming [75] was used which led to some worst-case ideas for displaying that people have not lowered their emissions. The created ideas were possible to flip to do as the opposite and therefore another sketching session was carried out for that.

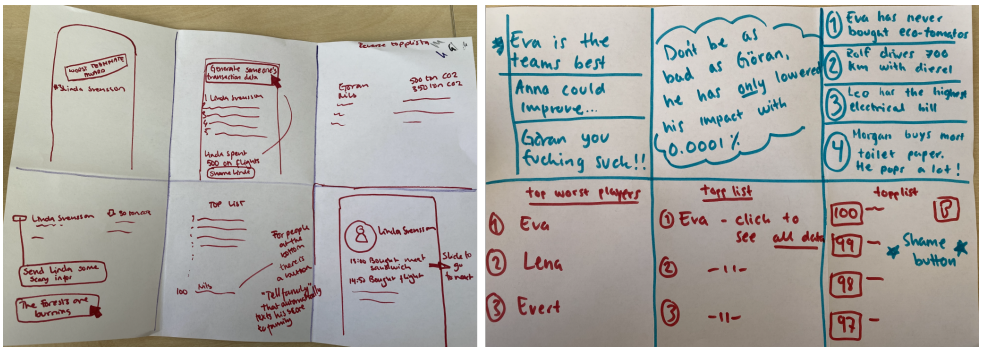

Figure 5.6: Reversed scenario for displaying that people have not lowered their emissions

Motivating people to lower their CO2
The remaining three sketching sessions were based on brainstorming on how to motivate people to lower their CO2. Ideas that came up from the first sketching session to motivate users through a quiz, to have a weekly or monthly climate hero or the ability to challenge another user were ideated on further. The ability to challenge another user is shown in Figure 5.7.

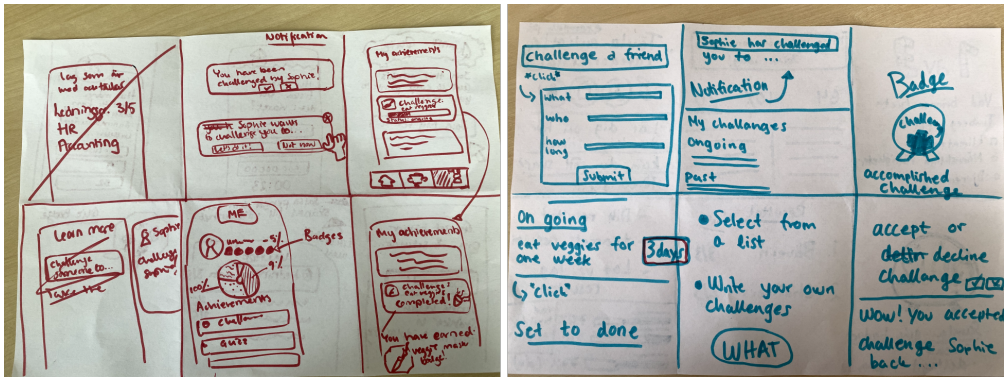

Figure 5.7: Crazy 6 on challenge another user

5.2.5 Guidelines version 1

A selection from the previous version of guidelines and the result from the Thematic analysis from the four interviews (P1, E1, E2, E3) was used to form version 1 of the guidelines. Firstly the guidelines were created in a document, then copied over to

Miro [74] to get a better overview.

The guidelines for version 1 were grouped into three levels: a main category in bold uppercase, a subcategory in italic and guidelines referred to as GX (X = number of guideline). Version 1 consisted of 32 guidelines divided into 8 categories and 12 subcategories. Seeing as most of them differ from the initial version of the guidelines that were based on the literature study, the full list is presented below.

Supporting references are shown on a subcategory level.

The guidelines are listed below:

SHOW OTHER USERS' ACTIVITY
Highlight that other people care too
- G1. Show that other people care about the environment (E3), [13], [107]

Highlight what others are doing
- G2. Show how other people have lowered their emissions (E2)
- G3. Highlight what others are doing (E2)
- G4. Learn from others (E3)
- G5. Get motivated to perform better (E1)

TRUST IN THE APP
Transparency
- G6. Be transparent (E3)

GAME ELEMENTS
Allow to set goals
- G7. Allow to set goals (E3)

GENERAL TIPS
Length of competition
- G8. Length of competition (P1, E1, E2)
- G9. Consider context/narrative (E2)

PROVIDE INFORMATION
Provide users with personalized information
- G10. Give tips and advice (P1), [32]
- G11. Personalized information (P1), [60], [71], [38]

Provide users with general information
- G12. Contextualize CO2 emissions (E2, E3), [61], [30]
- G13. Lower risk of adopting pro-environmental behavior (E3)
- G14. Highlight positive effects of changing behavior (E2, E3)

Do not make users feel bad
- G15. Do not guilt people [71]
- G16. Do not use scare tactics (E3)

DIFFERENT TYPES OF USERS
Allow users who have different interests
- G17. Option for people who do not want to share (P1)
- G18. People who are there for gaining more knowledge and people who want to play (E1, E3)

Allow users with different expertise
- G19. Accommodate new and expert environmentalists [60]
- G20. Break down categories [19]
- G21. Allow people to progress over time (E2)
- G22. Consider the level of activities/changes suggested (E2)

ENGAGEMENT
Keep users engaged
- G23. Send prompts [6], [35]
- G24. Keep the engagement through following up (E2, E3)

TEAM LEVEL
Team spirit
- G25. Team spirit helps me perform better (E1, P1)
- G26. Compete on a group level [3]
- G27. A driving force (enthusiast) (P1, E2)

Allow users to compare against others
- G28. Offer comparisons (E2)
- G29. Most interested in their own result comparing to others and not the team (P1)
- G30. Be careful letting people know they are below the norm (E3), [96]
- G31. Allow users to compete against people they know (E1, E2)

5.3 Iteration 2

During iteration 2 one interview and one design workshop were held. The workshop was based around the findings from the previous iteration regarding that respondents preferred to be anonymous on the leaderboard. A first version of the Sitemap was established. Based on guidelines from iteration 1, sketches were conducted and a low-fidelity prototype was created based on the sketches in the previous iteration. This was followed by a new version of guidelines, version 2, which is presented at the end of the iteration.

No changes were made to the personas and scenarios during this iteration.

5.3.1 Updated timeplan

Around this time we received information that it was unclear whether the climate step competition would be able to be held during the time span for our project. This led to our timeplan being adjusted to exclude the climate step competition

and focus on the other activities planned such as conducting interviews, workshop and test the design.

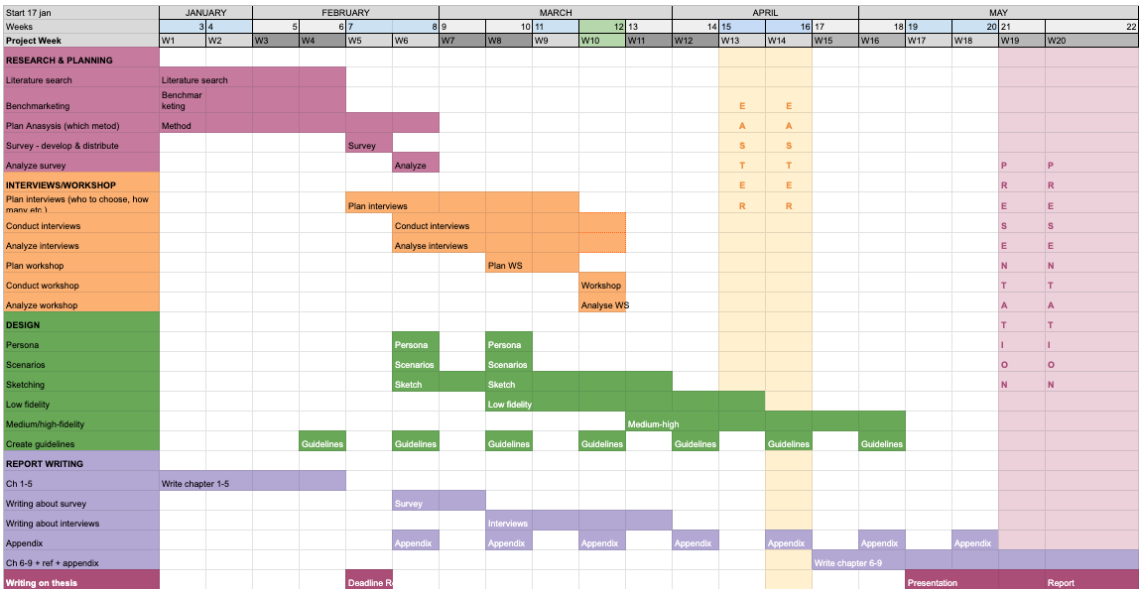

Figure 5.8: Updated timeplan version 2

5.3.2 Interview

Another interview was conducted during iteration two. The participant was someone who is involved on a daily basis in Svalna's products. The consent form was confirmed orally (instead of written as the other interviews).

The interview was mainly based on findings and problems that we had identified so far during this project surrounding Svalna's product, previous interviews and our own design work.

Analysis
The transcription and analyses was carried out in the same manner as for the interviews in iteration 1.

Takeaways
Below are the main findings from the interview with E4. Quotes have been translated from Swedish into English. The full list of questions from the interview can be found in Appendix 4.

1. **Low understanding of CO2 emissions**
   E4 emphasized that it is difficult for people in general to relate to and understand what CO2e means. E4 described it as:

   "As a friend of mine said; first of all, it's just weird that it's a gas and you measure it in ton. Gases are super light - tons, what? I don't understand

anything." - E4

E4 claimed that there is no standard way of describing it that everyone understands. However, the respondent suggested comparing it towards something else to make it more relatable, for example the amount of trees a certain amount of CO2 emissions equals to. E4 also suggests that tons can be easier for people to understand than kilos, because it is what the media usually refers to when reporting on CO2e.

2. **Homogeneous group at a company**
   Regarding competitions in a workplace, E4 discussed that a workplace has a rather homogeneous group of people. The level of CO2e may differ among employees, for example due to differences such as whether they fly or are vegan, but this does not affect the larger picture. E4 did not think it is worth focusing on people who start the competition with a low level of CO2 but instead to communicate to them that they are already performing well. E4 exemplified it as:

   "...you are actually the best, but it can be difficult for you to win this since you are already so good." - E4

3. **Choose a familiar concept**
   E4 highlighted the benefits of consciously choosing a concept that participants are familiar with. E4 says that Svalna's carbon calculator is inspired by a step-challenge as people can relate to and understand that concept.

4. **Greater effect of doing something together**
   E4 stated that showing how much a team has saved together can be more motivating than only showing it on an individual level. E4 described it as:

   "Of course if you are ten people in a group and nobody buys anything and you cause 150 kg. Then it's one and a half tons all of a sudden you have save together, it for sure sounds a lot more." - E4

   It does not only show a greater impact but E4 thought that it might be more fun to be a part of a group and know that together you have saved a certain amount of CO2. However, people who do not contribute to the goal of lowering their CO2 emissions need to be aware of their performance as it can trigger them to do better. E4 stated the following:

   "But it's almost a little embarrassing then, if you do not do something yourself /... / that's what drives you, that it's a shame that you haven't done anything."- E4

Bias
E4 is someone who is involved in Svalna's products, which can contribute to bias.

5.3.3 Design workshop

A design-workshop was held to come up with alternative solutions to a leaderboard. One problem we had identified at this point in the project was that participants of the climate competition had worried about being shown on a leaderboard and preferred to be anonymous. The notion of eco-guilt in regards to the use of a leaderboard was also supported by one of the expert interviews (P3) as well as research [71] discussing that people who have a larger CO2 footprint than others can experience eco-guilt. As this interfered with the possibility to use ranking as motivation in the competition, it was an issue that we decided to investigate further. As the issue around eco-guilt appeared to be more prominent on an individual level, we decided to limit the scope of the workshop to working with the problem around showing individual people on the leaderboard rather than teams. The goal of the workshop was then to explore how a leaderboard could be designed differently in order accommodate users who were worried about the above mentioned issue.

The design workshop was held with six colleagues from the interaction design program. This group was chosen because as well as being possible representatives of a potential user group of our study they were also not previously involved in the study and therefore were able to give a new perspective on the design problem.

The participants for the workshop were recruited through a request in the university Slack [97] channel as well as contacted directly by us. The workshop was held at Campus Lindholmen in Gothenburg and took 1.5 hours. Facilitation was divided so that one of us facilitated the first few activities while the other took notes, and the second half vice versa.

The workshop began with the participants being briefed on the project work and the purpose of the workshop: to look further into and brainstorm around the challenge regarding the use of a leaderboard and the wish by users to remain anonymous. A warm-up exercise was held to allow them to get to know each other and loosen up.

The brief was followed by an activity of reversed thinking where the participants were instructed to think about the worst possible way to visualize a leaderboard. The main part of the workshop involved individual sketching, dot voting, and a group solution sketch. In order not to influence the participants, a "stripped off" version of the current leaderboard of Svalna's app was shown, with the purpose of showing how the decrease/increase in CO2 emission is visualized today.

At the end of the workshop, a discussion was held about the solution sketches and provided an opportunity for the participants to and ask questions. They were also given the opportunity to leave written feedback around the workshop itself.

The workshop is referred to as "WS" in the guidelines. Full details of how the workshop was carried out can be found in Appendix 8.

Analysis

The workshop was discussed after the session while the information was fresh. This was followed by a dot vote of all sketches. The notes along with the resulting sketches were discussed and aspects that could be used as input for the project work were written down.

Takeaways
Some of the resulting discussions were about solutions that had been considered. For example, suggestions involved having a shorter leaderboard (top three), or using avatars or nicknames to not expose participants of the competition. The workshop also resulted in a few new ideas such as visualising progress in the form of shapes or illustrations of a field instead of text and numbers and visualizing CO2 with other objects instead of numbers, e.g. animals and showing rank in different categories. One of the participants suggested that it can be positive to "shame" people into behaving more environmentally friendly.

The feedback regarding the structure of the workshop was mainly positive. A few suggestions were brought up, for example mixing up the groups more with participants not only from the same education and using frames as support for the sketches, such as an iPhone frame.

Figure 5.9: A selection of images from the workshop

Bias
As the participants in the workshop were all students of our program, this might have resulted in a different outcome than if we had included for example people from the industry. Also, the recruiting of the participants involved us contacting some of them directly. This might have affected their motivation to take part in the workshop.

The workshop was conducted in Swedish. The results, both written notes by the participants and following discussions were translated by us. Even though translation was done carefully, this means that some information may have been altered or lost.

5.3.4 Sitemap

We used the method of Sitemap [54] to get a visual understanding of the user's goals and how they are connected to each other. Three main screens were created: the competition, the team's page and the user's own page.

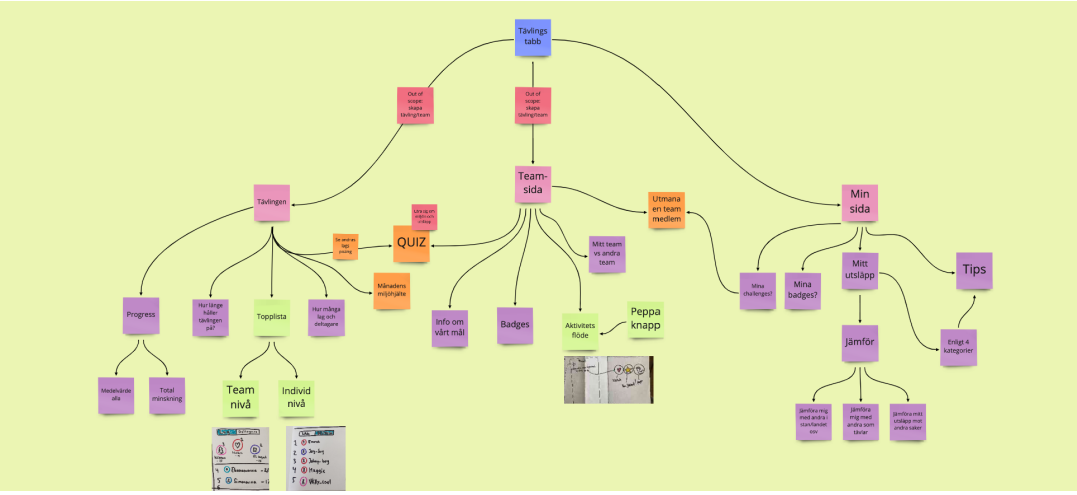

Figure 5.10: Sitemap version 1

5.3.5 Sketch

Four sketching sessions were carried out during this iteration. The sketching sessions focused on the topics of team spirit, providing users with general information, keeping users engaged, and how to visualize the leaderboard.

Team spirit

The first sketching session focused on the subcategory "team spirit" from the guidelines in the previous iteration. We started off by setting a timer for three minutes and wrote on post-its what team challenges could be, based on our understanding of the literature and the interviews. A user story was created to get a better understanding of how the user might feel in terms of team spirit, and it goes as follows: "as a user, I want to feel team spirit so that I can get motivated to perform better against other teams".

With the user story and post-it notes in mind, we sketched ideas for how team spirit could be shown in the app. The sketches were made individually and then presented to each other. Through dot voting we decided on which idea to iterate on further. The result of the sketching session led to the idea of having a team color and an activity feed to see what others in the team are doing along with being able to cheer on each other in form of a cheer button. The activity feed uses a technique known as social nudging [96], through which showing what other people are doing in regards to pro-environmental behavior can influence them into doing the same. In regards to nudging we had discussions about what the correct balance would be between nudging people through letting them see what others are doing and guilt.

Some ideas were to have encouraging messages comparing the user's emission categories they needed to improve in to that of the team mates, for example "Do like Anna, she has eaten vegetarian for one week". However, based on the interview findings regarding eco-guilt we reasoned that taking it to this level of social nudging through comparison could have a discouraging effect.

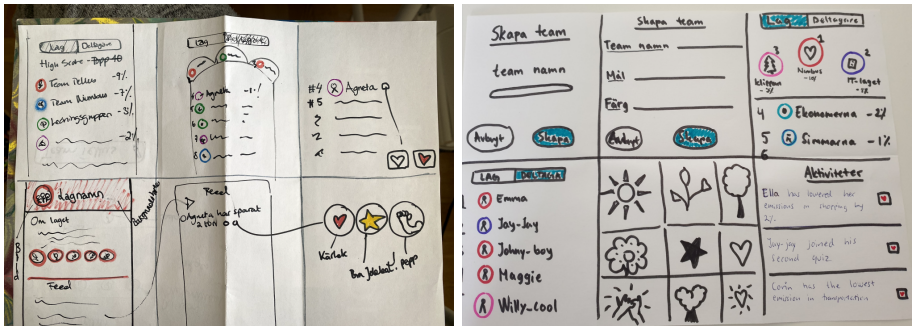

Figure 5.11: Crazy 6 on creating a team spirit

Provide users with general information

The next sketching session focused on the subcategory "provide users with general information". The sketching resulted in ideas around having a "learn more" page as well as small messages and tips spread out on different screens that show the user how they can lower their emissions, connected to the categories in which they have room for improvement.

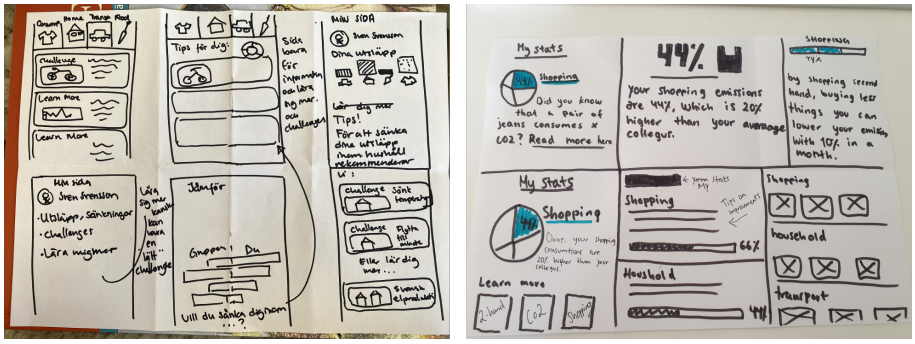

Figure 5.12: Crazy 6 on providing users with general information

Keep users engaged

The third sketching session for the iteration focused on the sub-category of "Keep users engaged". The idea of having challenges came up during the last iteration's sketching on "G2. Show how other people have lowered their emissions". After the sketching session, questions arose such as whether the competition was going to be performed as a group, individually or through invitations to one or several selected persons. Another question was whether a majority of people in a team would want to participate in the same challenge in order to create a feeling of team spirit through doing something together.

The idea of having a theme for each group arose. The idea was that the theme

should be decided on by the team at the start of the climate step competition to give the team a sense of team spirit and a common goal (more so than for example to lower emission by 10 percent). An example of themes could be either the categories that Svalna's app has now (shopping, transport, food and household) or according to different areas of interest such as animals, health and environment.

The sketching session was continued in Miro [74] where different ideas were explored on how a team challenge could be designed. One idea was to choose a common goal as a team and thereafter it would be up to each person in the team to choose the amount of effort they want to put in, for example, bike every day for 3 months, 1 month or 2 weeks. A second idea was to select 2-3 goals per team and then decide individually which one to proceed with.

Leaderboard
The fourth and last sketching session was conducted to ideate on the design of the leaderboard. The result from the workshop was used as a foundation for the design. The result of the session led to two options for showing the leaderboard both on team level and individually to work with the guidelines from previous iteration "G29. Most interested in their own result comparing to others and not the team" and "G26. Compete on a group level". The sketches of the leaderboard showed both overall ranks but also rank according to different categories. This would allow participants who are not able to lower their emissions in one category, for example, "transport", to be in the lead in areas in which they are actually able to lower their emissions, for example, "food".

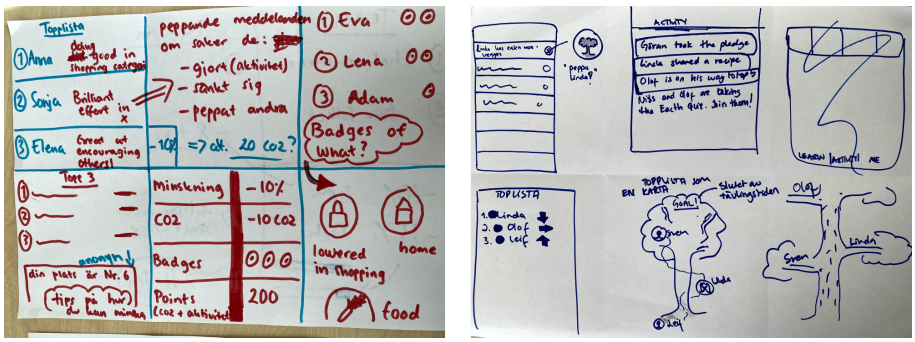

Figure 5.13: Crazy 6 on the leaderboard

5.3.6 Low-fidelity prototype

The sketches were developed into two low-fidelity prototypes to focus on the functionality rather than look and feel of creating a high-fidelity prototype.

Challenges
The idea from the third sketching session (keep users engaged) of having challenges turned into a feature of "challenge a friend" where one could invite one or several persons in the climate competition to participate in a challenge. The challenges were

designed to be selected according to difficulty to support the "G19. Accommodate new and expert environmentalists". Nudging has been utilized for the challenges feature in order to motivate the user to participate in a challenge. This was done by presenting an estimation of how much CO2 a user can save if completing the challenge.

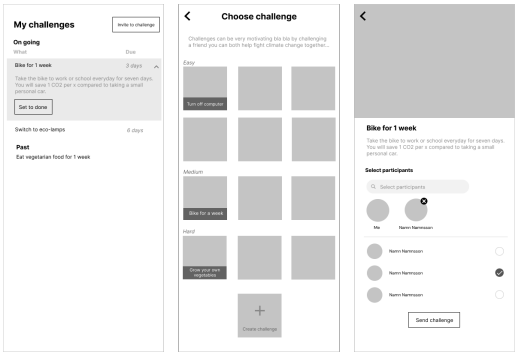

Figure 5.14: Low-fidelity of Challenges

Leaderboard

The leaderboard was also designed in a low-fidelity version in Figma [34]. The design showed a leaderboard of ten teams or people in the organization, as well as the user's individual placement. By default the screen shows "teams" and if a user wishes to see the ranking of people, it is possible to switch to this view by clicking on "people". Focusing on the teams can be supported by "G25. Team spirit helps me perform better".

When clicking on a person in the leaderboard the user can get tips on how that person has succeeded in the area of challenges and which category they are performing best in. This idea was based on "G2. Show how other people have lowered their emissions" from the previous iteration.

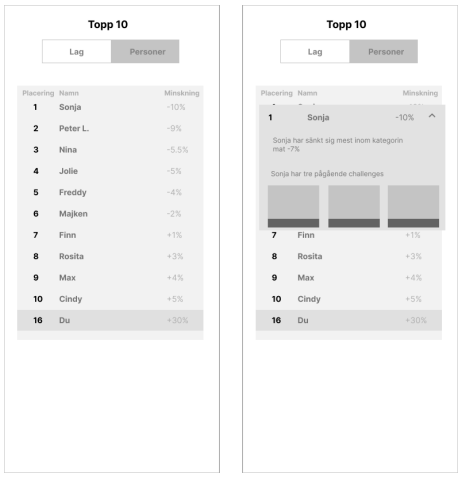

Figure 5.15: Low-fidelity prototype of the leaderboard showing top 10

5.3.7 Guidelines version 2

Version 2 of the guidelines consisted of a total of 39 guidelines divided into 10 categories and 16 subcategories. The result from one more interview (E4) was added, which led to seven new guidelines, two fewer categories and four fewer sub-categories.

