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Green Vibrations

An Intergenerational Approach Towards Mitigating Climate Change

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MASTER'S THESIS

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Hana Salihodžiċ

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Kurzfassung

Der Klimawandel betrifft die Existenz der gesamten Menschheit und stellt somit eines der drängendsten Probleme der jetzigen Zeit dar. Trotz der Dringlichkeit zur Eindämmung sind die meisten Aspekte dieses Problems unsichtbar und daher schwer nachvollziehbar. Daher, auch wenn das Thema in den Medien und in der Gesellschaft im Allgemeinen immer mehr Aufmerksamkeit erfährt, zeigen Einzelpersonen oft kein nachhaltiges Verhaltensmuster. Aufgrund der Komplexität dieses Themas sind kollektive Maßnahmen erforderlich. Frühere Studien zeigen, dass die Kommunikation zwischen den Generationen eine bedeutende Rolle bei der Entwicklung eines besseren Verständnisses des Klimawandels spielen kann. uch der auf diese Weise stattfindende Austausch von Wissen, Werten und Fertigkeiten stellt einen wichtigen Mechanismus zur Bewältigung dieser Komplexität dar. Hinzu kommt, dass die Zahl der älteren Erwachsenen (Alter von 56-74 Jahren), die ihre Seniorenjahre erreichen, ständig zunimmt. Dies unterstreicht, wie wichtig es ist, bei der Gestaltung neuer digitaler Produkte auch die Bedürfnisse älterer Erwachsener zu berücksichtigen.

Bislang wurde relativ wenig Forschung über generationenübergreifende Lösungen für den Klimawandel betrieben. Ziel dieser Forschung ist es, (i) die Barrieren zu analysieren, die bei der Kommunikation über den Klimawandel berücksichtigt werden müssen und Strategien zu finden, die dazu beitragen können, diese Barrieren zu überwinden und die Kommunikation zu verbessern, (ii) zu untersuchen, wie intergenerationelle Kommunikation über den Klimawandel angestoßen werden kann und (iii) eine technologische Lösung (Prototyp) zu entwickeln, die intergenerationelle Kommunikation ermöglicht und auf diese Weise hoffentlich die dringend erforderliche Verhaltensänderung hin zu einem nachhaltigen Lebensstil fördert.

Um diese Ziele erreichen zu können, wurden verschiedene Forschungsmethoden angewandt. Zunächst wurde eine gründliche Literaturrecherche durchgeführt, um eine theoretische Basis zu verwandten Themen aufzubauen. Darauf folgte eine empirische Forschung mit dem Ziel, die notwendigen Daten der Zielgruppen (Generation Z und Baby Boomer) zu erheben. Die empirische Forschung wurde mit zwei Methoden durchgeführt: semi-strukturierte Interviews und eine Online-Umfrage. Die Ergebnisse zeigen, dass aktive Kommunikation zu einem nachhaltigeren Lebensstil führen kann und dass der Wissensreichtum und der Werteaustausch, die zwischen den Generationen gewonnen werden können von großer Bedeutung sind. Abgesehen davon konnte beobachtet werden, dass die TeilnehmerInnen

dem Klimawandel gegenüber überwiegend negativ gestimmt sind. Die Erkenntnisse aus diesen beiden Schritten flossen schließlich in die Umsetzung der technologischen Lösung (Prototyp) ein. Die wichtigsten Merkmale, die für diese Art von Technologien in Betracht gezogen werden sollten, sind die folgenden: (i) Fokus auf Förderung des Wohlbefindens und menschlichen Potenzials (Positive Computing), (ii) Befolgung von Richtlinien des Inclusive Designs, um die Akzeptanz von beiden Generationen zu gewährleisten, (iii) Kommunikation kurz, sozial und positiv halten (Storytelling).

Abstract

Climate change is one of the most pressing issues that our humanity is facing today. Despite its urgency for mitigation most aspects of this issue are invisible and thus hard to grasp. Yet, even though this topic is gaining more and more attention in the media and in the society in general, still, individuals often show unsustainable behaviour patterns. Due to the complexity of this issue collective actions are required. Prior research shows that intergenerational communication can play a significant role in evolving a better understanding of climate change. Also the knowledge, value and skill exchange that takes place in this way represent an important mechanism to address this complexity. In addition to that, the number of older adults (aged 56-74) reaching their senior years is constantly increasing and reaching an ever-growing number in society. This highlights the importance of considering also needs of older adults when designing new digital products.

To date, relatively little research has been done on investigating the significance of an intergenerational context when considering potential technological solutions to climate change. The aim of this research is to fill this gap and (i) analyze psychological barriers that hinder people from taking action and find strategies that help to remove these barriers and enhance the communication, (ii) examine ways how intergenerational communication about climate change can be triggered and (iii) to develop a technological solution (prototype) that enables intergenerational communication and in this way hopefully fosters the much needed behavioral shift toward a sustainable living.

To be able to achieve these goals several research methods were applied. Initially, a thorough literature review was conducted to build a theoretical base around related topics. This was followed by an empirical research with the goal to collect the necessary data from target audience. Empirical research was conducted using two user research methods: semi-structured interviews and an online survey. Results suggest that active communication (at least once per week) leads to a more sustainable lifestyle. Besides that, findings show that participants mainly express negative mood toward climate change. All relevant insights were incorporated into the implementation of a technological solution (prototype), and eventually evaluated with the target audience. The main approach that is considered for the suggested technological solution is the following: (i) focus on fostering well-being and human potential (positive computing), (ii) follow guidelines of inclusive design to assure acceptance across both generations and (iii) focus on keeping the message short, social and positive (storytelling).

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Contents

Introduction

> We can't solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, maybe we should change the system itself. ... We have come here to let you know that change is coming, whether you like it or not. [1] [Thu19]

Climate change is one of the biggest challenges that the world has ever been faced with. The increasing concentration of atmospheric CO2 is attributable to the rise in temperature and the directly linked climate imbalance. Many human activities, and in particular burning of fossil fuels and the observable changes in land use, are accountable for green gas emissions [Kel19]. Figure 1.1 represents the sectors that are mainly responsible for the heat-trapping geenhouse gases. The Intergovernmental Panel on Climate Change (IPCC)[2] shows that the human-induced warming is constantly increasing by 0,2 °C per decade and that by now the earth has warmed by approximately 1°C above pre-industrial levels in 2017. Figure 1.2 visualizes Austria's growing temperature trends form 1901 - 2019. According to the World Economic Forum Report 2018[3] there is a high likelihood that various consequences will come along with this phenomena: extreme weather events, natural disasters, water crisis, food crisis, etc.

At the same time climate change represents an issue that comes along with mostly invisible, intangible aspects, e.g., distant impacts, invisible causes, delayed or absent

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[1] https://www.lifegate.com/people/news/greta-thunberg-speech-cop24 (website accessed on: 14 November 2019)

[2] https://www.ipcc.ch/

[3] https://www.weforum.org/reports/the-global-risks-report-2018 (website accessed on: 13 November 2019)

[4] Image adapted from: https://drawdown.org/ (website accessed on: 15 July 2020)