Note that the numbering of guidelines may differ between iterations as a result of guidelines being added or removed.

The categories, subcategories and guidelines that have been added will be presented below:

DESIGN OF THE COMPETITION
Added category:
A category, 'Design of the competition' was added to incorporate guidelines regarding factors that do not necessarily have to do with the design of the application itself, but on a more of a conceptual level.

Added subcategory:
The subcategory *'Keep it relatable'* was added.

Added guideline:
- G1. Choose a competition concept that people can relate to (E4)

This guideline was added based on the interview with E4, highlighting how a quicker on-boarding process can be achieved through using a concept that is already familiar to the user, for example a step competition.

PROVIDE INFORMATION
Added subcategory:
The subcategory *'New content/Keep up the excitement'*, was added to accommodate the new guideline G10.

Added guideline:
- G10. Keep information fresh [60], [62]

This guideline was added as a result of looking back at previous literature research [60] as well as newfound literature [62].

DIFFERENT TYPES OF USERS
Added guideline:
- G20. Allow users to compete individually (E4)

This guideline was added as a result of the interview with E4 who suggested letting people compete as individuals in case group dynamic does not work out.

- G25. Have different categories in which you can win (E4)

This guideline was added as a result of the interview with E4. It suggests allowing users to have the opportunity to win in different areas, such as different categories.

COMPETE AGAINST OTHERS
Added category:
The category 'Compete against others' was added to be able to separate general competition from team competition. This also meant that the subcategory *'Allow users to compare against others'* was moved to this category, from the 'Team level' category.

Added subcategory:
The subcategory *'Shame can lead to people performing better'* was added.

Added guidelines:
- G28. Let people see their placement even if they are doing poorly (E4)
- G29. It can be good to scare a little (E3)

"G29. It can be good to scare a little" contradicted some of the previous guidelines, for example "G15. Do not guilt people" and "G16. Do not use scare tactics" suggesting that opinions differ and that the context of the competition can call for different considerations regarding these guidelines.

TEAM LEVEL
Added guidelines:
- G36. Team with people who know each other (E1)
- G37. Compete on a group level (E4)

Two guidelines were added following the interview with E4. By allowing people to compete as a group the progress can be aggregated, which could be motivating.

5.4 Iteration 3

Two interviews were held at the beginning of iteration three. This was followed by a kick-off event for the pilot study for the climate step competition, which was then followed by three interviews with the participants of the competition. The personas were updated according to findings from the previous iteration. Two tests were carried out on the leaderboard and challenges prototypes from the previous iteration. Sketches, low-fidelity and high-fidelity prototypes were created. In previous iteration we found relevant literature that we decided to add into this iteration. The iteration ended with creation of guidelines version 3.

No changes were made to the Sitemap during this iteration.

5.4.1 Updated timeplan

At the end of the previous iteration we received information that the climate step competition was going to be held starting first of April. This led to us updating the

timeplan in order to incorporate interviews with the participants of the climate step challenge into our plan.

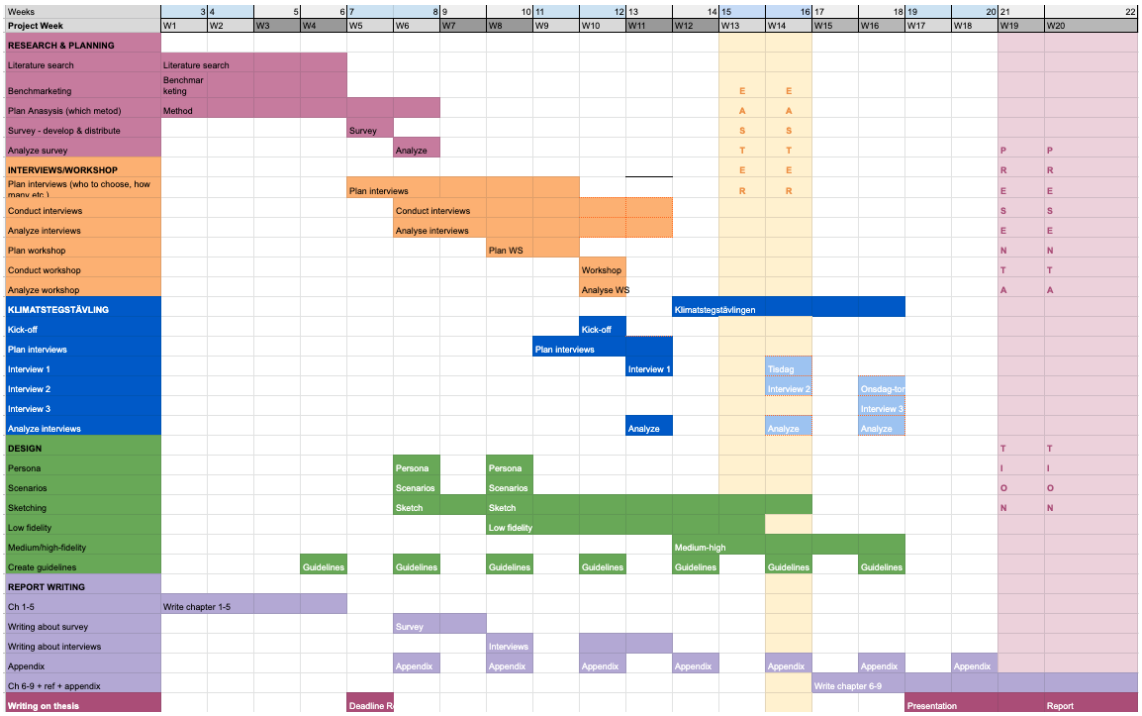

Figure 5.16: Updated timeplan version 3

5.4.2 Interviews

In this iteration, two interviews were held with experts within the field of gamification, here referred to as E5 and E6. The purpose was to get a better understanding of how gamification can be used to promote pro-environmental behavior.

Analysis

Both interviews were conducted and analyzed using the same procedure of doing a version of a Thematic analysis [17] as in the previous iteration, with separate analyzes. However, the transcription of these two interviews did not include transcribing exact phrasing of words but instead focused on the essence of what the interviewee was saying. This was done in order to speed up the process. For the analysis of the interview with E5, the result and quotes have been translated from Swedish to English.

Takeaways

E5

E5 was asked to participate because of their expertise within gamification. The full list of questions from the interview can be found in Appendix 5.

1. **Gamification and sustainability are a good match**
   E5 had the experience that gamification can give strong effects when it comes

to pro-environmental behavior learning. The respondent made a connection to exercise gamification, which along with sustainability gamification often has a common goal as a driving force. However, while E5 thought gamification elements, such as badges, can support engagement in the users, they felt like too much gamification is not good. The respondent gave the example of collecting points, which could become boring after a while.

E5 also mentioned to be aware that the use of leaderboards in systems aimed at learning needs to be considered carefully as it can cause stress, especially in Scandinavian culture. The respondent suggested solutions such as only viewing the user's own position in relation to three users above and three users below, or only showing a leaderboard of the teams.

2. **Opportunities to learn**
   When it comes to people's general understanding of the concept of CO2, E5's impression was that it is difficult to comprehend, and suggests to contextualize it and put it in comparison to the climate goals and average emission for living. E5 put it as:

   "This is what is needed, so that you do not get 20 000 kg. Okay, is this good or bad?" -E5

   E5 also brought up the importance of providing easily accessible information, to promote learning - so called micro-learning. The respondent meant that giving users access to information can lead to them feeling more engaged in the issue, than those who do not have access to learning. In addition to having a goal, this would provide the user with a sense of "why am I doing this". The respondent put it as:

   "It is only fun to collect points for a while... I need a goal and understand why I am doing this." -E5

3. **Keep it simple**
   The respondent's impression was that most people have a certain level of app-fatigue, and suggested keeping the system simple. In relation to engaging in sustainable gamification, E5 gave the example:

   "I am saving the world and I want to save the world, but I also want to help my daughters with their homework." -E5

   Especially in the case of having the competition as a workplace activity, the respondent suggested having the system embedded into already existing ones. In addition to making it easy, they also suggest that workplace competitions and competitions with friends can have different motivations, where competing with friends needs to be more "fun fun fun".

E6
E6 was selected as a participant due to their expertise in pro-environmental behavior in a workplace context. See Appendix 7 for the full list of questions from the interview.

1. **Easy and accessible**
   E6 referred to similar apps aimed at behavior change, such as nutrition apps and fitness apps, and stated that these types of apps need to be easy to understand and accessible. If they are non-intuitive or too complicated, the user might stop using it. The respondent explains it as follows:

   "When you open the app you want to know what it is you need to do. If you need 3 hours to understand what to do, you're uninstalling it." -E6

   Furthermore, the respondent's experiences indicated that in a workplace setting, the design should not be too distractive or take up too much time from the user's daily work tasks. A solution to make it efficient could be to have the app automatically calculate emissions, so that people do not end up having to make several entries each day.

2. **Motivation in the workplace is more difficult**
   Regarding motivation, E6 meant that a competition in the workplace has its challenges as a result of it not being as voluntary as it would have been if it was with a group of friends. The respondent said that this pressure can kill intrinsic motivation as it would be perceived as just another task to do at the same time as the social connections in a workplace can affect motivation:

   "It's not voluntary as it is when deciding to do something with a group of friends. That must not be bad because it generates some pressure, but the social bonds may be less encouraging." -E6

   E6 also brought up the difficulty with the friction between work and and private life that this type of competition can involve:

   "But where I got a pressure to do something with my colleagues which is not related to my work at all." -E6

3. **Game elements**
   In regards to gamification elements, E6 stated that social features in an application aimed at bringing about pro-environmental behavior needs to be considered carefully especially in the case of it being a workplace initiative. The reasons for this was that other ways to connect with people already exist, such as through social media, and this means that a similar social feature could be redundant. Additionally, E6 suggested to include a range of different game design elements in order to meet a range of different people's needs.

Regarding leaderboards, E6 thought that it should only view the top players in the competition.

4. **Make information tangible and comparable**
   E6 thought that when it comes to behaving pro-environmentally, people want direct feedback on what impact their behavior leads to and what it refers to. However, the feedback information needs to be tangible. The respondent explains how this could be done:

   "They want to see 'by doing this I'm saving 10000 km driving in a car' because they can understand what that is. They want to see 'what is my impact' and understand that they have an impact." -E6

   In addition to receiving tangible feedback, E6 thought that it could be interesting to let the user compare themselves against others to see if they are the benchmark. When it comes to providing the user with tips, the respondent thought that these should be tailored to the user and not general and that it should be considered if it is useful at all as it is possible to google to find information on what to do.

Bias
E5 and E6 had previously worked together, hence the point of view in the two interviews may be similar.

5.4.3 Pilot-study of the climate step competition

The pilot-study of the climate step competition took part in a public organization in a medium-sized city in Sweden. The climate step competition was scheduled to last for eight weeks (1st of April to 1st of June). The pilot-study was a try-out before launching a larger campaign during the autumn of 2022 where around ten companies would participate.

Three teams of different sizes were created from different departments in the organization.

Kick-off event
A kick-off event was held by Svalna AB as an introductory activity for the climate step competition. The purpose was to introduce the company and employees to the concept as well as to the Svalna app, and to answer questions regarding the competition.

30 employees were invited to the kick-off and around 12 people participated. The kick-off took part at the organization's office where everyone was gathered in a conference room except for the organizer from Svalna AB who participated digitally over Teams.

The kick-off started off by introducing the pilot-study and the app Svalna. Thereafter a card game named "Klimatkoll" [1] was played to create an awareness of what CO2 was equivalent to. Yet another presentation was held and the kick-off finished off with a discussion.

The participants were informed about safety of using the application and transaction data. Safety has been a concern of participants in previous carbon challenges using transaction data [7].

Several questions were brought up by the employees during the kick-off event. For example, issues such as shared economy were brought up. Since the calculations are done using bank transaction data, one employee was concerned about what happens if a person has a joint bank account with their spouse. Yet another question concerned how the app calculates previous purchases such as a flight ticket.

One person had tried the app and realised that a large portion of their emission was a result of structural conditions, such as limitations in energy providers. Another issue was that some areas offer limited choices of restaurants and shops, which may make it more difficult to make sustainable choices such as choosing to eat vegetarian.

Some suggestions for solutions or ways to think about the app were also made: using the app as a tool to determine what one can do as an individual and what is tied to external factors such as infrastructure and highlight in what areas a city is performing well or poorly.

Interview 1 of the pilot-study
Three employees at the organization where the pilot-study would be held were recruited to be interviewed. The participants worked at different departments and would be part of three different teams participating in the competition.

The interviews were planned to be done on three different occasions during the climate competition in order to gather insights over time. The first interview was held before the start of the climate competition, the second one was scheduled to take place in the middle of the competition and the last one at end of it.

The three interviews from the first interview occasion were conducted digitally through Teams. Each interview was scheduled to last for 30 minutes.

The interviews focused on the employee's interests of the sustainability and the climate, previous experience in competitions, and their expectations for the upcoming climate competition.

Analysis
The analysis of the interviews was conducted in the same way as in previous iterations. However, since all three interviews for the pilot study were conducted using the same interview template, they could be analyzed together using the method of

Thematic analysis [17].

Takeaways
The result of the Thematic analysis resulted in five themes: attitude towards competing, lack of knowledge regarding environmental effects, personal improvements, team setting can increase motivation and expectations of the upcoming pilot study. Quotes from P2, P3, P4 have been translated from Swedish into English. The full list of questions from the interview can be found in Appendix 6. The themes are discussed in detail below.

1. **Attitude towards competing**
   The interviewees expressed differing attitudes towards competing. P2 and P4 had a positive mindset towards competitions in general and in relation to the upcoming pilot study. P4 specifically thought that competitions on a team level could lead to team spirit which was encouraging.

   P3 was less of a competitive person and was not attracted to the competition aspect but was more interested in the team's progress. Even though P2 could see the benefits of being in the competition, the respondent thought there might be some fear from fellow colleagues who don't like to compete or don't believe that the tool calculates the correct value of their CO2 emissions.

2. **Lack of knowledge regarding environmental effects**
   P4 highlighted the importance of people having knowledge about the relation between CO2 emissions and the real world. The respondent emphasized that the effects of the lack of knowledge could lead to people thinking that "I sort garbage, therefore can I fly to Thailand". P2 believed that a reason why the environmental issue is having slow progress is due to people not realizing its urgency. The respondent claims that it is easier to take action when something is happening right now, for example when there is a war or if there is a fire.

3. **Personal improvements**
   Two participants (P2, P3) thought that they were doing a lot of pro-environmental behavior already. P3 did not have anything specific they wanted to improve but was open for suggestions from the tool:

   "It's interesting if the app can make me feel that, that it's something I should do even though I don't do it during this period I might do it in six months." -P3

   P2 had similar ideas and hoped to be steered into improved pro-environmental behavior. However, the respondent (P2) struggled with eco-guilt knowing that some behavior resulted in bad environmental impact. P4 who also felt that they had a level of consciousness about environmental effects believed that the tool would be able to help improve their pro-environmental behavior and hoped to gain more insight into how small purchases affect CO2 emissions.

4. **Team setting can increase motivation**
   P2 said that it's better to focus on a person's own improvements instead of the group since people who have high CO2 emissions might not feel like taking part. The respondent (P2) said that the competition can have a boomerang effect and lead to de-motivation and stated the following:

   "If you compete against each other, it's like if you were to compete in a step competition, you have an elite athlete with you and then you are a 'couch potato' and then there is the risk that you just don't care about it instead, you do nothing." - P2

   The respondent (P2) meant that it is people who have high emissions that need to take part in a competition like this. One respondent (P4) said that working together in a group could show a greater difference in the outcome and exemplified it as follows:

   "Wow, now we have already saved 200 tons, by only this small thing." - P4

   P3 said that it could be encouraging to discuss in the team what others have done, and if another person for example had sold their car, it would probably affect the respondent which might result in the them trying harder.

5. **Expectations of the upcoming pilot study**
   P4 had the expectation that the pilot study would be a starting point to see how well the tool worked, with the aim to market it towards residents in the area in which the pilot study took place. Similarly, P2 wanted to experience the tool and see how well it worked with the ambition to carry this forward in their daily work. P3 also wanted to experience how well the tool worked and was particularly interested if it had an effect on them as a group of how much they could lower their emissions. The respondent (P3) was curious if the tool could lead to discussions about sustainability that otherwise wouldn't arise at the workplace.

Bias
Potential interview participants were approached by one of the people responsible for the climate step competition at the organisation. It may be that these people were especially interested in matters regarding the climate.

5.4.4 Personas and scenarios

Changes were made to the personas and scenarios based on the interviews from the current and the previous iteration. The persona Martin was adjusted according to what some of our interviews (P1, E2) highlighted regarding that people who have low CO2 emissions from the start of the competition have a hard time lowering their emissions further. The persona Denice was also adjusted, where a frustration point regarding not wanting to share sensitive information added, based on the interviews

with P1 and E2.

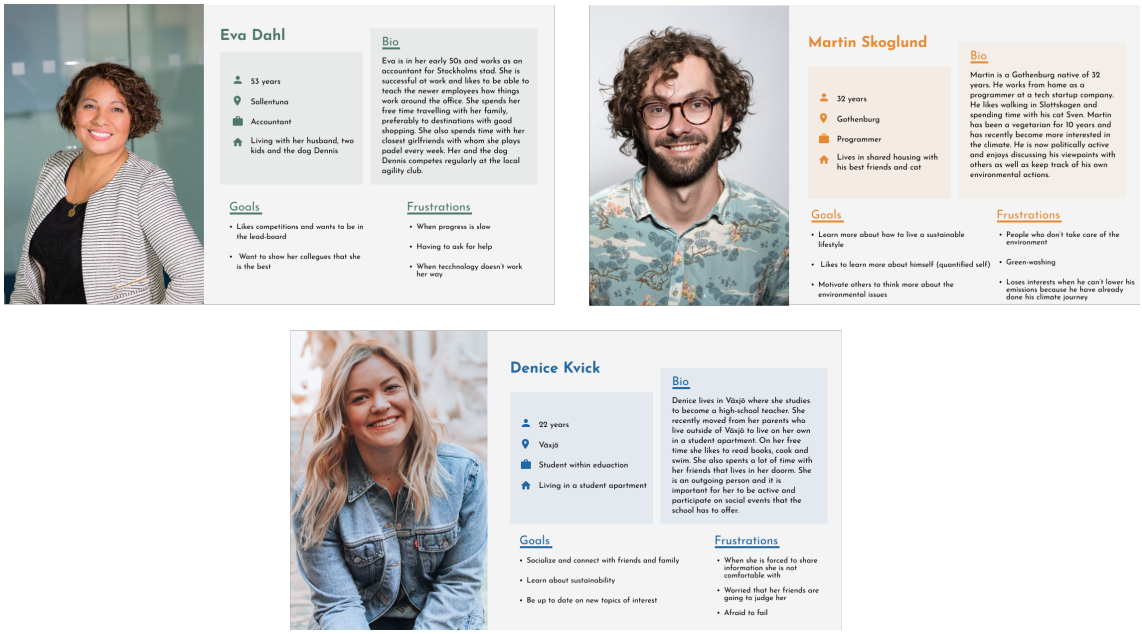

Figure 5.17: Persona final version

A scenario was also created for each of the personas to show the initial steps where the user gets introduced to the competition until the end of the competition. Eva's scenario (Figure 5.18) starts with one scenario but has the possibility to end in four different outcomes.

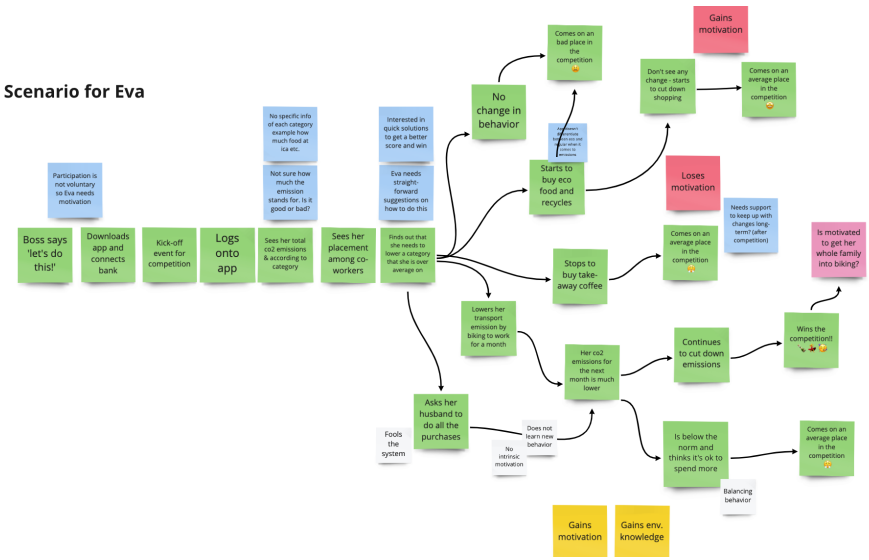

Figure 5.18: Eva's scenario

5.4.5 Sketch

Individual sketching of the leaderboard was carried out based on the workshop from the previous iteration. A dot vote was done and a shared sketch was made to get a

common understanding of how to proceed. The top voted sketch ended up showing three people or teams in the leaderboard instead of the whole list that Svalna's design currently has. The suggestion to limit the leaderboard by not showing all members was brought up in the workshop as well as in interviews (E5, E6).

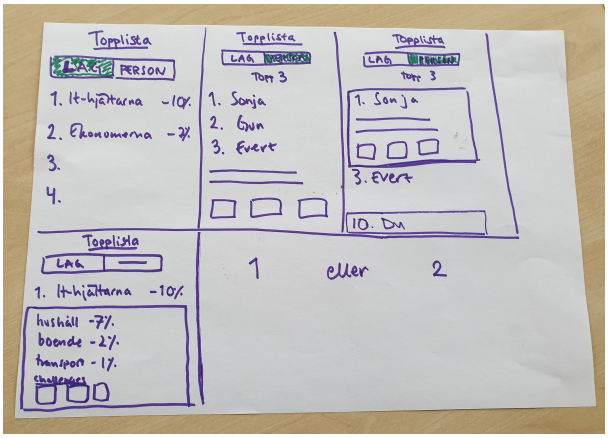

Figure 5.19: Joint sketch of the leaderboard

5.4.6 Low-fidelity prototype

The sketch of the leaderboard (see Figure 5.20) was created as a low-fidelity prototype in Figma [34]. "Top 3 emitters" were added during a discussion as a result of "G25. Have different categories in which you can win" from iteration 2, which highlights that users with already low emissions could be allowed to win based on different criteria.

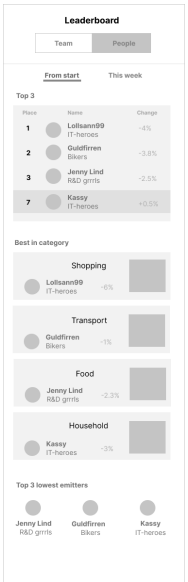

Figure 5.20: Low-fidelity prototype of the leaderboard

5.4.7 High-fidelity prototype

The leaderboard was developed further in Figma [34], where colors, images and icons was added. The green color is Svalna's theme color as well as the four category colors. The cards in "best in category" ended up side-by-side instead of under each other in order to not take up too much space since the main focus should be on the top three ranking.

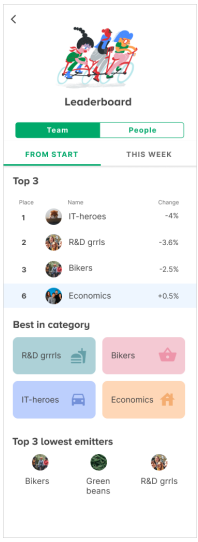

Figure 5.21: High-fidelity prototype of the leaderboard

5.4.8 Test

During this iteration, two low-fidelity prototypes "leaderboard" and "challenges" that were created in the previous iteration were tested. The leaderboard prototype was tested on four people. Some of these tests were carried out in person and some online. The challenges prototype was evaluated by one person physically. During this and the upcoming tests, we had in mind to select test participants with different experience in design, environmental awareness and of different ages to get as diverse group as possible.

Analysis
Highlights on key terms and phrases on the notes for the leaderboard and challenge prototype were conducted. The four tests focused on the leaderboard were analyzed in a shared document.

Takeaways
One of the test participants expressed that people with low emissions have no possibility to be shown in the leaderboard and that the leaderboard works well if everyone begins around the same starting point. Another participant wondered why "six months" was shown and not "from the start" and gave a suggestion to show the overall leaderboard as default and allow the user to select the leaderboard according to week if preferred. Another suggestion was the use of a point system where a user

could get points by helping others to lower their CO2e.

The test revealed that the design required improvements because there were some misunderstandings about what a challenge was, how long each challenge lasted and how many challenges one could select.

Bias
The test participants were people from our personal network, ages ranging between 25-32. A possible disadvantage could be that the respondents felt pressured to give positive feedback, however on the contrary, the fact that we know them could also give the effect of the respondents feeling safe to express critique.

5.4.9 Added literature

As a result of the focus on gamification during this iteration, we were recommended by one of the respondents in the interviews to look into a study that had been done on gamification and pro-environmental behavior in a workplace. The study had identified several motivators for employees to carry out pro-environmental behavior as well as considerations for an app design. The study resulted in a few design considerations that could contribute to a gamified app being successful in the area of pro-environmental behavior. Among these factors were to allow for social comparison and to have an easy to understand app that would not take up too much time from actual work tasks [62].

The interviews (P1, E2) highlighted that people can gain eco-guilt when viewing others on a leaderboard that are performing better than them. In our literature research we had limited sources referring to this problem and therefore we decided to fill this gap during the execution phase. According to a researcher [92], a leaderboard can be perceived as demanding in terms of motivation because a selection of people are displayed at the top of the ranking whereas a majority of people are at the bottom. On a team level, though, being on the leaderboard can be encouraging. Another factor which might increase the level of motivation is to have a goals that are possible to reach.

Additionally, we found that people had differing views on whether promoting pro-environmental behavior warrants the use of fearful information or eco-guilt. This led us to investigating the topic further, adding an article by Kessels et al. [90] to our reading list. Kessel et al.'s review of fear tactics in the communication of health information found that this type of behavior change method was not effective.

Finally, the first set of tests was carried out during this iteration. While planning the tests we realized that "Think-aloud" [85, p. 365-266] might add valuable insights into our tests, as this method allows the user to explicitly tell what they are thinking or doing out loud instead of for example retelling how it was at a later stage.

5.4.10 Guidelines version 3

The guidelines were adjusted at the end of iteration three based on the analysis from the five interviews (E5, E6, P2, P3, P4) conducted in this iteration, resulting in guidelines version 3. Since the two expert interviews revolved around the themes of gamification, sustainability and competitions in a workplace setting, these were themes that could be found in the new guidelines.

At the end of this iteration, four new subcategories and 20 new guidelines were added. In total, version 3 resulted in 59 guidelines divided over nine categories and 21 subcategories.

Note that the numbering of guidelines may differ between iterations as a result of guidelines being added or removed.

The changes in guidelines, categories and subcategories are listed below:

DESIGN OF THE COMPETITION
Added subcategory:
The subcategory *'Consider which context the competition is held in'* was added.

Added guidelines:
Five new guidelines were added to this category, the majority of them adding the workplace context as a result of the interview with E6:

- G2 Design for different cultures depending on which area of the world you focus on (E1)
- G3 Consider long term effects (P3)
- G5 Have automatic calculation of CO2e (E6)
- G6 Keep in mind that in a company context, people might feel obliged to participate (E6)
- G7 In a company setting, more effort can be needed to create 'team spirit' (E6)

GAME ELEMENTS
Added guidelines:
Four new guidelines were added to the category of game elements, as a result of the interview with E6, some of which were backed up by previous interview respondents:

- G11. Consider having predefined goals to choose from (E6)
- G1. Do not use chat functions (E2, E6)
- G14. Do not show all players on the leaderboard (E5, E6)

PROVIDE INFORMATION
Added subcategory:
The subcategory *'Provide feedback on consequences of a user's emissions' was added.*

Added guidelines:

- G21. Show how emissions affect the individual's life (E6)

DIFFERENT TYPES OF USERS
Added subcategory:
The subcategory *'Allow users to change their interests/personalities over time'* was added.

Added guidelines:
Four new guidelines were added as a result of the interviews with E5 and E6. These were mainly to do with suggestions for how the design could accommodate different types of players:

- G26. Have the system adapt to different player types (E5)
- G28. Design with a variety of game elements so that every player type would find something appealing (E6)
- G30. Consider that people who already have low emissions can have difficulties lowering their emissions (E6)
- G35. Design for people to change their personalities and interests over time (E5)

TEAM LEVEL
Added guidelines:
Five guidelines were added to this category, all emphasizing being able to compete on a team level and developing team spirit.

- G45. Team up with people who know each other (E5)
- G47. Help team members who are performing worst (E5)
- G48. Being able to cheer on each other (E5)
- G51. Have a common goal and allow players to choose their goal that leads to the common goal (E5)
- G52. A bigger impact can be achieved when working as a team (E5)

5.5 Iteration 4

This iteration carried the activity of updating the Sitemap based on the previous iteration's guidelines. Sketches and medium-fidelity prototypes were produced. A test was conducted based on the previous iteration's low-fidelity prototypes of challenges and leaderboard. The guidelines that became version 4 were established with new names and categories with the focus of improving last iteration's guidelines.

No more interviews were conducted or changes made to the personas or scenarios hereafter.

5.5.1 Updated timeplan

We held off planning any additional interviews with climate step competition participants until we would receive further information regarding the competition's start date.

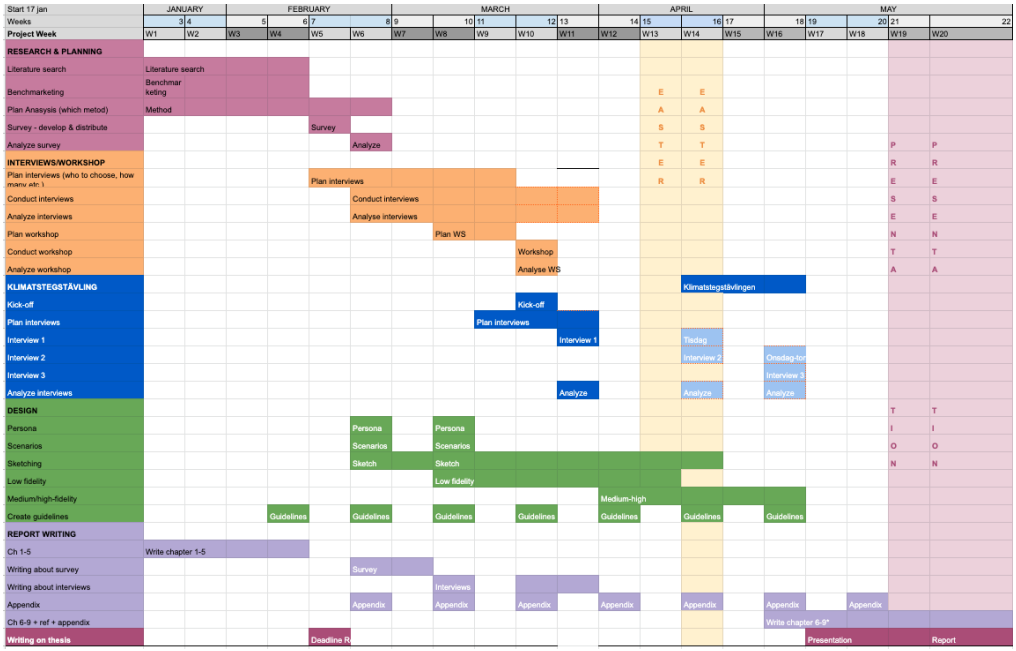

Figure 5.22: Updated timeplan version 4

5.5.2 Sitemap

Two screens were added to the Sitemap based on the guidelines "G6. Make CO2 emissions understandable by contextualizing them" and "G8. Provide users with information on how to adopt pro-environmental behaviors" from iteration 4. One page for "learn more" and another page for "challenges" were added. The "competition" screen was changed to "organization level" to make it more specific for the user what the screen contained.

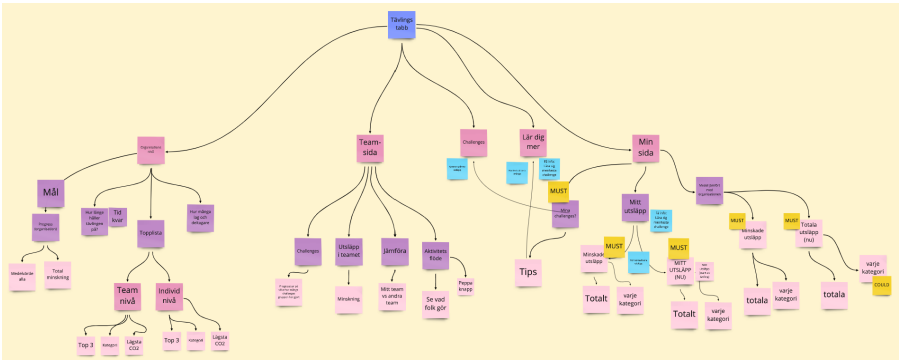

Figure 5.23: Sitemap version 2

5.5.3 Sketch

An individual sketching session on how to visualize people's change in CO2e was carried out followed by a dot vote to see which one would be iterated furthered on. A shared sketch was created based on the dot vote, showing five ways of visualizing how people have increased or decreased their emissions over time.

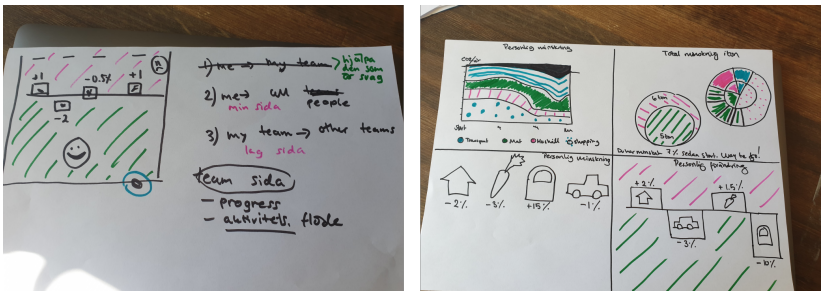

Figure 5.24: Joint sketch of a user's change in CO2e

A sketching session around the navigation of the different screens was held. A home page was created to be able to provide quick information, from where the user could get redirected to the full leaderboard by pressing a shortened version of it. This design was inspired by widgets. An idea also arose with having a shared view for the team and organisation in which the user could switch between the views with a button.

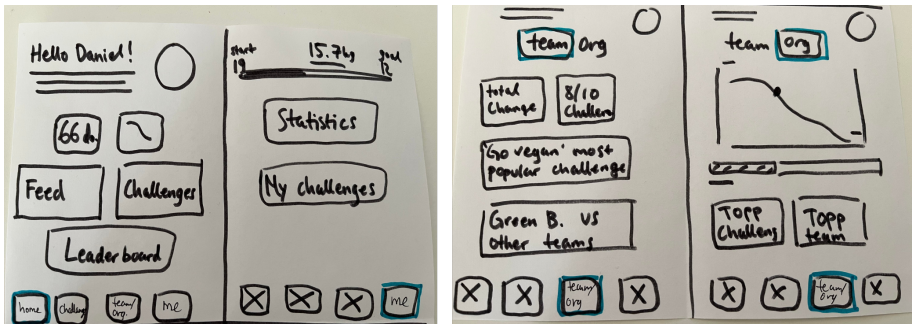

Figure 5.25: Joint sketch of the different screens

5.5.4 Medium-fidelity prototype

The sketches from iteration 2 were iterated further into medium-fidelity version. The tests during this iteration showed that participants wanted to sort the challenges based on categories (food, household, transport and shopping), since the list might get very long when having a lot of challenges. This led to four buttons being added, that would allow for sorting between the challenges. The concept was also changed from being able to send an invite to another people into taking part in the challenge yourself.

Another added functionality during this iteration was that users can see other people who are taking part in a competition. This is supported by the sub-category "Highlight what others are doing" in the guidelines. The added functionality is a way of nudging and motivating the user into doing what other people are doing. Caraban et al.[6] refer to this as spark nudge where the user has the ability but low motivation to do a task.

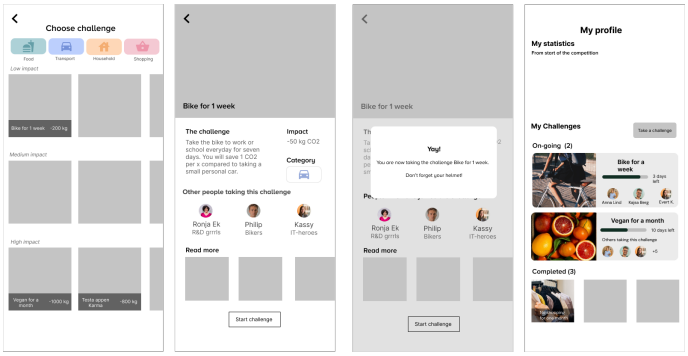

Figure 5.26: Medium-fidelity of challenge

The prototype throughout this iteration and all others has been designed with Don Norman's [82, pp. 7-25] seven principles in mind. In this iteration, we made use of the principle regarding feedback. When taking a challenge the user should get feedback that the challenge has been selected, which has been done with a notification in the design.

5.5.5 Test

A low-fidelity version of "challenge" was tested on two individuals. A phone was used to test the prototype where the participants freely walked though the design and used Think-aloud [85, p. 365-266]. The participants verbally agreed to take part in the test before it began. The test was held by one facilitator who also took notes.

Analysis
The notes were analyzed in a shared document where key terms and phrases were highlighted.

Takeaways
The main takeaways from the tests were that both participants preferred to have a quick way of choosing the level of impact that a challenge had rather than having to scroll. One of the participants said that it was difficult to grasp what "-50 kg" meant. It was also not clear whether other people that were participating in the challenge had completed it or were taking the challenge right now.

Bias
Both participants were recruited from our personal network which might have af-

fected the outcome. One of the participants had been part of testing the challenge prototype in the previous iteration. The prior knowledge of the prototype and concept can be viewed as a strength due to the fact that the participant might be focused on the content rather than trying to grasp the concept.

5.5.6 Guidelines version 4

As no additional interviews were conducted during this iteration, work regarding the guidelines consisted of re-naming and rearranging them. Seeing as we had 59 guidelines at the end of the previous iteration, we spent a full day doing a major sorting of the guidelines to discard those that were redundant and restructure the existing categories and guidelines.

We did some work regarding the level of the naming of the guidelines, and how much information should be "revealed" in the name itself. For example "Allow users to compete on a team level" versus "Allow users to compete on a team level to increase their motivation". The decision was made to describe the motivation for the guideline in the description of the guideline rather in the name itself.

We also considered what term should be used to describe the "users" of the guidelines (user, player, people, participant) and landed in the term "user" for the majority of context, but that other words can be used in some of the contexts, for example "player" in the case we are discussing game elements, or "people" when it is a more general description.

Some guidelines regarding the external context were discarded as these would not be part of the design itself. "Life around the app/narrative" and "After the competition" were deemed to be outside of the scope for what these guidelines are supposed to describe. However, we thought these could be part of some general description of other considerations to be made in addition to following the guidelines.

As a result of re-structuring the guidelines we ended up with 39 guidelines divided into 7 categories and 10 subcategories. Since a major rearrangement was done, where subcategories were dropped and categories and guidelines changed names, the full list will be presented below.

Note that the numbering of guidelines may differ between iterations as a result of guidelines being added or removed.

PROVIDE USERS WITH INFORMATION

- G1. Continually provide users with fresh content [60], [62]
- G2. Consider the consequences of fearful information (E3)
- G3. Be transparent about how emissions are calculated [7]
- G4. Provide users with information about their emissions
- G5. Teach users how they can lower their emissions (E2)
- G6. Make CO2 emissions understandable by contextualizing them (E2, E3,

E4, E5, E6), [60]
- G7. Give personalized advice based on the user's own emission profile (P1, E6)
- G8. Provide users with information on how to adopt pro-environmental behavior (E2)

GAME ELEMENTS
- G9. Allow users to set goals (E4, E6)
- G10. Divide goal into sub-goals (E6)
- G11. Follow-up on users' goals (E3)
- G12. Use a leaderboard for ranking [62]
- G13. Allow users to win based on different categories of performance (E4)
- G14. Show change in emissions rather than total CO2 emissions (E4)
- G15. Consider having social elements that let users give each other encouragement (E5), [24]
- G16. Consider using social communication channels (E2, P1)

COMPETITION CONTEXT
The category 'Competition context' was created to contain guidelines that concerned the surrounding context rather than the app itself.

- G17. Let the duration of the competition be 3-6 months (several months) (P1, P2, E6)
- G18. Consider that(how) the cultural context can influence users' needs (E1)
- G19. Consider that people who know each other can be more motivated to compete (E1, E2)
- G20. Consider that people in a workplace context may feel obliged to participate in a competition (E5, E6)
- G21. Choose a competition concept that is familiar (E4)
- G22. Make as much as possible of the calculations automatic (E5)
- G23. Make the app quick and easy to use (E5, E6)

COMPETE ON A TEAM LEVEL
The new category 'Compete on a team level' was created to contain guidelines about competing as a team and facilitating team spirit.

- G24. Allow users to compete on a team level to increase their motivation (E1, E4, P1)
- G25. Allow teams to have a designated person who drives the team forward (P1, E2)
- G26. Offer comparison against other teams (E6)
- G27. Allow users to support a team member who is performing poorly (E5)
- G28. Consider the team size (E6)

ME MYSELF, AND I
- G29. Consider allowing users to compete individually (E4)
- G30. Allow users to see their own results (E5)

- G31. Allow users to compare themselves to others (E1, E2)

PLAYER TYPES
This category consists of guidelines that were previously found under the category of "Different types of users" in Version 3 of the guidelines. Examples of guidelines in this category were "G35. Consider focusing on users who do not already have low emissions", "G34. Consider accommodating users of varying levels of environmental knowledge" and "G35. Design for users to change their personalities and interests over time".

- G32. Design with a variety of game elements so that every player type can find something appealing (E6)
- G33. Design for users to change their personalities and interest over time (E5, E6)
- G34. Consider accommodating users of varying levels of environmental knowledge (P1), [60]
- G35. Consider focusing on users who do not already have low emissions (E4, E6)

ALLOW USERS TO LEARN FROM EACH OTHER
The category "Show other users' activity" in version 3 of the guidelines was changed to "Allow users to learn from each other". This was done to highlight that the reason is for the users to be able to learn from each others' success. Guidelines included for example "Show that other people care about the environment" and "Highlight what others are doing".

- G36. Allow users to share how they have lowered their emissions (E2, E3)
- G37. Allow users to show that they care about the environment (E3), [13]

5.6 Iteration 5

The main focus during this iteration was on sketching and creating high-fidelity prototypes. Three different tests were conducted to evaluate the high-fidelity prototypes. Some guidelines were changed or removed which created Guidelines version 5.

No changes were made to the Sitemap during this iteration.

5.6.1 Updated timeplan

In this iteration we realised that we would not be able to carry out any further interviews with participants of the climate step competition within the project's time frame. As a result of this only one set of interviews out of three would be completed.

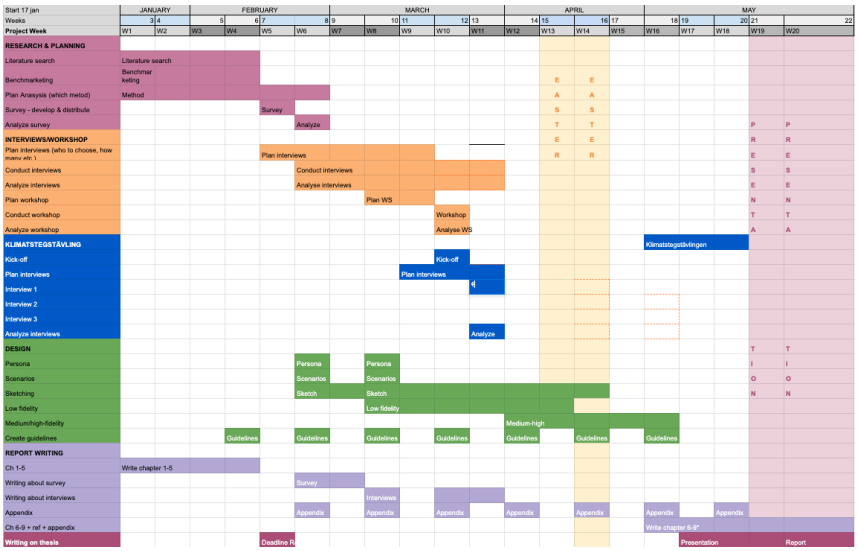

Figure 5.27: Updated timeplan version 5

5.6.2 Sketch

Findings from our questionnaire as well as interviews (for example E5) indicated a need for learning about sustainability and pro-environmental behavior. This led to the idea of having short articles that would facilitate quick learning. Another way to contribute to learning is to give example of what CO2e is equivalent to in order for users to understand what their impact can lead to.

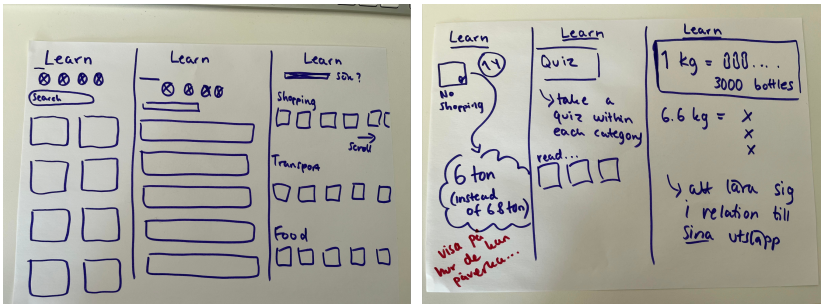

Figure 5.28: Sketch of Learn

5.6.3 High-fidelity prototype

Below four high-fidelity prototypes are presented: learn, leaderboard, challenges and home page.

Learn

The learning page includes an option to learn about CO2e through comparisons of what 1 ton CO2e equals. The examples shown have been chosen as they are food items common in Swedish supermarkets and therefore relatable to people living in Sweden. There are also articles to be browsed and sorted according to the four different categories.

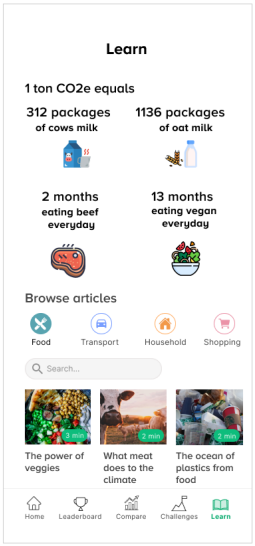

Figure 5.29: High-fidelity prototype of Learn

Leaderboard

The leaderboard displays the number of teams and members taking part in the competition. This was added to let users be able to know their placement in comparison to number of teams and members. The goal is also shown on the leaderboard to make it clear for the user what the goal is. The cards in "best in category" has been changed during this iteration from a row to horizontally in order for the focus to be on the top 3 ranking.

Based on "G27. Allow users to share how they have lowered their emissions", we made it possible to click on a team or a person to learn how others have succeeded in order for them to get inspiration and do the same. When clicking on a team in the top 3 list general information about the team, its placement and the challenges they are taken are shown. When clicking on a team in "best in category" information and challenges within that category are shown.

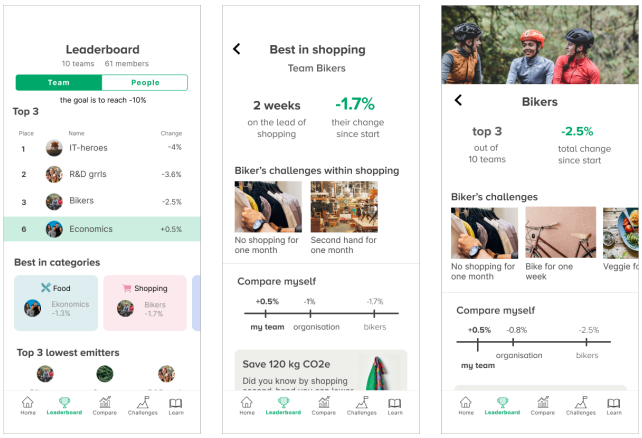

Figure 5.30: High-fidelity prototype of the leaderboard

Challenges

Also, based on "G27. Allow users to share how they have lowered their emissions", a view of the Most popular challenges was added. During the tests of iteration 4, respondents wanted more options to sort through the challenges. This led to "impact" being added to display "low, medium and high" impact challenges that the user can do to lower their emissions. This refers to what Caraban et al. [6] refers to as Facilitator nudges which are designed to make a task easier to carry out. High impact shows what a person can do to lower their emissions the most. Before we had "easy, medium, hard" which indicated how difficult it was to complete a challenges, compared to now - how much CO2e one can save. This was also a result of an internal discussion we had about that the different levels of "difficulty" and "impact" could be assumed to have some overlap where a challenge that is difficult to perform could also lead to the most saved CO2 emissions.

During this iteration the buttons for browsing a challenge were re-designed. The buttons in our design did not look the same as Svalna's current app or other screens that we have created. Don Norman [82, pp. 7-25] highlights that elements that look similar should operate in the same way in one of his seven principles called "Consistency".

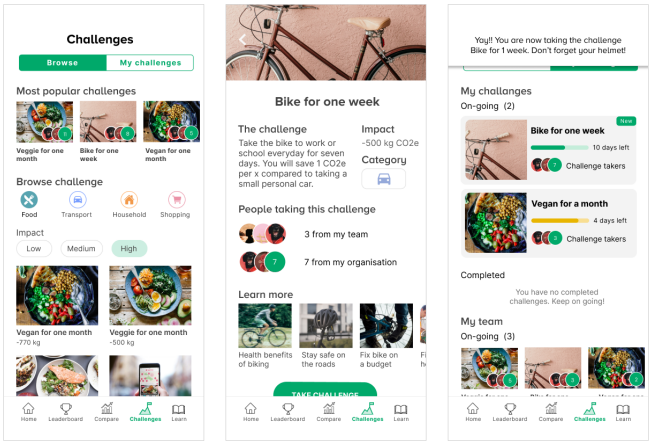

Figure 5.31: High-fidelity prototype of the challenges

Home

During this iteration two versions of the home screen were created. The design of the first prototype was based on the sketch of the previous iteration where the idea of displaying users with a quick overview of different functions was used as inspiration. As a result of testing, we saw some issues with this version as the respondent got confused by having a screen that showed both organization, team and individual related information. Therefore a second version of the home screen was created during this iteration.