[5] https://showyourstripes.info/ (website accessed on: 20 July 2020)
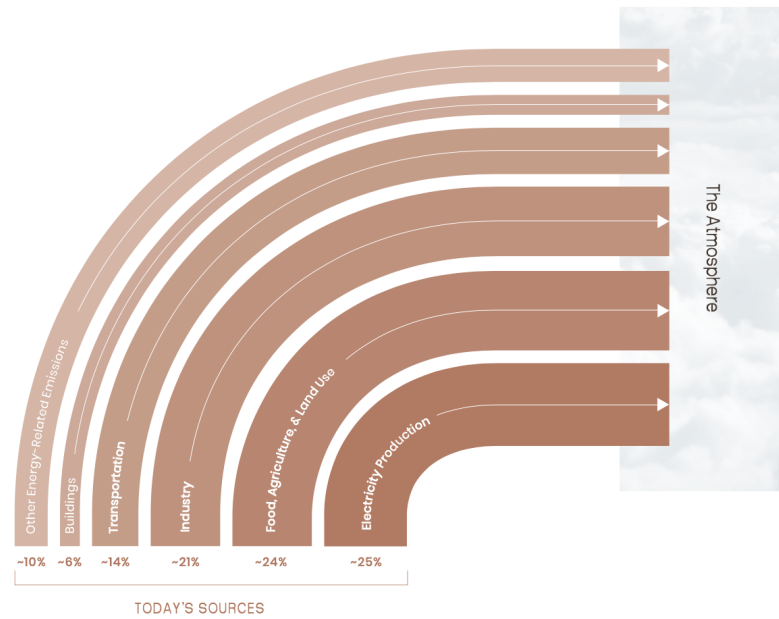
Figure 1.1: Sectors that are responsible for heat-trapping greenhouse gases (CO2)[4].
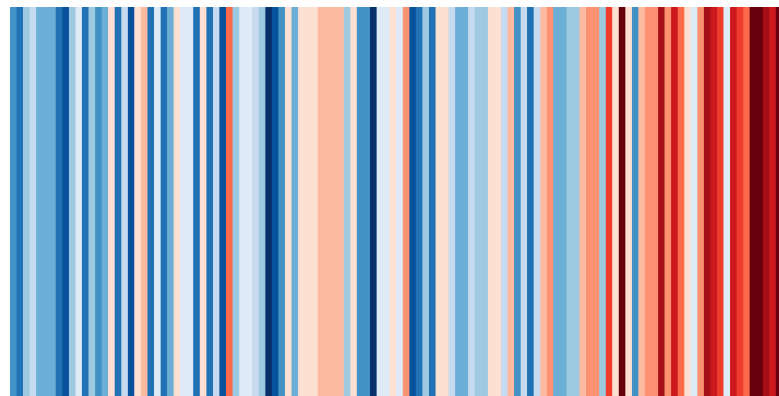
Figure 1.2: Increase in temperature in Austria form 1901 - 2019[5].

gratification for taking action, etc.; thus, making it difficult for most people to understand [Mos10]. With regard to this, even though people know more about the climate than ever before still their behaviour often shows very unsustainable patterns. Gifford [Gif11] discovered seven aspects of psychological barriers ("dragons of inaction") that hinder people to take action. These inner dragons include cognitive biases like minimising threats which appear distant in time and space, resisting change of the system that is already working, avoiding information which conflicts with own aspirations and beliefs, missing knowledge and social pressure. These barriers will be described in greater detail in the following chapter. In order to reduce negative impacts and adapt to the rapid

changes in the climate, significant behavioral changes are required. Even though changing human behaviour is not easy, it is an important step toward mitigating climate change and reaching the Paris Agreement goal of keeping the temperature rise under 2°C.

To date, there are several approaches that cope with the climate issue in different research areas. These solutions exist in different dimensions (e.g., physical games, tangible devices, CO2 calculator[6], etc.) and offer individuals possibilities to inform themselves and empower them to take action about climate change [PB19, DHLB17, FFL10]. So far, however, relatively little research has been done on investigating intergenerational solutions around this topic. Since communication in known to be an effective way to gain a better understanding of the foundations of a problem, fostering intergenerational communication about climate change seems to be a way toward a possible solution. Researchers have shown that especially communication within the family has an impact on our beliefs and the way we interpret the world [Mee14]. Therefore, the focus of this thesis is on developing an innovative technological solution which boosts intergenerational communication about climate change and in this way activates individuals to take action.

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[6] https://coolclimate.berkeley.edu/calculator (website accessed on: 13 November 2019)

1.1   Aim

The aim of this work is to gather a rich understanding of human behaviours toward climate change, study ways on how intergenerational communication can be triggered and develop an innovative system with a focus on intergenerational communication that offers people inspirations and meaningful options for changing toward a sustainable lifestyle. Based on that, the main objectives are (i) analyze the relationship between human activity and its impact on the climate from different perspectives, (ii) examine how intergenerational communication about climate change can be triggered and (iii) to develop a technological solution (prototype) that may enable the much needed behavioral shift toward a sustainable living.

Climate change is a complex issue that requires an understanding of various disciplines. This work, therefore, takes a comprehensive approach by covering social aspects and the natural responses to that. As a first step, multidisciplinary knowledge about climate change is gathered. Besides that, parameters about activation strategies and intergenerational communication are identified. Based on the identified content from the previous steps, the ideation process can start. This part consists of intensive brainstorming and sketching of new ideas. Based on the results of the ideation process, the best solution is selected, and a detailed prototype is created and evaluated.

Finally, the following research question are answered:

- **RQ1:** Which (psychological) barriers need to be considered when communicating about climate change and which strategies may help to remove these barriers and enhance the communication?

- **RQ2:** How can intergenerational communication surrounding climate change be triggered and which benefits are expected?

- **RQ3:** What technological solution can be used to enable intergenerational communication about climate change and which key features should be considered for such technologies?

1.2   Related Work

To date, most of the technological solutions in the HCI[7] field that try to tackle the challenges of climate change mainly focus on the younger population. The reason for this is that adolescents do not have a completely established worldview yet and, therefore, easier build climate change concerns [CRC+15]. Besides that, researchers demonstrate that adolescents can transfer climate change related concerns among their parents and in this way share and together construct knowledge about the issue [LSP+19, KG08].

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[7]Human-computer interaction

With the goal to raise children's awareness and enable a better understanding of climate change related elements and their interactions, Pittarello et al. [PB19] designed a tangible interface for public spaces (see Figure 1.3). This tool enables children to play around with different elements of environmental factors (location, time of the day, relative humidity, wind speed, and temperature) and observe their differences in resulting CO2 values (represented as black balls filling the visualisation screen). Similar to that, Doshi et al. [DHLB17] introduced a tangible interface where children could together design sustainable cities (see Figure 1.4). While interacting with different elements of a city (e.g., car, building, tree, bicycle, etc.) children could observe associated environmental and financial impacts. Both aforementioned tools try to break down the complexity of the climate change issue and teach kids how to lead a more sustainable lifestyle.
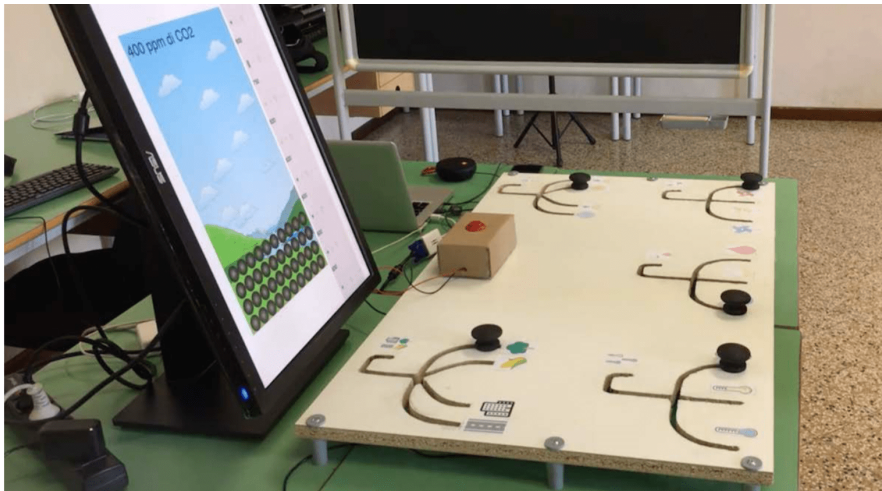

Figure 1.3: Tangible interface for public spaces. [PB19]

Other research projects investigate ways on how to visualize the consumption of environmental resources and in this way create awareness around climate change and motivate proenvironmental behaviour. In this context different eco-feedback systems were developed and analysed, e.g., visualising effects through digital art, power socket changing color depending on its source of energy, etc. [QJNN16, Hol07].