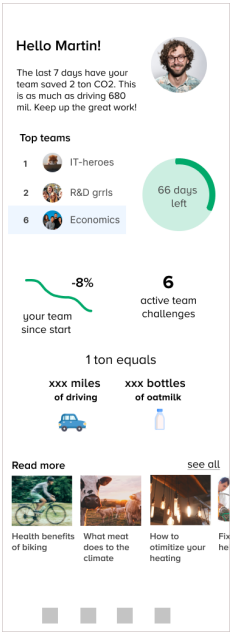

Figure 5.32: High-fidelity prototype of the home screen version 1

The second version of the home screen had a button that the user could navigate between "team" and "me" to distinguish these two apart. The graph that previously showed the days left was in this version used to show how much the organisation has lowered their CO2 emissions. The decision to change this was based on internal discussions about it being more important to quickly be able to see the goal and progress of the competition rather than time left, which could be assumed to be an easier function to understand. Having a clear goal and being able to follow one's progress supports "G9. Allow users to set goals" and "G11. Follow-up on users' goals".

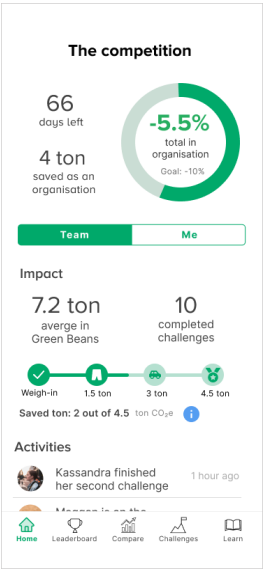

Figure 5.33: High-fidelity prototype of the home screen version 2

Statistics

The following figure shows a selection of high-fidelity prototypes of how to visualize a persons current CO2 emissions. An issue raised in the testing sessions in this iteration was regarding the change of CO2, and the difficulty of visualizing this especially when the value is decreasing. This led to us trying out many different ways of showing this.

Figure 5.34: High-fidelity prototype of different ways to visualize a persons emissions

Below is a selection of high-fidelity prototypes for showing a persons CO2 emissions compared to the average in the team and the organization.

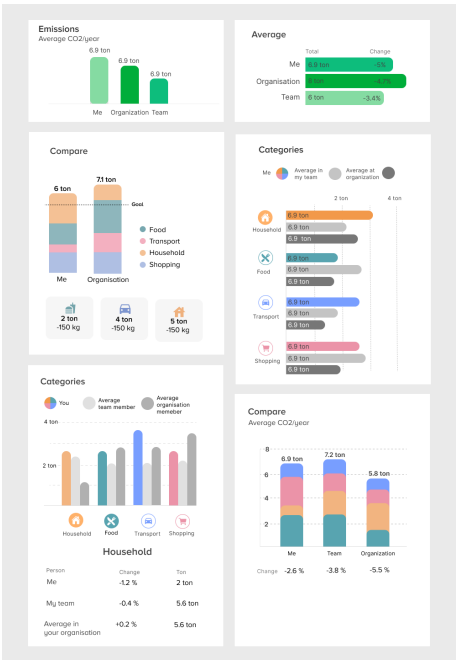

Figure 5.35: High-fidelity prototype of different ways to visualize comparisons of once emission against the team or organization

Bottom navigation
In the previous iteration sketches of the bottom navigation were created, including the following screens: home, challenges, team/organisation and me. We made some more sketches on this and discussed among us that we wanted the design to be more towards the feeling of being a competition. For this reason, and supported by research pointing towards a leaderboard being an important game element for motivation [62], we decided to let the leaderboard have its own screen. A medium-high fidelity prototype was made with the following screens: home, leaderboard, compare, challenges, learn. The home page included the organisation, team and personal information (see Figure 5.36).

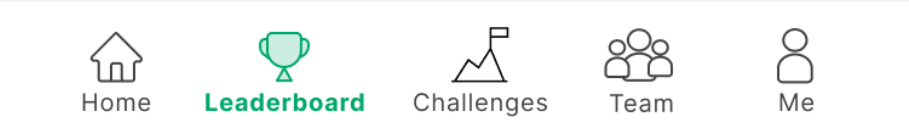

Figure 5.36: High-fidelity prototype of bottom navigation version 1

5.6.4 Test

Three tests were carried out during this iteration. The first test was done with two interaction design students who participated to evaluate the entire high-fidelity prototype. A consent form was signed before the start of the test that highlighted the purpose of the test and that the test participants would remain anonymous throughout our study. During the tests, which each took 30 minutes, one of us took the role of facilitator and the other as note taker.

The test was structured in two parts. The first part was where the facilitator asked the participants a statement or question and then the participant navigated in an interactive prototype on a phone. The second part was an open question about what the test participant has experienced, their struggles and suggestions for improvement.

The second test was conducted on one person where the person got to go through the prototype on a phone.

Based on the second test, the third test aimed to see if there was a simpler way of showing that someone had decreased or increased their CO2 emissions. A print screen of two alternatives was sent out to 8 people, where they were asked to answer if they preferred an arrow or plus/minus to indicate the amount of CO2e that someone had decreased.

Analysis
The notes from the first test were analyzed where interesting words and sentences were marked. The marked words were copied into five different categories according

to the different screens on the prototype: home, leaderboard, challenge, statistics and me.

Notes from the second test were discussed among us to draw conclusions of important insights. The final test provided straight-up answers which were gathered into a shared document of preferences.

Takeaways
The result of the first test revealed that showing both the organization's and the team's progress on the "home screen" was difficult to understand. The participants proposed that the team and organization have separate screens. Furthermore, the test participants did not know what elements were interactive and which were not, which led them to only attempting to click on a few elements. After the initial test, one of the test participants said in the interview that they did not understand anything at a first glance due to not having prior knowledge of what the level of CO2 is similar to. The person also expressed confusion about what "lowest emitters" in the leaderboard referred to.

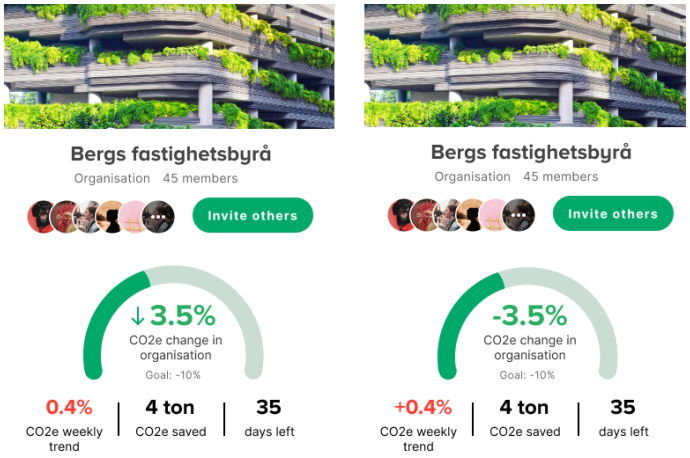

Figure 5.37: Prototype evaluated in test 3

The major findings from the second test were that the participant had a hard time interpreting the different CO2e values. It was especially difficult to understand what "-6.2% change since start" meant, but the fact that the text was green made the person understand that it was a positive outcome.

The result of the third test showed that the two prototypes were similarly good. Four out of eight people preferred an arrow and the remaining four preferred a minus sign to indicate a decrease of CO2.

Bias
The first test included two participants who were students of our program. We were asked to participate in their study and in return they offered to be part of ours.

As for the second and third test, the people participating were persons from our personal network who had been asked to participate.

5.6.5 Guidelines version 5

The categories for guidelines version 5 were the same as for version 4, however the guidelines were reduced in number from 39 to 28 as some themes were overlapping. During this iteration we started to approach what would be the final themes.

Note that the numbering of guidelines may differ between iterations as a result of guidelines being added or removed.

Below is a description of the changes made during this iteration:

PROVIDE USERS WITH INFORMATION
Removed guidelines:

- G1. Continually provide users with fresh content [60], [62]
- G3. Be transparent about how emissions are calculated [7]

Guidelines G1 and G3 were removed and the topics they covered were added to the remaining guidelines within this category.

Apart from this only minor changes were made to the names of the guidelines in order to make them more to the point. For example, G6 Make CO2 emissions understandable by contextualizing them was changed to G4 Contextualize CO2 emissions.

GAME ELEMENTS
Changed guidelines:
The guidelines that were to do with goal setting were combined into a single guideline of “Allow users to set goals”. The same was done with the guidelines that were to do with ranking or leaderboards, ending up with the guideline “Use a leaderboard”. The guidelines regarding “social elements” were also merged, and the resulting guideline “Consider having social elements” in this version discusses both positive and negative effects of using social elements in a carbon calculator app.

After merging existing guidelines, five guidelines remained within this category:

- G7. Allow users to set goals (E6)
- G8. Use a leaderboard [62]
- G9. Consider having social elements (E5)
- G10. Allow users to see their progress over time [32]
- G11. Give users feedback on their performance (E6)

Some names were changed as parts of the names were not needed in order to understand the guideline. For example "G12. Use a leaderboard for ranking" was changed to "G8. Use a leaderboard".

COMPETITION CONTEXT
Changed guidelines:
"G20. Consider that people in a workplace context may feel obliged to participate in a competition" was changed to "G14. Consider that social context can affect motivation to participate in a competition".

"G17. Let the duration of the competition be 3-6 months' was changed to "G12. Let the competition be time-limited" to follow the names of other guidelines of being less specific.

Removed guidelines:
- G22. Make as much as possible of the calculations automatic (E6)
- G19. Consider that people who know each other can be more motivated to compete (E5, E6)

The reason for removing the guidelines were that they were considered to be able to be discussed as points within other guidelines.

In addition to the above mentioned changes, only minor changes in the names of the guidelines were made.

COMPETE ON A TEAM LEVEL
Changed guidelines:
Only minor changes were made to the guidelines in this category. For example, "G24. Allow users to compete on a team level to increase their motivation" was changed to "G17. Allow users to compete on a team level". The reason for this was to get a name that was more open to the number of reasons for supporting competing on a team level. Apart from this, only minor changes in the names of the guidelines were made.

PLAYER TYPES
Changed guidelines:
Four guidelines were reduced to two. "G35. Design for users to change their personality over time" was removed and is instead discussed under "G25. Design with a variety of game elements so that every player type can find something appealing".

5.7 Iteration 6

This iteration had an emphasis on design work, which led to some major changes to the design compared to iteration 5. One of the changes included naming the prototype, as will be referred to as "Kallna" from now on (kallna meaning "cool down" in Swedish). The final version of Kallna was evaluated iteratively with users. During this iteration the number of guidelines was reduced from 28 in previous iteration to 12 in Guidelines version 6.

No changes were made to the personas and scenarios during this iteration.

5.7.1 Sitemap

The bottom navigation was changed as a result of test respondents finding it difficult to distinguish between information regarding the organisation, team and personal information on the home screen. This led to information about "team" and "me" were divided into two separate destinations on the bottom navigation.

The bottom navigation "Statistics" was removed. Instead a button on the screen "Me" navigates the user to a space where comparisons between the user, team and organisation are shown. This was changed to support "G10. Be aware of eco-guilt".

Instead of having direct destination from the bottom navigation to "Learn" the tips and information to learn more are spread out through all screens.

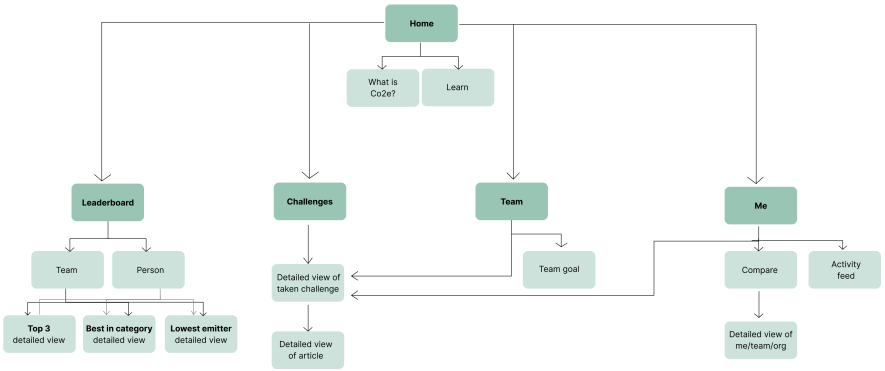

Figure 5.38: Sitemap final version

5.7.2 High-fidelity prototypes

This iteration involved some major changes of Kallna as is presented in the Sitemap (See Figure 5.38). In addition to this, smaller changes were also made. For example, based on the results from the tests in iteration 5 and 6, the title "Lowest emitter" in the leaderboard was changed to a more descriptive title "People with lowest emissions". A descriptive text under the team's progress bar was also added during this iteration as a result of the tests in previous iteration showing that the test participants were confused about what was displayed.

As the bottom navigation for "Learn" was removed in the previous iteration it was spread out through all screens. The conducted interviews (E2, E5) highlighted a need to contextualize CO2. We decided to incorporate a button near where CO2 is mentioned. The user is nudged to learn more by clicking this button. Additionally, when scrolling down on the Home screen a "learn more" section is instead presented. This "learn more" differs from other places where "learn more" is displayed such as on a challenge. The learn more on the Home screen uses nudges and is personalized towards the user. For example, if a user has added information about being vegan they would not receive information on what veganism is, because the person will

most likely know that. Instead other type of articles would be presented. Boven [15] discussed one problem with nudges which is that people may learn to rely on them to guide the user when making decisions, whereas nudges actually need people to take more personal responsibility.

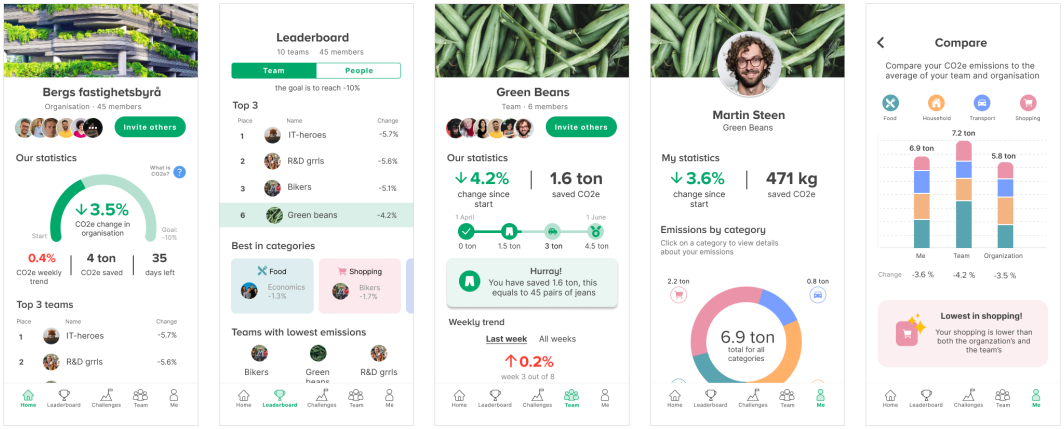

Figure 5.39: High-fidelity prototype from iteration 6

5.7.3 Test

Two test participants took part in this test session, one recruited from our master's program and one recruited from personal contacts. The test participants received information about the study and that the method Think-aloud [85, p. 365-266] would be used. Before the test began, the participants got to orally give consent to being part of the study.

The test was structured in two parts. First, the test participants got to browse the high-fidelity prototype of Kallna on a phone freely while using Think-aloud. The test ended with a few short questions about their experience and potential for further improvements.

The test focused on improving visibility, one of Don Norman's [82, pp. 7-25] seven principles. One of the tests from previous iterations resulted in some confusion where one of the test participants stated that they did not understand anything at first glance. Therefore, we focused on making sure that test participants would understand it as a first-time user.

Analysis
The notes were analyzed and marked to collect key words and sentences. The findings were transferred into into a shared document of the two tests.

Takeaways
Both participants thought that it was easy to distinguish between the organization,

the team, and the person to which the profile belonged. One of the participants did not understand what "lowest emitters" in the leaderboard were. The same findings had been shown in the previous test in iteration 5. For one of the participants, it was not clear whether or not the CO2 emissions on the page "me" was referring to what a person's level of CO2e are now or the amount of CO2 saved.

Bias
The participants were people from our personal network that we had asked to test our prototype. One of the participants had been part of the workshop in iteration 2 and a test in iteration 4 which might lead to them focusing on other aspects than a person who sees Kallna for the first time does.

5.7.4 Guidelines version 6

For the final iteration of the guidelines, we decided to have a 1-2 sentence description underneath each guideline's name to provide a short but quick overview of what the guideline involves. We also decided to specify the names further to make them reflect the area of sustainability or show that they have to do with lowering one's emissions.

A structure for each guideline was devised to make sure they all provided information of a similar structure and to make it easier for the reader to follow along. The structure contained three parts: a paragraph explaining the name of the guideline and motivating why it is important to follow it, a second paragraph highlighting important considerations when using the guideline and a third paragraph bringing up cases in which the guideline is not applicable and references to other guidelines.

During the final iteration, the number of guidelines was reduced from 28 in version 5 to 12 in version 6. The reduced number meant that there was no need to categorize them in the same way as in previous versions, hence the categories and sub-categories were removed.

During the iteration, we tried a 10 item version of guidelines. However, we found that a couple of them dealt with two separate issues which led us to divide these into two separate guidelines, resulting in a total of 12 guidelines.

Below are the new guidelines along with the changes made.

- G1. Support learning about pro-environmental behavior

The two guidelines "G6. Teach users about sustainability" and "G1. Consider the consequences of using fearful content" were merged into a common guideline "G1. Support learning about pro-environmental behavior". The reasoning for this was that we considered the discussion about fearful content to be more of a consideration when providing information than a full guideline in itself.

- G2. Provide users with concrete tips on how they can lower their CO2 emissions

The three guidelines “G2. Provide users with information about their emissions”, “G3. Teach users how they can lower their emissions” and “G5. Give personalized advice” were merged into one guideline. This was done as all of these had content that was overlapping.

- G3. Provide people with relatable and tangible examples to understand their CO2 emissions

The guideline “G4. Contextualize CO2 emissions was changed” to “G3. Provide people with relatable and tangible examples to understand their CO2 emissions” in order to clarify the reasoning behind the guideline.

- G4. Keep in mind that some types of game-elements may need to be adjusted to be suitable for pro-environmental behavior interventions

“G8. Use a leaderboard”, “G9. Consider having social elements” and “G25. Design with a variety of game elements so that every player type can find something appealing” were combined into one guideline. The new guideline reflects the specific gains and challenges of using gamification for pro-environmental behavior interventions.

- G5. Allow users to set goals for their target CO2 emissions and follow their progress

Three guidelines concerning goal setting - “G7. Allow users to set goals”, “G10. Allow users to see their progress over time” and “G11. Give users feedback on their performance” were combined into one guideline.The reasoning was that they in themselves did not constitute enough information to be separate guidelines, and would benefit from being considered together in a single one.

- G6. Take into consideration how external factors may influence the user’s ability to lower their CO2 emissions

“G13. Consider how the external context can influence users’ needs” and “G14. Consider that social context can affect motivation to participate in a competition” were combined into a single guideline that discusses different kinds of context and how they can affect motivation.

- G7. Consider a simple concept to balance the complexity of environmental issues

"G16 Make the app quick and easy to use" and "G15. Choose a competition concept that is familiar" were merged into a single guideline that motivates why a simple concept is to be preferred in the case of pro-environmental behavior interventions. "G12. Let the competition be time limited" was removed as a result of lack of support in literature.

- G8. Allow users to compete on a team level to increase perceived impact

The four guidelines "G17. Allow users to compete on a team level", "G18. Allow teams to have a designated person that drives the team forward", "G19 Allow users to support team members" and "G21. Consider the team size" were combined into a single guideline. The new guideline discusses the combined aspects of allowing for competition on a team level.

- G9. Allow for social comparison of CO2 emissions and progress

"G24 Allow users to compare themselves to others (individually)" and "G19 Allow users to compare themselves to others (team)" were combined as the motivation behind both individual and team comparison were perceived to be similar.

- G10. Beware of eco-guilt

A new guideline was created to discuss the notion of eco-guilt that was brought up in both interviews and in literature throughout the project. Prior to this version of guidelines, "eco-guilt" was described as a possible side-effect from letting users compare themselves to each other.

- G11. Allow users to learn from how others have lowered their emissions

"G27. Allow users to share how they have lowered their emissions" and "G28. Allow users to show that they care about the environment" were merged into one guideline as these were considered to be closely related.

- G12. Keep in mind the different needs of users with varying levels of environmental knowledge

"G26. Consider accommodating users of varying levels of environmental knowledge" changed name in order to highlight the user's differing needs as having varying levels of this type of knowledge.

6
Results

This chapter presents the high-fidelity prototype and guidelines which are the results from this master thesis.

6.1 Kallna

The high-fidelity prototype Kallna presented below is the result of six iterations based on a literature study, ten interviews, one workshop and testing of the sketches and prototypes. Kallna is based on Svalna AB's current app Svalna and aims at giving suggestions on how the company can improve their design for their climate step competition. To maintain the visual style of the prototype, elements such as fonts, typography, colors and components, for example buttons, are taken from the existing app.

Below the five resulting screens will be presented: Home, Leaderboard, Challenges, Team and Me.

Home Screen
The home screen works as a starting page and dashboard for the climate competition, showing the main statistics and progress, such as the organization's change in CO2, % of decrease and how many days are left. It also features a shortened version of the leaderboard and a "Learn more" section where the user can choose different articles in order to learn about sustainability and pro-environmental behavior.

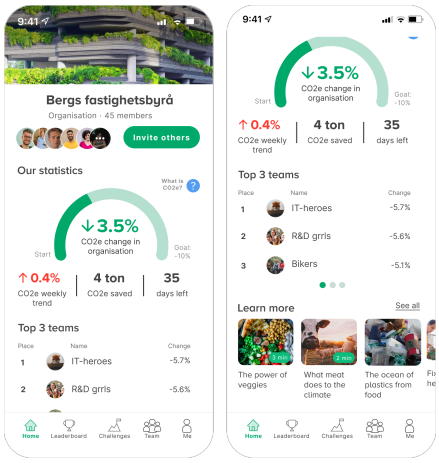

Figure 6.1: Home screen

The home screen also features a button “What is CO2e?” taking the user to a separate screen where CO2 is described as well as comparisons of what 1 ton CO2e equals to.

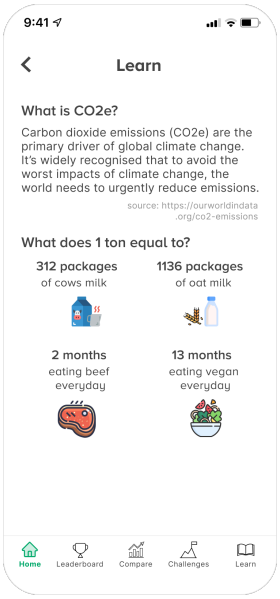

Figure 6.2: Learn - what is CO2e

Leaderboard

The leaderboard shows the teams and individuals who are performing the best in the competition. The ranking is based on three different categories: top three teams, best within in the four categories and the team or player who has the lowest emissions.

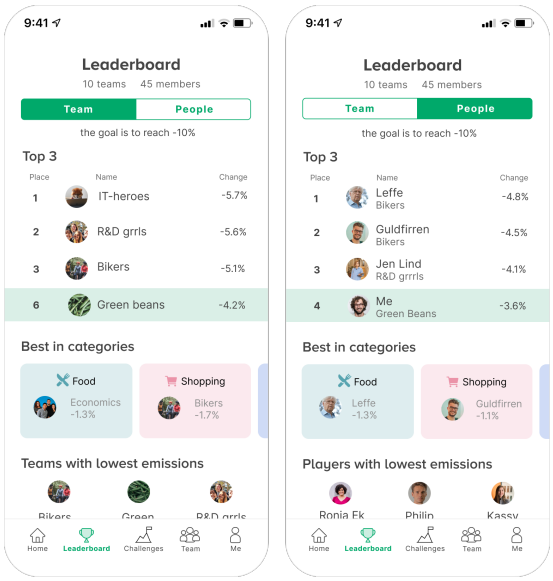

Figure 6.3: The leaderboard

When clicking on a team or a person on the top 3 leaderboard a detailed view is shown (see Figure 6.4). This screen aims to show how that team or person has succeeded in lowering their emissions by presenting what challenges they have taken. The screen also contains comparisons of the user or the user's team in relation to the team or user who is in the lead as well as to the organization.

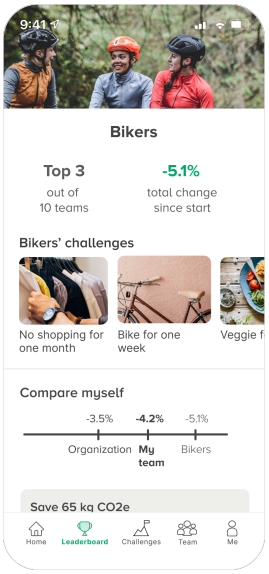

Figure 6.4: Screen when clicking on a team in "top 3"

When clicking on "Best in category" (see Figure 6.3), one is directed to view the four categories (food, shopping, transport and household) and the team or individual who has lowered their emissions the most in a specific category. To view all categories the user has to scroll horizontally. When clicking on a card, a detailed view is shown.