Nevertheless, climate change is a complex topic that requires activation from the society as a whole. As several researchers have shown intergenerational communication, especially within the family, has beneficial impacts on shaping climate change perception [GT09, VPS18]. Results from the study by Stevson et al. suggest that perceptions of how family members and peers view climate change predicts climate change concerns of adolescents [SPB19]. To the best of author's knowledge, based on the literature and market research, there are no proposed intergenerational (technological) solutions to the problem at hand. The goal of this thesis is therefore to extend the current state of scientific findings by fostering intergenerational communication to promote more awareness and hopefully achieve a behavioural change toward a more sustainable living.
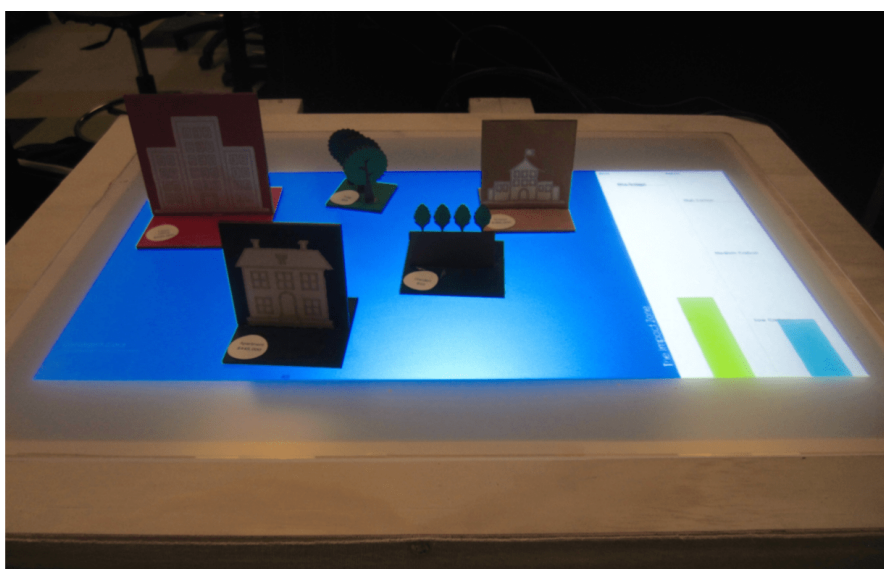
Figure 1.4: Tangible interface for designing sustainable cities. [DHLB17]

CHAPTER 2

Theoretical Foundation

Today, technology has made its way into all aspects of people's daily lives - affecting everything from communication and education to healthcare and entertainment. Moreover, computers, tablets and mobile phones have become regular companions that most people could not imagine living without. Through mobile data and the availability of free WIFI the status of instant and permanent connectivity emerged. Notifications from email clients, social media, messages, etc. keep coming in as long as the smartphone is switched on and constantly push the user to react. A study demonstrates that the presence of a mobile phone remarkably reduces the quality of face-to-face interactions [MCGY16]. Beyond unintended side-effects like these, technologies can also be deliberately designed to foster psychological well-being. By now, most technology is focused on enabling individuals to fulfill their intended tasks faster, better and more reliable. However, over the last years technological innovations in the field within human-computer interaction (HCI) are entering a new era of so called "positive computing" [CP14]. This concept aims at fostering the overall well-being of individuals through technology and therefore strongly relies on psychological models and theories.

With regard to this, the theoretical foundation of this thesis builds upon knowledge from multiple disciplines in order to understand how to empathize with the users and enhance their well-being when it comes to communication about climate change. Firstly, a dive into the environmental and behavioural psychology is made to gain a better understanding of psychological barriers that need to be considered when it comes to climate change. The most important findings are summarized in the Chapter 2.1. Chapter 2.2 represents several strategies that can be applied to achieve an effective communication about climate change. Besides that, since this thesis is following an intergenerational approach the subsequent chapter discusses some of the main differences between these two generations and their challenges. Next, a short insight into the field of positive computing is provided (see Chapter 2.5). After that, the importance of inclusive design for technologies that involve international audience is highlighted. Finally, the last chapter of the theoretical

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foundation introduces the theory behind the methodological approach of this thesis. This chapter includes a description of each data collection method that was used within this research.

2.1 Environmental & Behavioural Psychology I: Barriers

To gain a better understanding of how individuals perceive climate change and which issues were discovered by other researchers a thorough literature research around this topic was conducted.

Scientists anticipated climate change for more than three decades and repeatedly warned about its severe global impacts [RWN+19]. However, climate change related information was not as present across the media as it should have been until now. The missing presence of the topic in the channels where most people reside, made it hard to reach the society. Nevertheless, in the past few years most communication media (newspapers, radio, TV, social networks, etc.) started integrating the topic into their platforms. Besides that movements like *Friday for Future*[1] which was initiated in 2018 by Greta Thunberg inspired many people to understand the urgency for change. Especially young people showed interest in climate change activities. Despite growing concerns around climate change, many people still fail to establish pro-environmental behaviours and take action to mitigate the climate change [Gif11].

The following section will discuss several psychological aspects that keep individuals from assessing the size of the thread that the climate change poses.

2.1.1 Psychological barriers to inaction

Scientists have proven that there are several psychological barriers that keep people from taking action to effectively deal with climate problems. Gifford et al. [Gif11] (2011) defined seven psychological barriers to climate change mitigation and adaption (*Dragons of Inaction*). The author divided the barriers into seven main categories: Limited Cognition, Ideologies, Social Comparisons, Sunk Costs, Discredence, Perceived Risks and Limited Behavior. Collectively, these *dragons* help to explain why humans often agree that "there is a problem but" still do not manage to act against it.

Inspired by Gifford's et al. [Gif11] findings, a group of researchers [LGC19] recently measured the aforementioned barrier categories across six domains of environmental-behavior (food choices, transportation, energy use, water use, purchasing, and waste) and slightly restructured the defined barriers. Since their findings turned out to demonstrate a better representation of the barriers, this thesis will refer to new structure from Lacroix et al. [LGC19]. Following five psychological factors were defined as accountable for climate inaction:

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[1] https://www.fridaysforfutere.org/

- Factor 1: Change Unnecessary

- Factor 2: Conflicting Goals and Aspirations

- Factor 3: Interpersonal Relations

- Factor 4: Lacking Knowledge

- Factor 5: Tokenism

There are several aspects that make people believe that a *Change is Unnecessary*. One of the reasons for this behaviour is linked to worldviews that each person establishes throughout lifetime. A worldview consists of values, ideas, and the belief system that determine person's attitudes, beliefs, and ultimately, actions [KR04]. Beliefs in particular ideologies like *technosalvation* (technology will solve environmental problems just as it managed to solve many other problems), or superhuman powers like *Mother Nature* or religious beliefs in *God* may leave the impression that mankind is protected from serve climate disasters, thus minimising the need for behavioural change. Besides that, since benefits of climate actions are mostly invisible and often far-off in the future it convinces individuals that the problem is not needing urgent attention. Additionally, the missing direct link between individual's actions and observable climate benefits may evoke the feeling that individuals' single actions do not have the power to make a change. There are also other elements such as "System Justification" [Gif11] and the "Spacial Bias" [SMC+14] that build the belief that a change is not necessary. People often tend to prefer and justify the social system as it is now, simply because it exists (System Justification). The spacial bias is the tendency to perceive climate change risks more serious for other people and other locations than for oneself on a local level. This bias is also strongly related to the *optimism bias*, which causes someone to believe that others are more likely affected by the risk than themselves.

Another factor that hinders considerable improvements in climate change mitigation is attributable to humans *Goals and Aspirations*. Climate change related goals can interfere with other life goals that an individual has. As an example, very concerned parents may drive their kids to school by car because they are worried about their safety, even though they know that for kids health as well as for the planet it may be better to let the kid walk to school or take a bike. Depending on how one prioritizes the problem/goal results in how successful it will be integrated in one's life. If one perceives family- and job-related goals as more important and that a change could negatively impact these goals and the well-being often result in an aversion to change. Besides that, many ingrained habits interfere with seemingly sudden required mitigation actions and may be resistant to change (e.g., eating habits, mobility habits, etc.). Similarly, investments in the form of time, money, or lifestyle can make a change difficult.

As social animals, humans constantly compare their situation to that of others [Fes54]. Therefore, *Interpersonal Relations* have a significant role on one's own actions and behaviours. If an individual notices that many others around are involved in pro-climate

activities it may rise their motivation to take part in such activities as well. Being afraid of criticism, disapproval, embarrassment, and disappointment from people that one stands close to (e.g., friends, family, peers, co-workers, etc.) may be an influential factor for inaction.