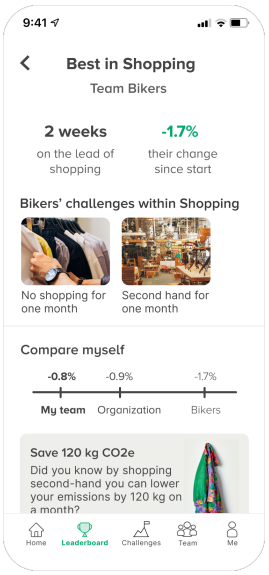

Figure 6.5: Screen when clicking on a team in "best in category"

Challenges
This screen allows the user to browse and choose to take different challenges that can aid them in lowering their CO2e. By taking a challenge the user can learn about and try out an action that is aimed at helping them reduce their CO2 emissions.

At the top of the page, the organization's three most popular challenges are displayed along with the number of people that have taken the challenges. This gives the user information about what other people in the competition are doing to lower their CO2e. Filtering of challenges can be done by selecting one or several categories and levels of impact. When a selection has been made the resulting challenges are displayed as cards below. Each challenge has a picture, a name and a number portraying the estimated level of impact that can be achieved by completing the challenge. This is shown in the form of a reduced number of kg CO2.

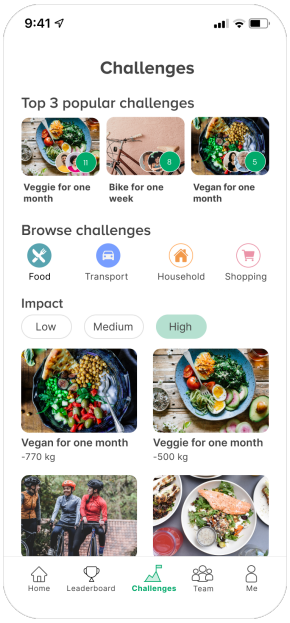

Figure 6.6: Challenges

Clicking on a challenge directs the user to a detailed view of the selected challenge (see Figure 6.7). This screen displays the name and brief description of the challenge as well as estimated impact in kg CO2 and what category the challenge belongs to. Below this descriptive section is another section showing who and how many people are taking the challenge, both on organizational and team level.

Further down on the "Challenge" screen is a "Learn more" section similar to that on the home screen but which aims at supporting the user in their progress of completing the challenge. As can be seen in Figure 6.7, the Learn more section for the challenge "Bike for one week" provides the user with information beneficial to their success of taking the challenge, such as health benefits of biking or how to stay safe on the roads. By clicking on one of these articles, the user is directed to a screen with details about the selected article.

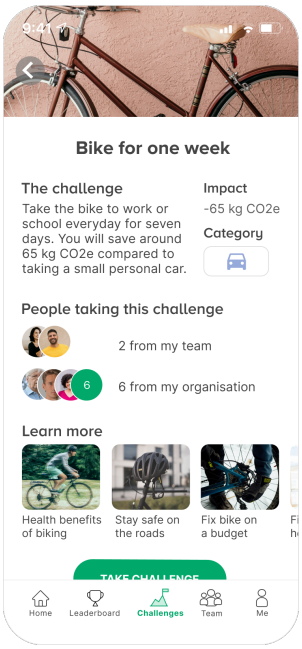

Figure 6.7: Details of the challenge "Bike for one week"

By clicking the button “Take challenge”, the user receives a notification with the feedback that they have joined the challenge, and is redirected to the "Me" screen where the user’s challenges are shown.

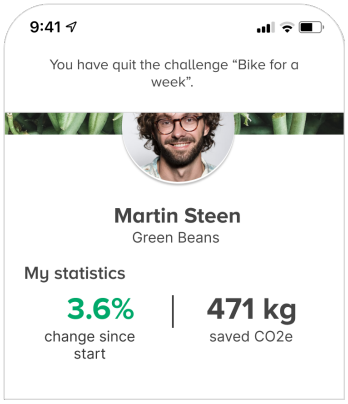

Figure 6.8: Example of the notification after a user has clicked "take challenge"

The newly added challenge can be seen at the top of the list of challenges, marked with “New”. If the user is already taking the challenge the “Take challenge” button is replaced by a “Quit challenge” button. By clicking this button the user gets a pop-up message with the option to quit. This leads to the challenge being removed from the list of challenges at the “Me” screen. However it is open for the user to go back and retake it at any point.

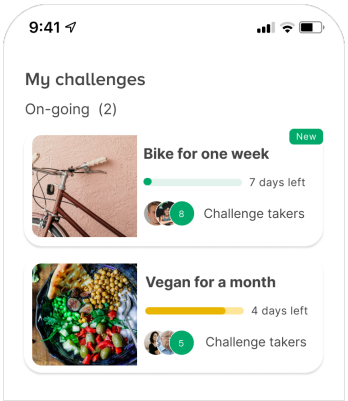

Figure 6.9: When taking the challenge "Bike for one week"

The challenges are self-reported and therefore when the final day of the challenge is reached the user receives a pop-up message. The user can select to complete or re-take a challenge, as there is no option to cancel a challenge. However, the user can do so by going into the detailed view of a taken challenge, and instead of "take challenge" (see Figure 6.7) the button says "cancel challenge".

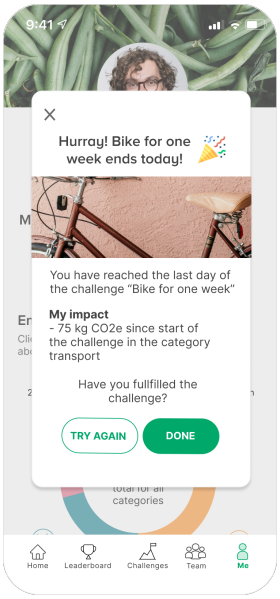

Figure 6.10: Complete or re-take a Challenge

Team

The top of the "Team" screen is identical to the "Home" screen, but instead information about the team is shown, such as the team's name and who is participating. The users belonging to the team can also invite others to join their group. This screen also shows the team's statistics in the form of level of change in CO2e and the amount of saved CO2e. A progress bar shows the start and finish date of the competition along with the team's current amount of saved CO2e.

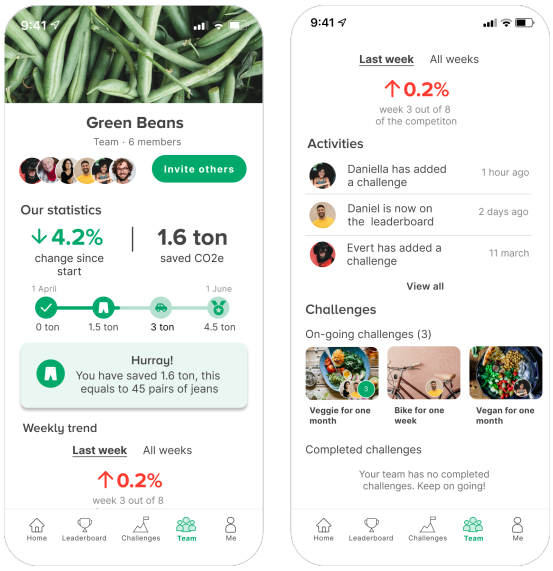

Figure 6.11: Team screen

The text underneath the progress bar provides examples of what the CO2e saved is equivalent to. Clicking the text redirects the user to a separate screen with information regarding the team's goal and sub-goals (see Figure 6.12)

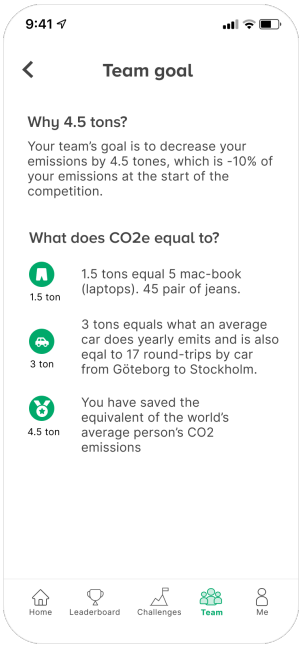

Figure 6.12: Team goal

The weekly trend presents how the team is performing on a weekly basis. The user can choose to view the current trend or trend for all weeks. The activity feed shows what the team members are currently doing, and it is possible to view the full list by clicking on "View more".

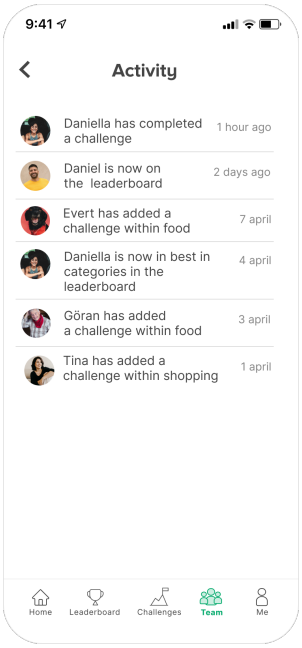

Figure 6.13: Full team activity feed

Me

At the top of the "Me" screen is the team's image and the user's own profile picture as well as information in the form of the user's name and what team they belong to. The statistics section has the same format as that of the "Team" screen, where change of CO2e since the start of the competition and saved CO2e are presented.

The section "Emissions by category" shows the user's total amount of CO2e. The pie chart is clickable, where detailed information on the amount of CO2e a category contributes to as well as the percentage of change since the start for that category is presented. The user is provided with small tips on how to lower their emissions in relation to the selected category.

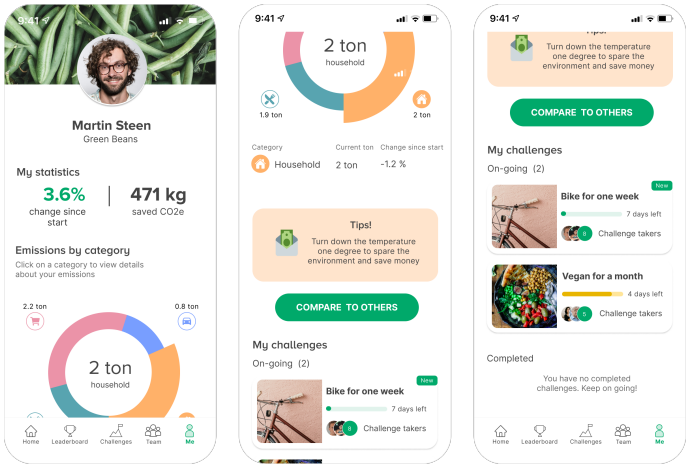

Figure 6.14: The Me screen when scrolled

When clicking on the button “Compare to others” (see Figure 6.14) the user is directed to a screen where a comparison of the user, its team and organization is presented. The user can select to sort according to category or see a detailed view of themselves, the team or organization by clicking on the bar graph (see Figure 6.15).

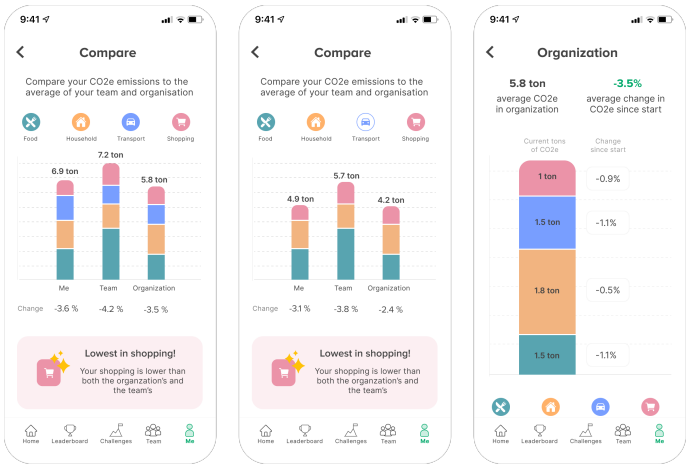

Figure 6.15: Compare view

6.2 Guidelines

Below are the resulting set of guidelines based on a literature study and ten interviews as have been described in the previous Execution and Process chapter (chapter 6). The guidelines should be viewed as a complement to already existing guidelines within relevant areas, such as interaction design and gamification. Examples of frameworks that can be relevant are Norman’s 7 design principles [82] for interaction design and the Octalysis framework [24] for gamification, both described in the Methodology chapter (chapter 4).

Each guideline contains a name, a short description and a few paragraphs structured in three parts. The first paragraph explains the name of the guideline and motivates its use. The second paragraph aims at highlighting important considerations when using the guideline. The third paragraph points out when the guideline is not applicable. Each guideline also provides examples of design solutions and refers to other guidelines.

G1. Support learning about pro-environmental behavior
People lack knowledge about CO2 emissions and the effect their behavior can have on the climate and are therefore in need of information on environmentally sustainable behaviors. What type of information is sent out can affect the user’s motivation.

Researchers [76],[38] have shown that people do not have enough knowledge of what level of emissions their daily activities contribute to. Participants in Mulrow’s study

[76] ranked transport as contributing to higher emissions than personal energy use, whereas the opposite is the case. One of the respondents (E3) in the present study had experience of people who claimed themselves to be environmentally conscious but who turned out to have low knowledge of how their choices affected the environment. These findings suggest that people need to receive information about environmental issues that is easy to understand and relate to.

When providing information about sustainability it is important to consider the effects of using fearful information. Research has had conflicting results whether it is effective or not to use fear to influence behavior change [90]. A respondent from our study (E3) thought that using scare tactics "moderately" was good in order for people to realize the importance of the situation. In support of this claim, research has shown that a feeling of worry can be linked directly to feeling personally responsible to act to mitigate climate change [14]. In addition to mentioned considerations, research [62] has shown the importance of continuously keeping up users' excitement by introducing new content, and that people otherwise might get bored after some time.

During this project, several ideas on how to support learning about sustainability have arisen. One suggestion evolved around providing a quiz, similar to what the app Deedster [27] offers, see Figure 6.16.

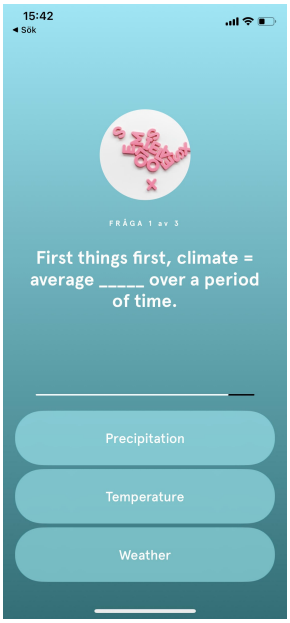

Figure 6.16: Print screen of a Quiz in the app Deedster [27]

Another suggestion is to have a learning screen where users can increase their understanding of sustainability with the help of reading articles (see Figure 6.17). The learn page could also incorporate comparisons between their own impact and what their future might look like if they increased their pro-environmental behavior.

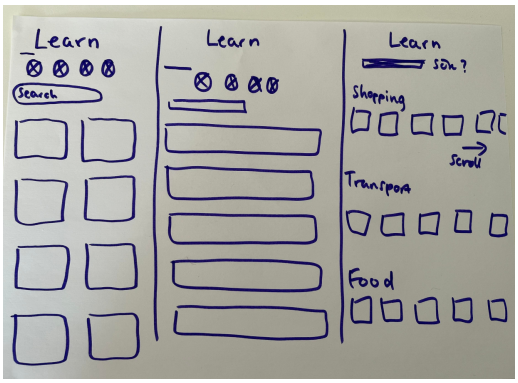

Figure 6.17: Sketch of learning screen

It is important to consider what level of environmental knowledge users have, where people who have more prior knowledge might need different types of information, see Guideline 12 for more details. It's also worth highlighting that information regarding CO2 needs to be tangible and relatable for people to understand, see Guideline 3. Furthermore, consider that people might pick up their information from other sources. As one respondent (E6) stated that if a person needs information they can simply use google. When it comes to people's attitudes toward learning, E3 points out that knowing that other people care about environmental issues can be motivating, especially if it is friends, family or a role model, see more details in "G9. Allow for social comparison of CO2 emissions and progress".

G2. Provide users with concrete tips on how they can lower their CO2 emissions
People need simple and concrete tips in order to get motivated to lower their emissions.

Respondents (P1, E2) of this study emphasized that people already have knowledge on how to lower their emissions. P1 meant that it is fairly straightforward how it could be done: cut down on traveling by flight, eating less meat, take the bike or walk instead of taking the car. However, the step to changing a behavior is difficult as people need to have the ability and motivation to be able to adopt a new behavior [35]. The respondents (P1, E6) proposed providing personalized suggestions on how a person can lower their emissions. General tips were perceived as having the risk of being de-motivating.

It is important to keep in mind that people are more willing to change their behavior if the tasks are simple to do and do not interfere with their lifestyle [19]. Similarly, one respondent in the present study (E2) claimed that simple and concrete tips on how to lower CO2 emissions are needed in order to change behavior (see Figure 6.18). Another respondent (E6) empathized that the tips should be carefully thought through and not seem randomly presented.

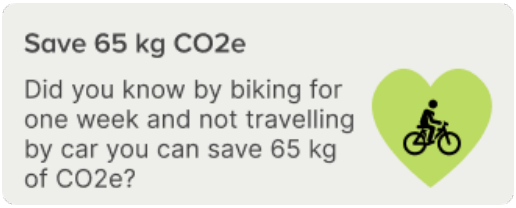

Figure 6.18: Kallna - People taking a challenge

The interviews also highlighted the importance of providing people with knowledge that their actions can make a difference and that what they do actually matters (E2, E3). This has been incorporated into the design of Kallna, with inspiration from the app Sats where people can see what work out classes friends have booked (see image 6.19).

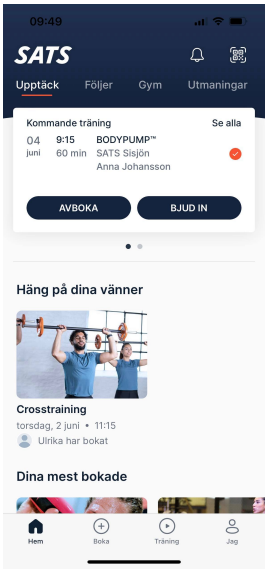

Figure 6.19: Print screen of the app Sats where friends' activities are shown [95]

People have the tendency to underestimate the impact of CO2 emissions, as highlighted by Guideline 1 and 3, thus this guideline should be followed when having a target group that has a variety levels of environmental knowledge. Finally, it is useful to keep in mind that research on having information about the environment and actually carrying out pro-environmental behavior is not clear [67]. There are other factors playing a part that can mediate or intervene with the behavior, such as having competing goals and values [39].

G3. Provide people with relatable and tangible examples to understand their CO2 emissions

Research has shown that people can have difficulties understanding the concept of "CO2", which indicates that they need CO2 to be contextualized with comparisons that are tangible and relatable.

A majority of interviews (E2, E3, E4, E5, E6) highlighted the understanding that people, in general, had low or no knowledge of what kilos or tonnes of carbon emissions actually meant or were equivalent to. Similarly, research [60] has shown the same result, suggesting that CO2 emissions should be made relatable and tangible. A respondent (E3) stated that the lack of knowledge often leads to people tending to underestimate the effect of their emissions and assuming that driving or flying consumes less CO2 emissions than it actually does, see "G1. Support learning about pro-environmental behavior".

Several respondents (E2, E3, E5) said that it would be easier for people to understand CO2 emissions if they were contextualized using real-life concepts. In our design work, we tackled the issue by conceptualizing the same amount of emissions such as 1 ton of CO2e but in different ways so that people could relate to it better. For example, 1 ton of CO2e is the same as 312 packages of cow milk and 1136 packages of oat milk [33], see Figure 6.19. Another finding from the interviews was that one respondent (E5) expressed the importance of clarifying whether or not a number of consumed CO2 emissions is good or bad. In our design we visualize this with the help of colors; green for positive (decrease of CO2) and red for negative (increase of CO2) along with a plus or minus indication.

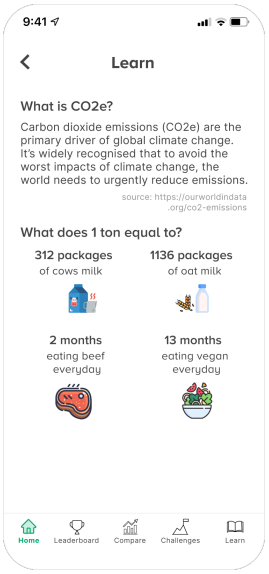

Figure 6.20: Kallna - Learn screen

Keep in mind that people can underestimate the effects of their lifestyle even though they consider themselves to be environmentally conscious, see "G2. Provide users with concrete tips on how they can lower their CO2 emissions". Therefore we argue that this guideline could be applied when having a broad target group of people who have a variety of environmental knowledge. Do also consider the cultural context and the choice of comparison in order for people to not misunderstand the given examples (see "G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emission").

G4. Keep in mind that some types of game-elements may need to be adjusted to be suitable for environmental sustainable behavior interventions

Not adjusting the game elements to support environmentally sustainable behavior interventions can lead to people losing interest.

Research has shown that gamification is linked to long-term environmental behavior change [66], [88] and that gamification can lead to motivation [29]. However, one respondent (E5) in our study said that incorporating too much gamification can have a negative effect because people lose interest when for example collecting points over a long time period, it is therefore important to keep in mind that some type of game-elements are more or less suited for environmental sustainable behavior change.

Findings from our study show that people's interest in competitions varies (E1, P2, P3, P4), where one respondent (E6) highlighted the importance of having a variety of game elements in order for all player types to find something appealing they enjoy using. The respondents (E6) also claim that it is important to have different game elements due to the fact that users may change their motivations or interests over time.

Conflicting opinions have been brought up in the interviews on gamification elements such as social elements and badges. For the use of social elements respondents (E2, E6) suggest that one should consider in which context the carbon calculator is used because in a setting where users already have daily communication (at a workplace for instance) chat channels and comment fields can be redundant. Respondents (E2, P1) brought up that supporting each other in a team could be encouraging and strengthen the team spirit. A solution that has been discussed during this project to support team spirit could be to have a like button to send cheers to other team members. As for badges, a respondent (E5) said that it could lead to engagement because it's dynamic and can act as a milestone towards the goal. However, E4 said that it could turn out negative because it could be a measure that people are eager to get points rather than doing real things (actual pro-environmental behavior) such as sorting waste which can be easy to do but does not have a direct impact of lowering a person's individual emissions.

Participants who have low CO2 emissions at the start of the competition might be less interested to see rankings but instead, as E2 discussed they might want to do other types of activities such as learning how to grow their own garden (see "G12. Keep in mind the different needs of users with varying levels of environmental knowledge" for more details on the different need of users with varying level of environmental knowledge). Research has shown that people find leaderboards encouraging [62], however, respondents in our study highlighted that seeing all players in the ranking can lead to eco-guilt (P1, E2) and that the leaderboard should show a selection of top players (E6) (see "G10. Be aware of eco-guilt"). The majority of

players may also feel demotivated if they end up at the bottom of the leaderboard [92].

G5. Allow users to set goals for their target CO2 emissions and follow their progress
Providing users the opportunity to set their own goals and sub-goals can provide motivation. To add motivation the app should provide feedback on the user's progress towards the goal.

The game element of setting goals can increase players' motivation [92]. Respondents in our interviews (E4, E6) suggested that having a shared goal in a team can have a more positive outcome than those set on an individual level, because as a group of people you can see a greater result. One respondent (P1) claimed that having a shared goal encourages the spirit of making a difference together.

E6 suggested considering team size, as goals suitable for a team of five people might not be suitable for a team of 25 people, and vice versa. The respondent also suggested considering providing pre-defined goals since people might not know what a realistic goal is, tying back to "G3. Provide people with relatable and tangible examples to understand their CO2 emissions" discussing that people can have difficulty understanding CO2 emissions. Respondent E2 highlighted the importance of not only setting goals but following them up on a regular basis in order to keep people motivated. The carbon calculator could follow a user's journey over time and give feedback in the form of personalized tips and tricks on how to progress forward (E2). Another way could be to provide a newsletter to follow up on the goals (E3) and finally the leaderboard is a way to show how close users are to the goal.

If a climate competition is held within a corporate setting it is important to consider that the goal might need to be different because people might feel pressured to participate (see "G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions"). The interviews (P1, E2) highlighted that people who already have low CO2 emissions are not able to lower their emissions as much as those who start with high emissions, see "G12. Keep in mind the different needs of users with varying levels of environmental knowledge" for more details on how to tackle this issue. Also, other factors can affect the user's progress, such as having time or money [39]. The external context can also affect the user's ability to progress, see "G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions".

G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions
Social, cultural and structural context are factors that have been discussed to influence the needs and motivations when it comes to adopting pro-environmental behavior. Not taking this into consideration when designing a competition in a carbon calculator could result in lack of motivation or ability to carry out the behavior that

leads to lowered emissions.

The social context was brought up by a number of respondents (P1, E2, E3). An example is opportunities to meet other people taking part in the competition and discuss together matters in order to see a greater perspective (P1) and to discuss what changes can be made towards sustainable behavior (E2). Additionally, friends and family were perceived as more motivating to compete against (E1) and seen as people who can influence motivation to carry out pro-environmental behavior (P1, E2).

The specific social context of a workplace competition suggested by an employer was discussed as being something that can affect motivation in users (E5, E6), especially if it is perceived as not being a voluntary activity (E6). One respondent (E6) suggested that the social connections in a workplace environment differ from those of a person's private life, and therefore more effort can be needed to create that "team spirit" in a competition. A suggestion is to let people choose their own team to team up with people they already know. Another respondent (E5) suggested that a competition aimed to be used among friends has different motivations and has to be "fun fun fun" all the time. Furthermore, some respondents suggested considering the friction between work and life expectations (E5) and how much time a competition can take from regular work activities (E5, E6).

One respondent (E1) in our study pointed out that cultural context and norms affect whether a person carries out pro-environmental behavior. An example given was norms around and opportunities to do recycling. An example of a structural context that can affect pro-environmental behavior is infrastructure such as the availability of public transport [61].

Ensure that the app's information and recommendations for a sustainable life-style are tailored to social, cultural and structural context in which the app is in use. A respondent (E1) exemplified it as being hard to sort waste in a country where no infrastructure has been established to do it. In order to make use of the narrative and context surrounding the competition, an idea is to combine using the carbon calculator with other initiatives. One example is the competition P1 took part in, where locals were offered free public transport concurrently to the competition.

G7. Consider a simple concept to balance the complexity of environmental issues

Consider using a simple concept to balance out the complexity of carbon emissions and environmental behavior. Complex content and a complex application can be distracting or de-motivating.

Environmental behavior can be seen as a complex issue [99], [61]. In addition to this, studies have found CO2 to be a concept that is difficult to understand [60] which was also evident from the interviews in our study (see "G3. Provide people with

relatable and tangible examples to understand their CO2 emissions"). One respondent (E6) suggested that carbon calculator apps need to be easily accessible and easy to understand. Similar to fitness apps, the user needs to be able to log on and quickly get an idea of what needs to be done (E6). To make the app easy to use was also supported by E5 who suggested that a lot of people have app fatigue and are busy with their private lives. Making information on pro-environmental behavior easily accessible can also be supported by research explaining that there are already a number of barriers standing in the way of a person acting pro-environmentally [39], [61]. When it comes to behavior change, Fogg's behavior model [35] states that designers must focus on simplicity and making it easier for a user to carry out a task and suggests that a behavior can occur even if motivation is low, if it is simple enough to carry out. An example of how to make the competition concept require less effort can be found in the design of our prototype. We designed the challenges so that the user only has to confirm starting and ending the competition instead of having to log every day/time they did an action.

Several respondents (P1, E2, E4, E6) suggested that in order to make it easier for the user, the app could do the calculations automatically, such as the Svalna app does. Another example of a solution can be to choose a competition concept that is already familiar, such as the step challenge, as suggested by E4. What is a familiar concept could depend on what cultural and social context a person lives in, see "G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions".

Based on responses from our interviews (E5, E6) this guideline can be useful to follow if a competition is held in a workplace setting. A study by Krath et al. [62] suggests that an app attempting to change behavior should be easy to understand and time efficient so that it is not too distracting from actual work tasks. In this case, a solution could be to make the competition a part of an already established system [62]. See "G2. Provide users with concrete tips on how they can lower their CO2 emissions" for the importance of giving the user simple tasks to carry out. It is also important to consider that people who are new to engaging in environmental issues may have different needs than people who are more experienced (see "G12. Keep in mind the different needs of users with varying levels of environmental knowledge").

G8. Allow users to compete on a team level to increase perceived impact
By allowing users to compete as teams where their individual results can be aggregated, impact can be larger and be reached faster. When progress appears to be too slow, this can lead to decreased motivation.

Several respondents in this study (P1, P3, P4) favored competing as teams and thought that a larger impact in reduced emissions can be achieved as a team compared to as individuals (E4, E6). Participant E3 meant that this was encouraging as people could see that their collective efforts would make a greater difference to the environment. Competing as teams were also seen as motivating (P3, E6), encouraging (E3) and that it could help with their own performance (E1). As one respondent

(E1) put it “as a team you have that competitive nature, as a team you cheer each other on and give each other motivation, make yourself work harder”. Indeed research has shown that collaborative actions can have effect on pro-environmental behavior [3] and competing on a group level can lead to increased sustainable behavior [81], [88].

When it comes to goal setting for teams, one respondent (E6) pointed to the importance of considering team sizes. A larger team may have an easier time reaching a certain type of goal than a smaller team, and vice versa. See "G5. Allow users to set goals for their target CO2 emissions and follow their progress" for more considerations regarding goals. To increase motivation within the team, a couple of respondents (E2, P1) suggested having a designated person (“eldsjäl”), similar to a team leader, who takes the role of encouraging and motivating other people in the team. E2 also suggested making sure to have regular meetings to boost morale.

However, as pointed out by one respondent (E4) when group dynamics do not work out, this can call for the opportunity to compete individually. One solution that we incoperated into Kallna is to allow people to compete both as teams and individuals (see Figure 6.21). Another respondent (P2) brought up that for people with high emissions, having to work in a team can be “scary” and de-motivating and that they should be allowed to focus on their own improvements. This suggests that in cases where eco-guilt exists, individual effort is preferred.

Figure 6.21: Compete on team and individual level

G9. Allow for social comparison of CO2 emissions and progress
Allowing for social comparison of CO2 emissions and progress with friends and family can increase users’ motivation.

Offering social comparison in carbon calculators can lead to pro-environmental behavior and a positive outcome [71]. It has been found to help with motivation [62] and engagement [60]. Respondents in this study found that it could support discussions outside the use of the carbon calculator (P1, P2). Respondents in our study (E1, E2) also thought that comparing one’s emissions to others would be motivating (E1, E2, E3). Some respondents thought it would especially be motivating if it was with people they already know, such as friends or family (E1), or to an average person living in Sweden or Europe (E2). The app Deedster [27] offers a similar concept of comparison, see Figure 6.22.

A few of the respondents (P1, E2, E4) thought that knowing that you are outside of the norm can be motivating to perform better. This is supported by research on nudges suggesting that social nudges can help influence a person’s behavior by showing them if they are above or below average [96].

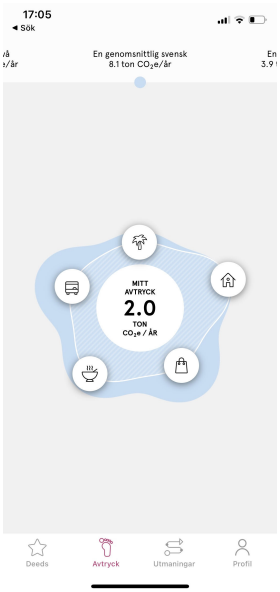

Figure 6.22: Print screen of Deedster where comparisons of CO2e to an average Swede is presented [27]

Even though comparison can be motivating, some respondents in our study (P1, P2) pointed out that it could make them feel bad. For example, P1 felt like it was positive in cases they were above average but that it could be triggering when the comparison was done towards people with a different lifestyle. P2 felt like there was a risk that comparing others in the group can lead to people with high emissions feeling bad and not wanting to participate in the competition.

There is also the potential consequence of the "boomerang" effect where people who are already better than average feel like they do not have to lower their energy use as they are already better than the norm [96]. In our prototype we decided to include a space where users can compare their own CO2 emissions to that of their own team and organization. With the result of the research in mind, the user had to click a button "Compare to others", which meant that they could choose themselves whether they wanted to see the comparison and not be faced with it as soon as they sign in to the app (see Figure 6.23).

Remember that people can have different motivations for competing, see "G4. Keep in mind that some types of game elements may need to be adjusted to be suitable for environmental sustainable behavior interventions". Not being careful with how comparison is presented is also supported by "G10. Be aware of eco-guilt".

G10. Be aware of eco-guilt
Eco-guilt can arise as a result of people feeling like they are outside of the norm, and can be a result of allowing people to compare themselves against others or against the norm. This could lead to both negative and positive behavior effects.

Research suggests that people whose behavior opposes the social norm can experi-

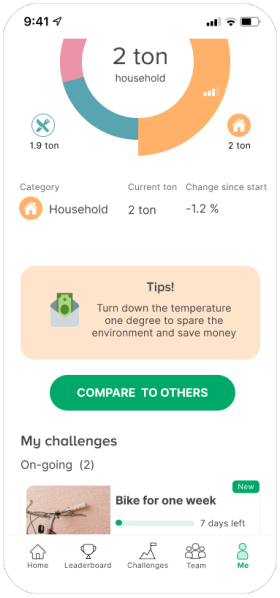

Figure 6.23: Kallna - Compare to others

ence self-criticism and guilt [26], and people who have a larger eco-footprint than others can experience eco-guilt [71]. Results from our study have pointed towards the need for consideration when using the game element leaderboard. P1, who had previously taken part in a climate competition, explained that people in the competition worried about being judged for having high CO2 emissions. This led to them opting to be anonymous on the leaderboard, which meant the leaderboard was not being used as intended.

Research suggests that some eco-guilt can be positive as it can lead to pro-environmental behavior, but points out that it is useful if the carbon calculator provides the user with information on how they can improve their pro-environmental behavior [71]. A solution for this could be to provide the user with concrete tips on how to change their behavior (see "G2. Provide users with concrete tips on how they can lower their CO2 emissions"). For Kallna we included encouraging messages with tips based on the user's emission progress, a feature that was appreciated in the testing of the prototype (T3, T4) see Figure 6.24. Using positive reinforcement is also supported by Schultz study [96] where people who were presented with a smiley face did not increase their energy use.

Figure 6.24: Kallna - Encouraging message based on a team's CO2 savings

In order to decrease the risk of eco-guilt when it comes to using a leaderboard, one

solution is to limit the leaderboard to only present the best three or ten people in the competition (WS, E6), see Figure 6.25 for our solution for the problem. Another suggestion that has been brought up by several respondents (E5, WS) is to show three people below and three people above your position on the leaderboard. In this way, users would compete in their own range. However, that requires the number of users to be large, or else it would lose its purpose (E5).

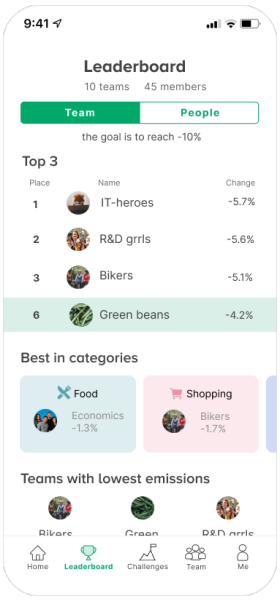

Figure 6.25: Kallna - Leaderboard showing top three teams

This guideline is connected to Guideline 1 where use of fearful information is discussed. It is also applicable on Guideline 9.

G11. Allow users to learn from how others have lowered their emissions

Allowing users to show how they have succeeded in lowering their emissions can help other users be motivated and learn to do the same. Seeing that other people are taking action can also be motivating and make people feel less alone in their efforts, as well as foster conversations outside of the app.

Several respondents (E1, E2) in our interviews pointed out that it would be motivating to be able to see how other people have lowered their emissions in order to learn from it, as E2 stated: "What have they done to lower their emissions this much? Because it might help me". In addition to learning from each other, respondents also pointed out the importance of seeing that other people care about the environment and that they are taking action (E2, E3, E4). People misjudging how concerned others are about the environment, and worry of being judged themselves which can lead to a lack of pro-environmental behavior [13]. One respondent we interviewed referred to people having a herd mentality and suggested that it can be motivating to see that others care about the environment too, especially if it is family, friends or people who are important to them (E3).

In addition to showing that someone has a high rank, for example through a leaderboard (see "G4. Keep in mind that some types of game-elements may need to be adjusted to be suitable for environmental sustainable behavior interventions"), a suggestion is to show how users have succeeded in reaching their high rank, for example showing what type of behavior they have carried out to lower their CO2 emissions. Respondent E2 suggested having an activity feed showing the actions of team members, for example when they have joined a challenge. This is something we incorporated into Kallna. In Kallna we also made it possible to click on a person or a team in the leaderboard, and see what kind of challenges they have participated in which could explain their success in lowering their emissions (see Figure 6.26).

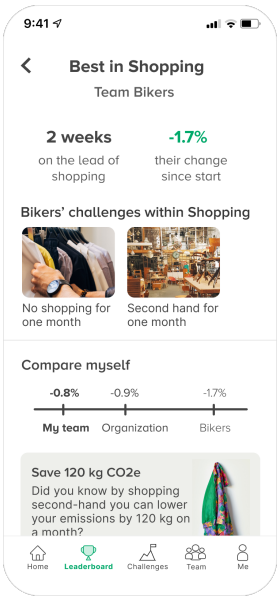

Figure 6.26: Kallna - Best in category

A consideration could be how much and what type of information should be shared. As is mentioned in other guidelines (for example "G10. Be aware of eco-guilt") some respondents were uncomfortable thinking that they would be judged by others based on their progress. A suggestion is to either allow users to choose what information they want to share, or to not directly link their information to a behavior. In our design we chose to guide the user to the challenge the top three persons with the highest ranks had been part of, which could be the reason for their success. However, as mentioned in Guideline 9, comparison is by some respondents preferred to be done with people they already know in which case they might not mind sharing these things.

G12. Keep in mind the different needs of users with varying levels of environmental knowledge

Different levels of environmental knowledge can call for different solutions when it comes to the type of information and design elements that are incorporated into the design.

Users with different levels of prior environmental knowledge can be in need of different kinds of information in carbon calculators [60]. For example, as opposed to more environmentally experienced users who were in need of more detailed information, Barendregt and Kok [60] found that novices needed more basal information on how they could improve themselves as well as step-by-step instructions. Respondents (P1, E2) in our study also brought up that different levels of previous environmental behavior can affect how well they perform in the competition. Respondent P1 had experienced that people who already had low emissions had difficulties lowering them further which led to decreased motivation as the goal of the competition was to lower emissions as much as possible.

Respondents in our study had varying opinions regarding what level of user should be focused on. One respondent (P4) thought that the focus should be on those who are not already engaged in environmental issues, and E2 saw the value in focusing both on those who are already interested in these issues and those who need a "kick in the butt" (E2). A solution to include already experienced users could be to allow them to be able to win the competition based on other metrics than how much they have lowered their emissions. For example, in our design (see Figure 6.23) we accommodate three different types of "winners": those who had lowered their total emissions the most given the time frame, those who had lowered their emissions the most within a certain category and those who had the lowest emissions at the end of the competition. In order to meet different levels of knowledge, one idea is to have challenges of different difficulty, or provide increasingly difficult examples of actions to take as E2 proposed that people who have done their "environmental journey" towards a sustainable lifestyle might need other ways to be engaged such as inviting others to lower their emissions.

A way to accommodate users with differing emission levels or environmental knowledge, an idea could be to offer information that is personalized and based on a user's own emission profile, see "G1. Support learning about pro-environmental behavior". E4 stated that if the target user group is homogeneous (for example held in a workplace) there might not be a need for solutions that accommodate users of varying levels of environmental engagement.

7
Discussion

In this chapter, the results and its challenges will be discussed, along with a discussion of the methods used in this project. Validity and generalizability as well as ethical consideration for this thesis will also be covered. At the end, opportunities for future work will be touched upon.

7.1 Result

The result will be discussed in regards to the design Kallna and guidelines.

7.1.1 Kallna

Our aim was to match Svalna's minimalistic design for our prototype Kallna, which is something we argue that we succeeded with. We also wanted to find a suitable level of game elements in order to keep the app simple yet engaging enough to be used in a climate step competition in the workplace. In addition, Svalna's concept of a competition already involve a range of game elements, which led to us not wanting to incorporate too many additional features of this kind. If more time was provided to the project, it would have been interesting to explore if points and badges could motivate users in a different way than Svalna's existing solution that makes use of transaction data.

In retrospect, more energy could have been devoted to contextualizing CO2 since the need for this was highlighted in a majority of our interviews and tests. Despite that a learning page explaining what CO2 is equivalent to and having different challenges representing how much a user could potentially lower their CO2 emissions (for example bike for one week could lead to the decrease of 65 kg CO2) some of the tests revealed a lack of understanding of what the levels of CO2 meant. By providing users with an on-boarding before starting the climate competition could act as a help in better understanding the concept, similar to the kick-off that was held during the pilot study.

Some of the test participants thought the idea of having challenges could be encouraging and could act as a way of getting users to understand what they could do to improve their level of CO2. What was brought up during interviews (P2, E4) was that people did not manually want to input their habits into an app. As a result of that the challenges were designed around the user's transaction data

which meant that there was a low need for interaction. This could also be beneficial from Svalna AB's point of view, since our suggestion is based on their structure of transaction data. However, a potential pain point can be that challenges that are stated as "low impact" might not lead to a visual change in the transactional data. For example, a person taking the challenge of biking for one month may not see changes in their CO2 if they had just fueled up their car recently as this could affect their CO2 within that category. As a result of this, people might see no change and feel demotivated which could lead them to losing interest in the climate competition.

By seeing the climate competition as a stand-alone competition we argue that we could design and come up with more ideas than if our design was bound to fit into Svalna's current app. As a result of this, it might not be possible for Svalna AB to implement everything as their current climate step competition has limited space in their app. However, we believe that some of the design ideas could be incorporated into their existing solution with limited resources, for example providing tips, articles and contextualizing what CO2 is. Based on the interviews we saw a need for these types of features to boost understanding and motivation.

7.1.2 Guidelines

The guidelines produced can be useful for designers, decision makers or others who are interested in helping people lower their CO2 emissions. They can be used all together or one by one, meaning that they could also be of value for people other than those they were originally aimed for, for example people who are interested in how the topics of sustainability and pro-environmental behavior can have an influence on the effects of gamification or what factors can contribute to this type of behavior.

Through having had the opportunity to collect insights from interviews with both experts in fields relevant to our study as well as participants of a climate competition, we managed to get both perspectives to support the resulting guidelines. A majority of the guidelines has some support from both experts and participants as well as support from relevant literature. The guidelines are also supported by examples from our own work as well as other apps, providing inspiration for how the guideline could be applied in a practical setting.

During work with the guidelines we started off with many different topics. Towards the end we made the choice to boil these down to a fewer set of guidelines. The choice to combine previous guidelines that were overlapping made it possible to discuss different angles and draw connections between issues within the scope of one guideline. However, it could also mean that some guidelines may seem to be covering many topics but on a more shallow level, or that the topics do not seem to belong together. Even so, we saw more benefits from combining overlapping guidelines in order to provide the user of the guidelines with fewer but well thought through topics that they can choose to look into deeper should they wish to.

Moreover, the results from our study as well as previous research pointed towards

different opinions regarding some of the topics brought up in this report and in the guidelines (for example "G10. Be aware of eco-guilt"). In these cases we made the choice to shed light on both standpoints in order to be transparent about the issue. This can provide the user of the guidelines with information that can help them choose which approach is more suitable for their competition context.

Finally, many of the guidelines are closely connected to each other. We have highlighted this by referencing between them. This provides the user of the guidelines with an understanding of how the different topics are connected and how they by following the guidelines can benefit from how they support each other.

7.2 Methodology

When starting the project the literature search that we conducted was deliberately aimed at a wide range of topics. This was due to us not knowing which angle would be suitable for the problem at hand. While this approach provided us with different viewpoints from which to get close to the problem, it was at times a bit overwhelming where some of the themes we thought would play a larger part than it did in the work with the final guidelines and design. While the resulting guidelines and design had support from a portion of the themes in the literature study, topics such as nudging was not used to the same extent as anticipated.

When moving on to user research (as mentioned in Chapter 5), the plan was to conduct interviews with participants of Svalna's climate step competition as well as collect quantitative data from the current Svalna app. However, as the competition kept being postponed, we had to change our plan of action at several points during the project. When the climate step challenge started towards the end of this project (iteration 3), we had already conducted a number of expert interviews. This meant that when adding the climate step competition participants, a total of 10 interviews were conducted. As many of these were with experts within different fields of practice, most of the interview templates had to be tailored towards different topics to be able to yield valuable insights. The planning, conducting and analyzing of the interviews turned out to be very time consuming. In hindsight, we could have spent less time planning for and transcribing the interviews, and more time on analyzing them which would have been useful for producing the guidelines and the design. However, in iteration three we decided to transcribe the interviews in less detail in order to be able to save time and focus our energy on analyzing it. Another option could have been to not take on the climate step competition in order to focus on the data already collected in the expert interviews. However, we valued being able to get input from users of the climate competition and saw this as an opportunity to get valuable insights for both the design and guidelines. Yet another problem occurred that resulted in the carbon challenge starting one month later than what we expected. By that time we had already conducted our pre-interview, which led us to not having enough time to hold the other two planned interviews.

As for the themes for the interviews, we took base in what themes had arisen in

the previous interviews when we planned for the subsequent one. This meant that the path of topics that we chose to investigate further were in part determined by the interviews in the start of the execution phase. This way of working allowed us to delve deeper into the challenges that were deemed interesting and relevant. However, a downside to this could be that the themes for each interview were not objective but subjective to the result from previous iterations, which could mean that there was not as much room for completely new angles or topics. In order to work around this we had the motivation to not have the interviews be too structured but allow for other themes to emerge.

Overall the chosen design process and methodology that was used supported us in working iteratively and allowed us to be agile for the times when our plans changed. This was especially useful as many of the challenges we encountered were wicked problems where we had the need to move back and forth between realizations and solutions. For example, how to visualize a decrease in CO2 as something positive led to us trying out many different solutions which has been brought up in the Result chapter (chapter 6). At times during the process we discussed narrowing our scope for what to focus on. How to visualize CO2 was one of the challenges that we in hindsight could have spent more time and focus on trying to develop, rather than having as wide a scope as we had.

7.3 Validity and generalizability

As has been discussed in the Theory Chapter (chapter 3), pro-environmental behavior can be viewed as a complex issue [99] with many different individual and external factors being able to influence a person's behavior in this aspect [61]. This could mean that the content in our prototype, such as information and suggestions on activities to perform to lower a person's level of CO2 could be difficult to generalize. For example, cultural and social context can affect the needs for the design as suggested by guideline "G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions".

Kallna was a re-design of Svalna's app which meant that we were guided by the tone and visual elements that were already used in the app. For example, Svalna's climate step competition is currently used in a Swedish context where it is aimed at organizations and companies. When designing a competition in a different context, some of our insights and design suggestions may not apply. However, the literature research was based on studies conducted in different countries meaning that this part of the contribution could be assumed to be applicable in other contexts and settings.

As a couple of respondents (E5, E6) in our study pointed out, similarities can be found between sustainability apps and fitness apps. We propose that some aspects of the guidelines and design could be applicable in other types of applications or initiatives where the aim is to quantify and change behavior. During our study we have found that climate discussions and pro-environmental behavior can be a sensitive topic, especially in light of social norms and being judged by others. Perhaps

the solutions we have found to combat this could be useful in contexts with other sensitive topics, especially the considerations for game elements, see guideline "G4. Keep in mind that some types of game-elements may need to be adjusted to be suitable for environmental sustainable behavior interventions".

Finally, the user research involved qualitative data gathering. Seeing as interviews are subjective it is not possible to generalize these findings but they can instead be viewed as examples of unique experiences. One of the initial plans was to use data from the app, which could have backed up some of the findings from our interviews. We took some steps to avoid us influencing the participants more than necessary during the interviews. For example, the structure for how they were carried out and analyzed was largely the same throughout the iterations. We also tried to avoid leading questions or to influence the participants' responses, more than the themes of the questions being asked, as suggested by Preece [51]. However the expert interviews provided us with insights mainly from their previous research, some of which could be assumed to be more generalizable.

7.4 Ethical considerations

There are some ethical considerations to be made in light of this project. Firstly, as presented in the Theory chapter (chapter 3), some researchers criticize nudging as having the risk of being unethical [6]. Thienen et al. [110] empathize that nudging always leads a person in a certain direction and that this is important to be aware of as a designer. A discussion to be is whether nudging and potentially manipulating tactics is in fact warranted in order to stave off a major emergency such as the climate crisis. Our aim has been on leading the user into pro-environmental behavior but there is a fine line between leading and steering too much. A potential way to make the use of nudging less manipulative is to make sure nudges are transparent [103] i.e. that it is clear what the intention behind the nudge is.

Another potential consideration is whether instilling eco-guilt is ethical or not. In our research, we have found that seeing that other people are contribute to pro-environmental behavior can be motivating (see "G11. Allow users to learn from how others have lowered their emissions"). However, seeing that other people are doing better can result in a "boomerang effect" where the user feels demotivated and gains eco-guilt.

During the project the inclusion of fearful information has also been considered in the form of pictures and text about the climate crisis. We feel that concealing the urgency of the climate crisis could be unethical as it could lead to people not believing that they must act now. However, with nudging and manipulation in mind, we argue that contributing to a positive space in the app and providing encouragement could lead to a better result than shaming and guilting.

Another ethical consideration that could be made is what consequences sharing information of a person's CO2 emissions could lead to, as was brought up in two

of our interviews (E3, E4). For example, one respondent (E4) pointed out that the degree of CO2 emissions could be a reflection of a person's income, in relation to this another respondent (E3) highlighted that buying ethically and locally produced food often is more expensive meaning that the ability to do some pro-environmental behavior could be a question of class differences. With this in mind, as discussed in "G9. Allow for social comparison of CO2 emissions and progress", sharing of information and comparing CO2 emissions against one another could at the same time be motivating and lead to pro-environmental behavior [71]. We suggest, as mentioned in guideline "G10. Be aware of eco-guilt", that some of these issues could be helped by providing encouraging information to the users and allowing them to choose whether they want to compare themselves of not.

Finally, something that also has been raised during our project's interviews is the ethical aspects of having a competition at a workplace but where a person's transactional data is the basis for the competition. The transactional data is something that is not connected to a person's employment or work activities but is the basis for the competition at the workplace with colleagues. As has been highlighted in interviews (E6) in this project, people may also feel pressured to participate when managers invite them to take part, as well as if a majority of colleagues participate one might not dare to withdraw. In order to get past this, we think it would be useful if the employer is clear about what the purpose of the competition is and what is expected of the employee as well as inform them about what kind of information will be visible to others in the workplace.

7.5 Future work

Even though the project has gone through several iterations where the design work and testing has been carried out, there are additional ideas mentioned in the Execution and process chapter (chapter 5) that could be explored further, such as providing a quiz or challenging another player. Along with this, additional evaluation of the entire prototype could be beneficial, especially with people in different age ranges, seeing as the majority of testing carried out in this project was done with participants around the same age (25-32 years old).

Our final design work for Kallna contains several screens that are designed to work as a complete carbon competition app. Svalna's current app's climate competition has limited space due to other features in the app. A consideration for future work could therefore be to incorporate Kallna into Svalna's existing app.

Another area that could be further researched, as was the initial plan for this master thesis, would be to conduct a longitudinal study where a number of participants in a climate competition are studied over a longer time period. As suggested by [86] studying gamification over a longer period of time could allow the researcher to see if people's behavior changes over time, perhaps as a result of the app, and in the case of this competition if they act according to what they say they do.

This thesis does not include research and design for a variety of impairments and disabilities. Therefore, as a final suggestion for future work, the accessibility of the app could be improved. For example, the suggestions of challenges in the concept of challenges have not been evaluated by users and can solely act as a template to get a feeling of what a challenge could involve.

Due to this project being time limited, a final future work consideration could be to explore more in regards to "G3. Provide people with relatable and tangible examples to understand their CO2 emissions" as well as show a decrease of CO2 in a simple way. Contextualizing CO2 was brought up by a majority of our interview and test participants where we acted according to the input we got. However, we can not confirm that our suggestions of what CO2 is, can be interpreted by a larger mass of people, as it needs to be tested more. When it comes to showing a decrease of CO2 in a simple way, we ideated a lot on how to visually show that a person had lowered their CO2 with different charts. When the design was tested it was difficult for people to understand if the value was their current value, their saved CO2 or their lowered CO2. The fact that the graph is getting lower/higher when the CO2 is changing was difficult to interpret. This indicates that more effort could be put into testing this in future work.

8

Conclusion

The aim of this master thesis was to answer the research question:

What should be considered when designing a time-limited competition for an application intended to encourage people to lower their CO2 emissions?

The thesis was done in collaboration with the company Svalna AB. The original plan was to cover a climate step competition where participants compete to lower their CO2 emissions with the help of Svalna AB's carbon footprint calculator, Svalna. The thesis work would consist of collecting insights from interviewing the participants in the competition, which would be used in order to create a high-fidelity mockup of a climate competition as well as guidelines on how to engage people in lowering their CO2 emissions through a time limited competition.

Due to delays of the climate step competition, we changed our plan several times during the project. Following re-planning we investigated the research question with insights from interviews with six experts in fields relevant to our study in addition to four participants of the climate step competition. Sketching, creation of high-fidelity and low-fidelity prototypes and testing were carried out throughout the project. A workshop was also held with fellow interaction design students, with the aim of tackling an issue around eco-guilt. This work resulted in the design named Kallna.

Findings from literature research, benchmarking, user research, workshop and testing of the prototype resulted in 12 guidelines suggesting how to design a climate competition with the purpose of lowering people's CO2 emissions through the use of an app.

- G1. Support learning about pro-environmental behavior
- G2. Provide users with concrete tips on how they can lower their CO2 emissions
- G3. Provide people with relatable and tangible examples to understand their CO2 emissions
- G4. Keep in mind that some types of game-elements may need to be adjusted to be suitable for environmental sustainable behavior interventions

- G5. Allow users to set goals for their target CO2 emissions and follow their progress
- G6. Take into consideration how external factors may influence the user's ability to lower their CO2 emissions
- G7. Consider a simple concept to balance the complexity of environmental issues
- G8. Allow users to compete on a team level to increase perceived impact
- G9. Allow for social comparison of CO2 emissions and progress
- G10. Be aware of eco-guilt
- G11. Allow users to learn from how others have lowered their emissions
- G12. Keep in mind the different needs of users with varying levels of environmental knowledge

We believe that the guidelines produced can be useful for designers, researchers and people who are interested in a sustainable future. Some of the guidelines that are not solely focused on pro-environmental behavior could also be applicable to other contexts as well. Regarding future work, we think it would be interesting to explore further how CO2 can be contextualized to be more easily understood and how a decrease in CO2 can be visualized in a way that conveys that it is positive. It would also be interesting to see how well the concept of Kallna fits into Svalna's original app. Finally, we think it would have been interesting to apply the guidelines to a different design context to see if they actually bring about the effect they are intended to.

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A

Appendix 1

Survey questions

Purpose

This survey aims to getting an understanding of people's environmental behaviors. It focuses on use of carbon footprint calculators and competitions to lower greenhouse gas emissions (CO2).

We Kassandra and Sophie, are doing this survey as part of our master thesis at Chalmers University of technology within Interaction Design technologies in Gothenburg, Sweden.

You are anonymous and have the right to withdraw at any time during the survey. The data will be deleted after the thesis is finished after June 2022.

If you have questions don't hesitate to contact us on: gsophie@student.chalmers.se

This survey will take you approximately 3-5 minutes to fill out. Thank you for your participation!

Basic questions

- What is your age? *
  - 18 or younger
  - 19-30
  - 31-45
  - 46-59
  - 60 or older

- Where do you live? *
  - Europe
  - Asia
  - Africa
  - Australia/Oceania
  - North America
  - South America
  - Other...

Climate change and the environment

You will now be asked to answer some questions about climate change and the environment.

- To what extent do you feel concerned about climate change? *
  - No concern [1] [2] [3] [4] [5] Very concerned

- To what extent do you consider yourself to be environmentally friendly (e.g. use renewable products, recycle, conserve water etc.)? *
  - Never environmentally friendly [1] [2] [3] [4] [5] Very environmentally friendly

- How active are you in trying to reduce your environmental impact? *
  - Not active at all [1] [2] [3] [4] [5] Very active

CO2 emissions

You will now be asked a few questions regarding CO2 emissions in general

- Which out of the options below do you think is equivalent to 900 kg CO2 emissions? *
  - A one-way flight between London and New York
  - Buying a new laptop
  - Shower 5 minutes everyday for a year

- How much of the total CO2 emissions do you think comes from household consumption? *
  - 11%
  - 21%
  - 31%

Carbon footprint calculators

You will now be asked to answer some questions about your experience with carbon footprint calculators.

A carbon footprint calculator is a tool (app or website) that measures an individual's greenhouse gas emissions (CO2) based on their lifestyle (such as household, energy consumption, shopping behavior, food and transportation).

- Have you used a carbon footprint calculator? *
  - Yes
  - No
  - I don't know
  - Other...

- Do you think that you could decrease your carbon emission with the help of a carbon calculator? *
  - Yes
  - Somewhat
  - No
  - Other...

****
Participants is steered to either "Have experience of carbon calculators" or "No experience of carbon calculators" depending on their answer if they have used a carbon calculator before.

Have experience of carbon calculators

Additional questions about carbon footprint calculator and competitions to lower carbon emission

A carbon footprint calculator is a tool (app or website) that measures an individual's greenhouse gas emissions (CO2) based on their lifestyle (such as household, energy consumption, shopping behavior, food and transportation).

- Which type of calculator have you tried? *
  - App (such as Earth hero, Deedster, Svalna etc.)
  - Website (such as WWF, nature.org, carbonfootprint.org etc)
  - I don't remember
  - Others...

- Have you made any climate related changes since the use of the carbon footprint calculator? *
  - Yes
  - Some changes
  - No
  - Other...

- What did you like about the tool you used?

- What did you not like about the tool you used?

Competition in a carbon footprint calculator

Consider being part of a competition in a carbon footprint calculator that measures individual's greenhouse gas emissions (CO2) based on their lifestyle (such as household, energy consumption, shopping behavior, food and transportation).

- How would you prefer to compete? *
  - As part of a team
  - Individually
  - Both

  - Other...

- If you were to create a team, who would you prefer to include in your team? *
  - Friends and/or family
  - Colleagues from work or school
  - Others people (for example people you don't know from before)
  - Other...

- What would be the main goal for you to take part in a competition on a mobile application? (choose how many you like) *
  - To win
  - To have fun
  - To socialize
  - To learn
  - Other...

- Would you like to add anything?

No experience of carbon calculators

A carbon footprint calculator is a tool (app or website) that measures an individual's greenhouse gas emissions (CO2) based on their lifestyle (such as household, energy consumption, shopping behavior, food and transportation).

- Would you consider using a carbon footprint calculator? *
  - Yes
  - Maybe
  - No
  - Other...

- If you were to use a carbon calculator, what do you think would encourage you to use it? (choose how many you like) *
  - Be able to compete against others
  - Be able to set my own goals
  - Be able to earn points
  - Get information about the environment
  - Get tips for how I can be more sustainable
  - Nothing, I don't think it would encourage me.
  - Other...

Competition in a carbon footprint calculator

Consider being part of a competition in a carbon footprint calculator that measures individual's greenhouse gas emissions (CO2) based on their lifestyle (such as household, energy consumption, shopping behavior, food and transportation).

- How would you prefer to compete? *
  - As part of a team
  - Individually
  - Both
  - Other...

- If you were to create a team, who would you prefer to include in your team? (choose how many you like) *
  - Friends and/or family
  - Colleagues from work or school
  - Others people (for example people you don't know from before)
  - Other...

- What would be the main goal for you to take part in a competition on a mobile application? (choose how many you like) *
  - To win
  - To have fun
  - To socialize
  - To learn
  - Other...

- Would you like to add anything?

B

Appendix 2

Interview Guide Participant P1 (In Swedish)

Syfte

Vi skriver vår masteruppsats på Chalmers i Göteborg och undersöker hur Svalnas klimatstegstävling fungerar och hur den nuvarande designen kan förbättras.

Vi är intresserade av dina erfarenheter kring klimatstegstävlingen. Det finns inte något rätt eller fel svar på frågorna, utan utgå bara från dina erfarenheter.

Du kommer att vara anonym i vår studie, vilket innebär att vi inte kommer ta med ditt namn. Vi kommer även spela in ljudet på samtalet för att ha som underlag för vår analys.

Samtycke

För att kunna delta i studien behöver vi ditt samtycke. Vi har skickat ett samtyckesformulär som beskriver syftet med studien och hur datan kommer att användas. Skulle du kunna skriva på detta i efterhand istället?

- Är det något du undrar nu innan vi startar igång?

Warm-up

- Skulle du vilja berätta vad din sysselsättning är inom din organisation?
- Hur ser ditt intresse ut för miljö och hållbarhetsfrågor?
  - Hur ser detta engagemang ut?

Uppföljningsfrågor om tävlingen 2020

Nu kommer vi blicka tillbaka till den klimatstegstävlingen som ni deltog i.

- Vad är ditt generella intryck av klimatstegstävlingen?
- Hur har dina tankar kring miljön ändrats sen du varit med i tävlingen?
  - Har du utvecklat några nya vanor?

Appen

- I appen fick du information om dina utsläpp inom de olika kategorierna.
  - Tycker du att appen gav dig tillräckligt med information om hur du kunde minska dina utsläpp?
  - Var det någon vana som du eller någon av de andra deltagarna hade svårt att ändra på?
    - Finns det något som appen skulle kunna göra för att underlätta för dig?

- I appen visas ditt utsläpp i en viss kategori med antal ton koldioxid.
  - Om nej: Har du några tankar kring på hur det skulle kunna presenteras mer lättförståeligt?
  - Om ja: Märkte du om andra hade svårt att förstå detta?
  - Om ja: Tror du att andra med mindre erfarenhet hade svårt för detta?
    - Kände du att du förstod vad det innebar? (tex. 1.8 ton)

Tävlingen

Nivå

- Hur väl tycker du att tävlingen var anpassad utefter deltagarnas olika nivå av miljökunskaper?

- Hur påverkade det tävlingen?

Lag/individuellt

- Appen visar resultat på lag-nivå men även individuellt.
  - Kommer du ihåg vilket resultat som intresserade dig mest?
    - Varför var det intressant att få den här informationen?

Socialt

- Påverkade tävlingen dig även i andra sammanhang när appen inte användes aktivt?
  - Exempelvis i hemmet, på arbetet eller i samtal med vänner

Placering i gruppen

- Hur upplevde du att dela dina framsteg och bli rankad i en topplista?
  - Hur skulle avtrycken kunna visas istället?
- Hur upplevde du att kunna se andra deltagares framsteg i en topplista?
  - Bidrog det till din motivation?
  - Jämförde du dig med andra?

- Appen visar även om du har lägre eller högre utsläpp än genomsnittet i gruppen. Exempelvis: “Du har lägre utsläpp än 50% av alla medlemmar i gruppen”.
  - Var detta något du påverkades av?

Wrap-up

- Har du använt appen sedan tävlingen avslutades?
  - Om nej: Har du några ideer på något som skulle kunna ha gjort att du valt att gå tillbaka till den efter tävlingen?
    - Vad skulle få dig att använda appen mer?
  - Om ja: på vilket sätt? Hur har du använt den? Hur ofta?

- Skulle du kunna tänka er att delta i klimatstegstävligen igen?
  - Om nej: Finns det något som skulle kunna göras annorlunda som skulle få er att vilja delta igen?

- Generellt, tror du att klimatstegstävlingar kan engagera folk att anamma en mer hållbar livsstil?

- Finns det någon funktionalitet som du saknade i tävlingen?

- Har du något du vill tillägga något som inte tagits upp idag?

Vi vill bara påminna om att ljudupptagningen kommer att transkriberas och sedan raderas senast 15 mars 2022 och transkriberingen och anteckningarna kommer i sin tur att raderas när studien är klar i juni 2022.

Tack för din medverkan!

C

Appendix 3

Interview Guide Participant E1

Purpose

We are writing our Master's thesis at Chalmers University of Technology in Gothenburg. The research we are conducting is focused on how to engage people to behave environmentally friendly through a competition in an app. We are collaborating with Svalna, a research based company. Svalna has developed a carbon calculator app that calculates the user's carbon emissions and allows them to take part in a competition in lowering their emissions. We are studying how this climate competition works and how the current design can be improved.

We are interested in your views on the topic and would like to emphasize that there is no right or wrong answer to the questions.

You will be anonymous in our study and final thesis, which means that we will not use your name.

We would like to record the audio of the interview to be able to analyze and transcribe it.

You have signed a consent form that describes the purpose of the study and how the data will be handled.

Do you have any questions before we start? Feel free to ask questions if anything is unclear

Warm-up and Introduction

- Would you like to tell us a little bit about yourself:
  - What is your occupation?
  - What is your research area?
  - What are your interests?

Previous experience in competitions

We will start off with some questions about your own experience with competitions.

- Do you have any previous experience with competitions in the form of competitions in apps or websites? (For example apps like step challenge where you can set your goals, track progress and compete against others)
  - If yes:
    - What did the competition consist of?
    - What was the goal for you to take part in the competition?
    - Did you reach your goal?
  - If no:
    - What do you think could have helped you reach your goal?

- Did you compete in a team or individual against other people?
  - Why?
  - In general, do you prefer to compete in a team or an individual?
  - When it comes to other games than this. What are the pros and cons?

- Were you able to feel engaged throughout the competition?
  - If yes:
    - What made you feel that way?
  - If no:
    - do you have any ideas on how you could have felt more engaged?
    - With this competition you took part in, is there something that could be changed in order for you to feel more engaged?

- How long did the competition last?
  - Was it a good amount of time?
  - Do you prefer longer? Shorter?

Carbon Calculator competition

We are studying how people can be motivated to lower their emissions by taking part in a competition, and will now ask you some questions about the topic of carbon calculators and competitions.

- A carbon calculator is a tool that calculates a person's impact on the environment in the form of CO2 emissions. To what extent do you consider yourself to be involved in environmental issues?
  - Are you actively trying to lower your impact on the environment?

- Have you used a carbon calculator before?
  - If yes:
    - Which one?
    - Did you like it?
  - If no: Would you consider using one?
    - Why/why not?

Statistics

- Svalna's carbon calculator app shows a person's carbon emissions in the form of a number of tons of CO2. For example, you have consumed 4 tons of CO2 per year. If you were given this information, how would you interpret it?
  - If person finds it easy:
    - In your experience, do people have the same understanding as you when it comes to interpreting this type of information?
  - If person finds it difficult:
    - Can you think of a way in which it could be presented that would make it easier for you to understand?

- In the app, people can see each others' decrease or increase in carbon emissions over the course of the competition. You are not able to see the exact number of CO2. How would you feel about sharing information like this with other people?
  - How would you feel to see other people's information, such as decreased or increased carbon emissions?
  - If person finds it okay: Would you find it motivating to be able to see your own position compared to that of other people?

Team/individual

- If you were taking part in a competition to lower your carbon emissions, would you prefer to compete individually or in a team?
  - As a team: Why?
  - Individually: Why?

Gamification

General gamification

The app Svalna makes use of gamification by incorporating a few game elements such as badges and leaderboards.

- Are you familiar with gamification?
  - If yes:
    - What is your experience?
  - If no:
    - Gamification is a non-game-context that contains game elements.

Gamification and climate change

- What do you think about gamification used to engage people in subjects such as climate change?
  - If yes:
    - How could this be done?
    - Do you think it could be used to motivate people?

  - If no:
    * Why not?

Gamification for learning

- Do you have any experience of using gamification to educate people in a specific area?
  - If yes:
    * how was it used?
    * Do you think it was a productive way?

- Do you have any thoughts on how gamification can be used to teach people in a certain topic?

Games and competitions

- An issue we have encountered is that climate change is a sensitive topic. When competing against colleagues, people preferred to be anonymous on the leaderboard that shows their placing among other colleagues when it comes to increase or decrease of their emissions. Within games, can you think of any other ways than leaderboards to visualize people's placement or progress?
  - One way to do this could be through the use of badges to symbolize a player's achievement. What is your experience of the use of badges to symbolize a player's achievements?
    * In your opinion, is it motivating?

When it comes to participating in games and competitions.

- Some players may be interested in the competition element and some may be interested to learn new things or to socialize. How do you think people with different motivations for playing games and gamified apps can be approached?

Wrap-up

- Would you like to add something that hasn't been mentioned?

We would like to remind you that the audio recording will be transcribed and deleted 15th of March 2022 at the latest. The information in the form of transcribed text will be deleted when the study is completed by June 2022.

Thank you for your participation

D

Appendix 4

Interview Guide Participant E2 (In Swedish)

Syfte

Vi heter Kassandra och Sophie. Jag Kassandra kommer att hålla i intervjun medan Sophie kommer att föra anteckningar.

Vi skriver vår masteruppsats på Chalmers i Göteborg med syfte att studera hur man kan engagera människor med hjälp av tävlingar i en app. Vi undersöker hur Svalnas klimatstegstävling fungerar och hur den nuvarande designen kan förbättras. Vårt masterarbetet sker i samband med Svalna som har tagit fram appen.

Vi är intresserade av dina erfarenheter och vi vill styrka att det inte finns något rätt eller fel svar.

Du kommer att vara anonym vår studie, vilket innebär att vi inte kommer ta med ditt namn. Vi skulle vilja spela in ljudet på samtalet för att ha som underlag för vår analys. Syftet med detta är att vi enklare kan fokusera på vad du säger än att skriva ner allting.

Samtycke

För att kunna delta i studien har du signerat ett samtyckesformulär som beskriver syftet med studien och hur datan kommer att användas.

- Har du några frågor innan vi sätter igång?

Okej, om något är oklart under tiden så är det bara att fråga.

Introduktion och uppvärmning

- Skulle du kunna berätta lite kort om dig själv?
- Vad är ditt forskningsområde?
- Hur ser ditt intresse för miljö och hållbarhetsfrågor ut?
  - Hur ser detta engagemang ut?

Klimatförändringar

- Under vår forskning har vi tittat på det glapp som verkar finnas mellan att ha kunskap om klimatproblem och att agera på denna kunskap.
  - Enligt din erfarenhet, vilka tror du är de främsta orsakerna till det här glappet?

- Vi har under vår research sett att det finns en grad av känsla av hopplöshet hos människor i att deras agerande inte kan göra någon skillnad för klimatet.
  - Har du stött på detta?
  - Har du hittat ett sätt att komma förbi detta för att motivera till agerande?

- Enligt din erfarenhet, vilka typer av förändringar för en mer hållbar livsstil verkar folk ha lättast resp. svårast att anamma? (Tex. folk vill inte ändra sina flygvanor)

Klimatkalkylatorer

- Vad ser du att det finns för utmaningar inom området klimatkalkylatorer?

- Hur tycker du att klimatkalkylatorerna ska anpassa sig utifrån de olika typer av användare (nybörjare och miljömedvetna) som finns?
  - Vilka typer av användare tycker du att man ska satsa på mest?

- I vår tidigare intervju med en deltagare som varit med i klimatstegstävling visade det sig att majoriteten av deltagare var klimatintresserade sedan tidigare.
  - Hur kan man motivera de som redan innan tävlingen är miljökunniga och redan har sänkt sina utsläpp?

Tävlingar i klimatkalkylatorer

- Vi genomförde en survey härom veckan som visade på att människor har svårt att relatera till vad exempelvis 900 kg CO2 innebär.
  - Enligt din erfarenhet, hur stor kännedom har människor om vad en viss grad av CO2 innebär?
  - Finns det sätt att göra informationen mer lättillgängligt? I så fall vad?

Dela sina avtryck

- Det visade sig även att en del användare av klimatkalkylatorer inte verkade bekväma med att dela sin placering när det kommer till deras utsläpp och ville förbli anonyma i topplistan över förändrade utsläpp.
  - Är detta något du stött på i din forskning?
  - Vad tror du kan vara den bakomliggande orsaken till detta?
  - Finns det andra sätt att motivera i en tävling än att ha en topplista?

Socialt

- Du nämnde under din presentation du hade den social kontext sist vi pratades vid, så som hur användare beter sig utanför appen, till exempel samtal i fikarummet och i hemmet.
  - Hur viktigt är den sociala aspekten utanför appen för beteendeförändring?
  - Hur kan man ta tillvara på den sociala aspekten (samtal utanför appen) för lag som tävlar inte träffas i verkligheten?

- Tidigare deltagare av klimatstegstävlingen menade på att det var viktigt för dem att göra något tillsammans snarare än tävla mot andra lag.
  - Hur tror du att man skulle kunna stärka lagkänslan i en klimatstegstävling?

Motivation

- Hur tror du att man kan hålla uppe motivationen över en längre tid i en klimatstegstävling?

- Vilken typ av information tror du folk, i detta fall användare, behöver för att få stöd i att ändra sitt beteende?
  - Hur kan man visualisera det i en app?

- Hur tror du att det skiljer sig mellan folk som väljer att delta självmant vs folk som är en del av ett team på ett företag vad gäller den information de behöver för att vara motiverade?

- Hur kan man engagera användare som har olika motivering till delta i tävlingen, exempelvis de som är där för att lära sig mer om sina utsläpp och de som är där för tävla?

- När det kommer till att använda klimatstegstävlingar är det vanligt att använda spel element i tävlingen för att engagera deltagare.
  - Har du några exempel på spel element som har visat sig vara framgångsrika?
  - Om vi vänder på frågan, finns det några exempel på spel element som man bör undvika?

Wrap-up

- Om du skulle ta fram 3 faktorer som är viktigast för en framgångsrik klimatstegstävling, vad skulle det vara?

- Angående din egna forskning: Vilka är dina största takeaways efter att ha forskat inom teknik och hållbarhet som du tror skulle kunna bidra till den här studien?

- Har ni något ni vill tillägga något som inte tagits upp idag?

Vi vill bara påminna om att ljudupptagningen kommer att transkriberas och sedan raderas senast 15 mars 2022 och informationen i form av text kommer att raderas när studien är fullgjord i juni 2022.

Tack för din medverkan!

E

Appendix 5

Interview Guide Participant E3 (In Swedish)

Syfte

Vi skriver vår masteruppsats inom interaktionsdesign på Chalmers med syfte att studera hur man kan engagera människor med hjälp av tävlingar i en app. Vi gör ett samarbete med ett företag som heter Svalna som har tagit fram en klimatkalkylator i form av en app. Klimatkalkylatorn räknar ut privatpersoners klimatavtryck baserat på deras banktransaktioner. Här har organisationer och företag möjlighet att tävla i att sänka sina koldioxidutsläpp genom en så kallad klimatstegstävling. I vårt arbete undersöker vi hur Svalnas klimatstegstävling fungerar och hur den nuvarande designen kan förbättras.

Vi är intresserade av dina erfarenheter och det finns inga rätt eller fel svar.

Du kommer att vara anonym i vår studie, vilket innebär att vi inte kommer ta med ditt namn. Vi skulle vilja spela in ljudet på samtalet för att ha som underlag för vår analys. Syftet med detta är att vi enklare kan fokusera på vad du säger än att skriva ner allting.

Samtycke

Du har även skrivit på ett samtyckesformulär så som beskriver syftet med studien och hur datan kommer att användas.

Har du några frågor innan vi sätter igång?

Om något är oklart under tiden så är det bara att fråga.

Introduktion och uppvärmning

- Skulle du kunna berätta lite kort om dig själv?
- Vad är din sysselsättning?
- Hur ser ditt intresse för miljö och hållbarhetsfrågor ut?
  - Hur ser detta engagemang ut?
- Vad var det som gjorde att du började engagera dig i dessa frågor?

Kampanjen

Vi är intresserade av att lära oss mer om ditt arbete med kampanjen.

- Hur ser intresset ut för kampanjen i dagsläget?
- Har ni någon särskild målgrupp som ni försöker nå med kampanjen?

Engagemang

- Är det något särskilt argument som får folk att ta steget och skriva under på kampanjen?
  - Enligt din erfarenhet, hur effektivt är det att använda en mer skrämmande taktik såsom att 'varje gång du flyger så påverkar det en annan persons liv'?
- Vad gäller de personer som engagerat sig och valt att inte flyga, har ni sett att det lett till andra hållbara vanor?
  - Vad tror du att de har svårt att ändra på?
- Gör ni något aktivt för att hålla igång engagemanget hos era anmälda?
- Vi hörde i en intervju med dig för några år sedan, att ni hade en förhoppning om att andra länder skulle anamma konceptet för kampanjen och att olika länder skulle kunna tävla mot varandra.
  - Att ha ett tävlingsmoment, är det något ni har tagit vidare?
  - Hur ser det ut med engagemanget i andra länder?
    - Finns det något land som sticker ut ur mängden och har ett stort klimat engagemang?

Utmaning

- Vilken har varit den största utmaningen för kampanjen?
  - Hur har ni försökt hantera utmaningen?

Klimat och beteende

Vi kommer nu att gå in på klimatfrågan från ett bredare perspektiv.

- Enligt din uppfattning, hur ser engagemanget ut i Sverige för klimatfrågan idag?
  - Ser du någon skillnad sedan innan pandemin?
- I vår studie har vi funnit att det finns en stor kunskap om klimatfrågan men att människor inte alltid agerar på den kunskapen.
  - Enligt din erfarenhet, finns det några utmärkande faktorer som bidrar till det här glappet mellan kunskap och agerande?
- Vi har i vår studie sett att folk kan ha en känsla av hopplöshet i att deras agerande inte kan göra någon skillnad för klimatet.
  - Är det här något du har stött på?
  - Har du hittat ett sätt att komma förbi detta för att motivera till agerande?

Motivation

- Människor kan vara olika mottagliga och intresserade av klimatfrågan. Enligt din erfarenhet, bör man lägga engagemang på de som redan har någon nivå av intresse eller bör man försöka nå de som inte är intresserade?
  - Hur kan man nå de människorna som inte är intresserade av klimatfrågan?
  - Hur skiljer sig taktiken för att nå de olika grupperna?

- För de som är engagerade och redan har gjort förändringar för att sänka sina avtryck...
  - Har du några tips på hur man kan hålla uppe engagemanget?

Beteende

- Om man tittar mer på individnivå, enligt din erfarenhet, vilka hållbara beteenden tycker människor är enklare att ställa om till?
  - Vilka är svårare för människor att ställa om till?

- För att människor ska ställa om och skapa nya vanor, hur viktigt är det att det finns förebilder att se upp till?
  - Hur har ni arbetat med förebilder i er kampanj?
  - Har du någon uppfattning om vilken typ av förebild som har mest effekt?

Klimatkalkylatorer

Vi kommer nu gå vidare och prata om klimatkalkylatorer som beräknas folks koldioxidutsläpp.

- Har du någon erfarenhet av klimatkalkylatorer?
  - Om inte använt:
    - Är det något du kan tänka dig att använda?
  - Om använt:
    - Kommer du ihåg vilken du har använt dig av?
    - Vad var ditt intryck av den?
    - Gav verktyget dig informationen om hur du kunde förbättra och sänka dina utsläpp?
    - Vad gillade du med klimatkalkylatorn?
    - Var det något du saknade?
    - Var det något som kunde förbättras?

- När det kommer till kommunikation av en persons klimatavtryck i en klimatkalkylator brukar det kommuniceras i antal ton koldioxid per år, till exempel "Ditt årliga utsläpp är 5 ton koldioxid."
  - Enligt din erfarenhet, har folk förståelse för vad informationen innebär?
  - Skulle man kunna presentera informationen på ett annat sätt?

- När vi har en klimatstegstävling tar vi ett svårt ämne såsom klimatkrisen och gör det till en tävling.
  - Är det något särskilt man behöver tänka på?

- Tror du en tävling om att sänka sina utsläpp är något som skulle kunna få fler människor att engagera sig i klimatfrågan?
  - Tror du att det är något speciellt man bör tänka på när det kommer till tävlingar inom miljöarbete?

Wrap-up

Har du något som du vill tillägga som inte har tagit upp idag?

Tack för din medverkan.

Vi vill bara påminna om att ljudupptagningen kommer att transkriberas och sedan raderas senast 15 mars 2022 och informationen i form av text kommer att raderas när studien är fullgjord i juni 2022.

F

Appendix 4

Interview Guide Participant E4 (In Swedish)

Typer av inköp

- Hur fungerar appen när det kommer till att skilja på olika typer av inköp?
- Vad ser du att det finns för utmaningar inom Svalnas klimatstegstävling?

Anonymitet

När vi pratade med de som varit med i klimatstegstävlingen uttryckte de att ville de vara anonyma i topplistan där individers minskning/ökning syns pga de inte ville verka dåliga.

- Att kunna välja att vara anonym, var det en funktion ni hade från början eller utvecklades det efter feedback från användarna?
- Har ni funderat på en lösning att folk inte vill synas i topplistan, som inte är baserat på anonymitet?

Förståelse för CO2

- Enligt din uppfattning, förstår folk vad ett visst antal ton eller kg CO2 innebär när det presenteras i appen?
- Efter att ha läst och pratat med intervjudeltagare har vi också sett att det finns ett behov av att få information, anpassad efter ens egna profil, alltså anpassat efter ens egna nivå och intresse. Har ni tänkt på detta?

Typer av användare

- Hur har ni tänkt kring olika typer av användare och hur man kan motivera dem?
- Vilka typer av användare riktar ni er åt?

G

Appendix 5

Interview Guide Participant E5 (In Swedish)

Syfte

Vi skriver vår masteruppsats inom interaktionsdesign på Chalmers med syfte att studera hur man kan engagera människor med hjälp av tävlingar i en app. Vi gör ett samarbete med ett företag som heter Svalna som har tagit fram en klimatkalkylator i form av en app. Klimatkalkylatorn räknar ut privatpersoners klimatavtryck baserat på deras banktransaktioner. Här har organisationer och företag möjlighet att tävla i att sänka sina koldioxidutsläpp genom en så kallad klimatstegstävling. I vårt arbete undersöker vi hur Svalnas klimatstegstävling fungerar och hur den nuvarande designen kan förbättras.

Vi är intresserade av dina erfarenheter och det finns inga rätt eller fel svar.

Du kommer att vara anonym i vår studie, vilket innebär att vi inte kommer ta med ditt namn. Vi skulle vilja spela in ljudet på samtalet för att ha som underlag för vår analys. Syftet med detta är att vi enklare kan fokusera på vad du säger än att skriva ner allting.

Samtycke

Du har även skrivit på ett samtyckesformulär så som beskriver syftet med studien och hur datan kommer att användas.

Har du några frågor innan vi sätter igång?

Om något är oklart under tiden så är det bara att fråga.

Introduktion och uppvärmning

- Skulle du kunna berätta lite kort om dig själv?
- Hur började ditt intresse för gamification?

Gamification

Nu kommer vi gå in på gamification lite mer.

Generellt

- Skulle du vilja berätta mer i vilka sammanhang du har arbetat med gamification?
  - Har du märkt att gamification har varit mer användbart i vissa specifika sammanhang?
  - Har du applicerat gamification i något sammanhang när det har fungerat mindre bra?

Spelelement

- När det kommer till design av gamification så kan man inkludera olika spelelement såsom leaderboards, badges och så vidare. Enligt din erfarenhet, vilka spelelement brukar vara mest effektiva?
  - Finns det några vanliga misstag som designers gör när de ska gamifiera en idé?
  - Vilka spelelement har visats vara minst effektiva?

Gamification och klimatrelaterat

Nu går vi över lite på gamification i relation till klimat och hållbart beteende.

- Har du någon erfarenhet av hur gamification kan användas för att främja hållbara beteenden?
  - Om ja: Kan du se några utmaningar med att använda sig av gamification i svåra ämnen som klimatfrågor?
  - Om nej: Tror du att gamification skulle kunna hjälpa till när det kommer till att få människor att anamma mer hållbara beteenden?
- Tror du att man bör tänka annorlunda när det kommer till val av spelelement inom hållbara beteenden jämfört med andra områden?
  - På vilket sätt skiljer det sig åt?

Vår studie

Nu kommer vi att gå in på lite utmaningar som vi har stött på under vår studie. Vi undersöker alltså hur en tävling i en app kan användas för att få folk att sänka sina koldioxidutsläpp.

Teamkänsla

- I vår studie har personer vi intervjuat uttryckt att det är viktigt att ha en en teamkänsla och känna att de göra något ihop som ett lag. Vad har du för erfarenhet av gamification i relation till att skapa en bra teamkänsla?
  - Har du några exempel på sociala spelelement som folk uppskattar?

Användare

- I vår studie har vi sett att det finns olika typer av användare. Dels de som vill lära sig mer om klimatet och ändra sina vanor, och dels de som vill tävla.

Enligt din erfarenhet, hur kan man motivera och engagera spelare som har olika intressen?
  - Enligt din erfarenhet, är det mer värde i att fokusera på en typ av användare eller försöka designa för olika typer av användare?

Mål

- Vi har funderat på att ha mindre utmaningar i appen så som att cykla till jobbet eller äta vegetarisk kost i 3 veckor. Men vi tänker att alla i ett lag kanske inte kan anpassa sig till samma utmaning. Enligt din erfarenhet, finns det fördelar med att låta deltagarna ha individuella mål istället för gemensamma mål?

- I vår studie har vi sett att deltagare vill lära sig om hur andra i tävlingen har lyckats att sänka sina utsläpp. Har du någon erfarenhet av hur man kan låta deltagarna lära sig av varandra?

- Något vi har stött på är att deltagare inte vill visa sin utveckling för andra i en topplista. De skäms över att inte ha "gjort tillräckligt mycket" för att sänka sina utsläpp. Under tävlingen valde de därför att vara anonyma istället för att visa sina namn. Har du stött på den här typen av problem inom andra områden?
  - Kan du se hur man skulle kunna lösa det här problemet?
  - Har du någon lösning på hur man skulle kunna visa topplistan på ett annat sätt?
  - Enligt din erfarenhet, kan det vara motiverande att veta/se att en själv ligger sämst till?

Utveckling och avancering i appen

- I vårt arbete med klimatstegstävlingen har deltagare sagt att det är svårt att vara motiverad när utvecklingen sker långsamt. Det tar alltså lång tid att se framsteg i form av minskade utsläpp efter att ha ändrat sitt beteende, tex. att endast cykla en dag i veckan istället för att ta bilen gör inte så stor skillnad. Har du någon erfarenhet av den här typen av utmaning, när det är svårt för användare att se sin utveckling?
  - Hur skulle man kunna designa för att göra det motiverade för dem att inte känna att det är hopplöst?

Wrap up

- Angående din egna forskning: Vilka är dina största takeaways efter att ha forskat inom gamification (som du tror kan vara bra för oss att ha i åtanke)?
- Har du något du vill tillägga?

Tack för din medverkan!

H

Appendix 6

Interview Guide P2, P3, P4 (In Swedish)

Syfte

Hej, vad roligt att du vill vara del av vår studie.

Vi skriver vår masteruppsats inom interaktionsdesign på Chalmers i Göteborg. Vi kommer att följa pilotstudien där ni ska tävla om att sänka era klimatavtryck. Vi kommer att utvärdera och undersöka hur konceptet kan förbättras.

Detta är det första intervjutillfället av tre som vi kommer hålla under de kommande veckorna, och vi kommer intervjua tre personer som är med i piloten.

Vi är intresserade av dina erfarenheter och det finns inga rätt eller fel svar.

Du kommer att vara anonym i vår studie, vilket innebär att vi inte kommer ta med ditt namn. Vi skulle vilja spela in ljudet på samtalet för att ha som underlag för vår analys. Syftet med detta är att vi enklare kan fokusera på vad du säger än att skriva ner allting.

Samtycke

Och du har även skrivit på ett samtyckesformulär som beskriver syftet med studien och hur datan kommer att användas.

Är det något du funderar över innan vi sätter igång?

Introduktion och uppvärmning

- Skulle du kunna berätta lite kort om dig själv?
- Vad är din roll på företaget?
- Deltog du på kick-offen fredagen den 25 mars?
  - Om Ja: Vad tyckte du om kick-offen?
  - Om Nej: Hur fick du information om Svalnas pilotstudie?

  - Känner du att du har tillräckligt med information inför den kommande pilotstudien där ni ska använda Svalnas app?

Klimatintresse

Nu kommer vi gå in på frågor kring klimatet

- Hur viktigt tycker du att det är att människor agerar miljövänligt
- Hur engagerad känner du dig för klimatet?
- Gör du något för klimatet idag?
- Vad tror du skulle motivera dig till att agera mer miljövänligt än vad du gör idag?

Tävlingar (generellt)

Nu kommer vi ställa lite frågor generellt kring tävlingar.

- Har du varit med i någon tävling förut? (t.ex. stegtävling)
  - Vad tyckte du om att vara med i den tävlingen?
- Hur engagerad brukar du vara i tävlingar?
  - Lite till mycket engagerad: Vad driver dig till att vilja tävla?
  - Inte engagerad: Vad skulle få dig att bli mer motiverad att vilja vara med i en tävling?
- När du tävlar, hur tävlar du helst, i lag eller individuellt?
  - Lag
    - Vad är det du gillar med att tävla i ett lag?
    - Hur skulle du beskriva en bra laganda?
  - Individuellt
    - Varför är det mer motiverande?
    - Vad tycker du om att kunna jämföra dina resultat mot andras?

Klimatkalkylatorer

Om vi går vidare till klimatkalkylatorer, så som Svalna som ni ska använda nu i pilotstudien. En klimatkalkylator räknar alltså ut en individs koldioxidutsläpp. Detta kan göras antingen genom att man själv svarar på frågor om ens vanor, men kan också räknas ut genom att titta på transaktionsdata, såsom Svalnas app fungerar.

- Har du vid tidigare tillfälle använt dig av en klimatkalkylator för att räkna ut dina koldioxidutsläpp?
  - Om ja:
    - Vad var ditt intryck av den?

    - Gav verktyget dig informationen om hur du kunde förbättra och sänka dina utsläpp?
    - Vad gillade du med klimatkalkylatorn?
  - Om nej:
    - Har du hört talas om klimatkalkylatorer tidigare?

Förväntningar på tävlingen

Om vi tittar på den pilotstudien som ni ska genomföra så kommer ni sänka era utsläpp tillsammans på arbetsplatsen men också ingå i lag där ni tävlar mot varandra.

- Vad är dina förväntningar på de kommande veckorna?
  - Om du skulle sammanfatta dina känslor inför den kommande pilotstudien med tre ord, vilka skulle de vara?
- Hur känner du kring tävlingsmomentet, att tävla om att sänka dina utsläpp?
- Hur engagerad tror du att du kommer vara i tävlingen?
- Vad hoppas du få ut av att vara med i tävlingen?
- Tror du att denna erfarenheten kommer att påverka dina vanor till mer miljövänliga?
  - Om ja: Vad tror du i så fall att det skulle kunna vara?
  - Om nej: Hur känner du för att ändra på dina vanor till mer miljövänliga?
- Tror du att det kommer finnas några utmaningar?
  - Vad tror du i så fall att det skulle kunna vara?

Det var alla frågor vi hade idag. Har du något du vill tillägga eller som du undrar över?

Vi är tacksamma för att du tog dig tiden att vara med idag. Om du har några frågor i efterhand går det bra att maila till någon av oss.

I

Appendix 7

Interview Guide Participant E6

Purpose

We are writing our Master's thesis at Chalmers University of Technology in Gothenburg. The research we are conducting is focused on how to engage people to behave environmentally friendly through a competition in an app. We are collaborating with Svalna, a research-based company.

Svalna has developed a carbon calculator app that calculates the user's carbon emissions. It works by the use of people's bank transaction data, where their different purchases are calculated into emissions of CO2. In the app it is also possible to take part in a competition where companies or organizations compete to see who can lower their emissions the most in a set amount of time. We are studying how this climate competition works and how the current design can be improved.

Anonymity

We are interested in your views on the topic and would like to emphasize that there is no right or wrong answer to the questions.

You will be anonymous in our study and final thesis, which means that we will not use your name.

Consent

You have signed a consent form that describes the purpose of the study and how the data will be handled.

We would like to record the audio of the interview to be able to analyze and transcribe it.

Do you have any questions before we start?

Feel free to ask questions during the interview if anything is unclear

Warm-up

- Would you like to tell us a bit about yourself?
  - What is your area of research?

Sustainability and Gamification

- What is your experience of gamification for sustainable behavior?
  - When has gamification worked well?
  - What can be a challenge with gamification?

Game elements

- When it comes to design using game elements it is common to use leaderboards, badges, and so on. According to your experience, which game elements are useful when it comes to gamification for sustainable behavior?
  - Which game elements have proven to be less effective?

- Do you think that one should think differently when it comes to the choice of game elements within sustainability compared to other fields?
  - In what way do they differentiate?

- How important is it to incorporate social elements (like buttons, chat..) when attempting to promote sustainable behavior?
  - Have you used social elements in your research?
  - What are some positive effects of using social elements?

- When it comes to the social element of activity feeds, is that something you have experience of?
  - For example where a group can keep track of each others' activities.

Goals

When it comes to keeping the users motivated through goal setting...

- In your experience, are there any certain considerations that should be made when designing goals that support sustainable behavior?
  - What kind of goals can people find reachable and motivating when it comes to encouraging sustainable behavior?

We are studying a competition where an organization's employees compete to lower their carbon emissions over the course of a few months. The entire organization has a common goal of lowering their total emissions with 10 procentage (or a percentage that is agreed upon before starting the competition). When it comes to keeping the users motivated through goal setting...

- This means that the individual participants don't set their own goals, but are part of a shared goal. In your experience, does this affect the individual's motivation?

- In gamification, how important is it to have sub-goals to reach the main goal?
  - What could these sub-goals be?

Challenges

We are thinking of implementing challenges, where teams can commit to a challenge in different areas such as "be vegan for 3 weeks" or "bike to work for a month".

- We are thinking that the team members might have different interests or opportunities that might affect their motivation. How can a goal be formulated to fit the needs of a potentially diverse group of people?
  - Do you have experience with this?

Gamification in the workplace

- Is there something in particular that can be important to think about when designing for colleagues who are perhaps coerced into participating in a competition compared to friends that freely choose to participate?

  In our case, colleagues take part in the carbon competition but outside of the workplace since they use their own transactional data from their bank to measure their CO2 emissions.

- Do you think a competition that takes place outside of the workplace has to be approached differently than if it was a competition that took place only in the workplace?

- In our study, we have conducted interviews and have gotten feedback that the tool, in our case the app, should be easy to adopt and not take too much effort to use.
  - Do you have any experience in how this could be accomplished?

Competing as a team

In our study, we interviewed people who had taken part in a carbon competition. Some of them preferred to take part to do something together as a group with their colleagues and some to compete as individuals.

- In your experience, are people more motivated to change their behavior by doing things as a group or as individuals?

Player types

We have also experienced that people have different motivations where some want to learn about sustainability and others want to compete.

- In your experience, what are some important considerations when designing for users with different motivations?
  - Should one type of general player be designed for or to accommodate different players?

In our study, we have found that a lot of people who take part in a carbon competition like this one are people who are already interested in climate-related topics and have rather low emissions where they feel satisfied with their level of CO2 emissions.

- Do you have any experience on how to include people who are already well informed on environmental issues?

- Another problem related to this is that it's difficult for people who have low emissions to lower them even more in the carbon competition. The goal of the competition is to lower your emissions and these people have made a lot of changes.

  - Do you have any idea how these people can be motivated in the competition?

Time-limited competition

Our competition is time-limited to 6 weeks up to 3 months.

- Do you have any experience of working with something that is time-limited where the competition ends when the time is up rather than a goal is fulfilled?

We are considering how the mechanic of leveling up could be used in our design...

- Since it is a time-limited competition, should we approach it differently? Ie. it's limited in regards to how much time each level can take.

Information

We have learned both from literature and through interviews during our study that people want to learn more about sustainability. We have had conflicting responses when it comes to whether this information should be neutral, encouraging, or even a bit scary. Scary as in showing the effects of climate change.

- What is your experience when it comes to what type of information motivates people to change their behavior?
  - What is a common mistake when it comes to providing information?

Final questions

- Is there something from your research that you wish to add that was not brought up today?

That was all of our questions, thank you for taking your time for this interview.

J

Appendix 8

Workshop guide (in Swedish)

Samtycke

Du har rätt att avbryta din medverkan närhelst du vill under workshopen. Du behöver inte medverka om du inte känner för det. Era namn kommer inte användas någonstans i vår dokumentation eller i vår rapport.

Är det OK att vi tar några foton under workshopen? Det kommer inte gå att identifiera någon i bilderna.

Det finns inga rätt eller fel lösningar på denna workshop, utan ha roligt och känn er kreativa!

Har ni några frågor innan vi startar?

Warm-up

Nu ska vi göra en övning där vi ställer upp oss i tystnad på ett led enligt några olika påståenden. Man får alltså inte prata men det är okej att gestikulera.

- Vem bor närmst Campus (Lindholmen). Den som bor närmast ställer sig närmast dörren. Ni får två minuter på er.

- Tänk på ditt favoritdjur. Arrangera er enligt storleksordning, där minsta djuret är närmast dörren. Ni får två minuter på er.

Introduktion

Vi börjar med att berätta lite om vårt masterarbete.

Vi skriver vårt masterarbete tillsammans med Svalna som har tagit fram en app som räknar ut en persons utsläpp av CO2 en så kallad klimatkalkylator. Personers utsläpp beräknas genom de köp de gör där användare kopplar upp sig med sina banktransaktioner, och utsläppen delas upp i de fyra kategorierna transport, hushåll, konsumtion och mat. I vårt masterarbete tittar vi på hur delar av appen kan förbättras.

Problemformulering och mål med workshopen Målet med den här workshopen är att titta närmare på en av utmaningarna vi har hittat.

I appen kan företag tävla om vem som kan sänka sina utsläpp mest. Det innebär att det finns en topplista som visar vem som sänkt sina utsläpp mest och minst, och det visas i procent.

Vi har intervjuat tidigare deltagare som varit med i en sådan här tävling och fick veta att folk inte gillade att synas i en topplista. De kände oro över att bli placerad sist på listan, där alla andra kunde se hur dåligt de presterade för klimatet. Detta ledde till att majoriteten av deltagarna ville vara anonyma i topplistan.

Vi skulle vilja ha era i synpunkter gällande om man kan designa om och tänka på en topplista på ett annat sätt än den traditionella topplistan som vi ser här, som skulle ta i beaktning den känslighet som deltagarna uttryckt. (Visa hur topplistan ser ut nu).

Har ni några frågor kring detta?

Ideate

Brainwriting på post-its

Vi kommer börja med en övning för att komma igång. Den går ut på att vända vårt tänkande, och tänka tvärtom (såkallad reversed thinking), där frågan är:

Med tanke på den problematik vi berättat om, hur skulle det värsta tänkbara scenariot se ut för att visa en topplista för folk som känner oro över att synas på topplistan?

Ni kommer att få 3 minuter på er och använd er av post-it lapparna som finns på bordet framför er. Ni får rita eller skriva ner så många idéer ni har på denna tiden.

Har ni några frågor innan vi sätter igång?

Dela

Nu tar vi ett par minuter till att dela med era grannar om det var något spännande ni kom fram till. Om något är roligt eller konstigt, kan det vändas till något positivt?

Skecthing

Individuell sketchning

Nu ska ni få rita lite, till en början individuellt. På bordet framför er har ni papper med 6 rutor på. Ni kommer att få 8 minuter att disponera som ni vill där ni får rita

individuellt gällande ett alternativ till topplista. Alltså inte reversed thinking utan idéer som ni tror kan vara passande.

Som nämnts tidigare så finns det inga rätt eller fel.

Har ni några frågor? Varsågoda att börja!

Dela

Nu tänkte vi att vi tar 10 minuter där var och en får 1 minut på sig att presentera sina sketcher och så får ni ställa frågor till varandra om ni har några.

Dot vote

Nu tänker vi att vi gör en liten dot vote på era sketcher på whiteboarden. Ni får tre prickar var för att sätta på de lösningar ni tycker är intressanta på något sätt. Ni kan använda whiteboard pennor och sätta markeringen. När ni är klara så tar vi 5 minuters fika-paus!

Grupp sketchning

Nu kommer vi att dela in er i tre grupper för att göra en gemensam sketch. Vi kan dela in er så som ni sitter...

Ni kan använda sketcherna från dot-voten som inspiration eller om ni vill kan ni kombinera flera eller komma på något helt nytt.

Er uppgift är alltså att ta fram en slutgiltig sketch hur topplistan kan visualiseras. Ni får 20 minuter på er för den här uppgiften så ni har gott om tid på er att utforska olika idéer.

Har ni några frågor innan vi sätter igång?

Vi kommer säga till när halva tiden gått. Vi kommer även gå runt och titta lite vad ni gör.

Dela

Nu får ni några minuter per grupp för att presentera sketcherna och diskutera.

Wrap up

Vänligen fyll i en utvärdering som tar 2-3 minuter.

Tack för din medverkan!