Besides that *Lacking Knowledge* is another factor that allows people to make incorrect assumptions about the magnitude of the climate problem. First problem in this context is related to the information overload around this topic that results in confusion among people, not knowing where to start and what actions to take. Secondly, people may not be aware of how much their everyday actions can contribute to the mitigation process. Also, the options that are currently offered to the mankind are mainly limited to singing online petitions from which most people do not expect too much, leading to uncertainty and inaction. Besides that, the functional risk may also play a role: If one purchases, for example, an electric car, it might, since it is a fairly new technology, have battery or range problems.

Finally, since many people are already involved in some pro-environmental activities, there often arises the belief that after accomplishing one pro-environmental action (e.g., changing incandescent light bulbs to LED light bulbs) one has done enough and that no further involvements are necessary. This phenomenon goes by the name *Tokenism*. Moreover, the involvement in such activities can also lead to a *Rebound Effect*. This phenomenon occurs when a climate beneficial act is made and is than compensated with something less beneficial. For example, a person that replaces the traditional light bulbs with energy-saving LED light bulbs may leave the lights longer on. Similarly, owners of fuel-efficient cars may drive longer distances and use the car more often than they did with the less-efficient cars. The "moral licence" that one gets after doing something positive for the climate can sometimes lead to an even less beneficial behaviour. Besides that, once a person develops its own personality and becomes satisfied with the way how one does things it may be hard to change.

Besides that, a study conducted by Morton et al. [MRMB11] compared how different framing (positive or negative) of a message about climate change can influence individuals actions toward climate change. Their findings show that a message that is framed to emphasise possible losses due to climate change, increased uncertainty among the participants and resulted in decreased intentions to engage in actions that mitigate climate change. Whereas, the same message that was solely framed in a way so that it emphasises the possibility of avoiding loss reversed the effect of uncertainty and motivated people to take action.

2.2 Environmental & Behavioural Psychology II: Strategies

After gaining an insight into the psychological barriers (Section 2.1) that prevent people from taking action, the next step is to understand how to address these barriers and succeed in engaging people in sustainable lifestyles. Scientists from multiple research areas (psychology and environment) defined a number of strategies that can help activate people to take action against climate change [MDX14, PF15, Oja12, BFL99, HFM+15, MBB+19, ND16]. The main goal is to define how climate change should be communicated in a way that makes people feeling more engaged, informed, and willing to do something different. The Yale Program on Climate Change Communication defines that climate change communication is "about educating, informing, warning, persuading, mobilizing and solving this critical problem. At a deeper level, climate change communication is shaped by our different experiences, mental and cultural models, and underlying values and worldviews."[2] In general, the way how a message is framed can effect how people think and interpret about certain issues [MRMB11].

As discovered in the chapter before - *"Man is not a rational animal; he is a rationalizing animal."* [Hei12] Human beings cannot always make rational decisions because their thinking process is affected by various factors like beliefs, values, etc. This implies that humans will always try to find a good reason and justify themselves with convincing excuses even for inappropriate actions and worst behaviors. Nevertheless, there are several techniques that can help to overcome the aforementioned limitations. Sander van der Linden et al. [VdLML15] defined five "best practices" that policy makers should consider when empowering people to take action on climate change (see Figure 2.1).

There are several aspects that should be considered to achieve when framing the communication. The next sections represent some of the main findings.

2.2.1 Make it Local and Personal

As discussed in the previous Section 2.1, climate change is often perceived as a psychologically distant issue. Depending on where one lives and to what extent the effects of climate change are apparent in that region, implies often how serious the problem is interpreted [MDX14]. Individuals that already experienced one of the bad effects of climate change such as bushfires, droughts, etc. usually feel more threatened by the climate change [MDX14]. Often media depicts climate change mainly as an environmental issue by showing which effects it has on the environment (melting of ice, sea rise, extreme weather events, etc.) and less about the consequent impact on society's health, their food and shelters [BGC20]. As the researchers show, framing climate change solely as an "environmental" problem, protects individuals from feelings of "anxiety, over-extension, and helplessness by providing distance from or denial of the problem's source and its solution, and minimizing personal responsibility" [KLH11]. Besides that, since many facts

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[2]https://climatecommunication.yale.edu/ Website accessed on: 22.02.2020

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Psychological lesson	Policy guideline	Example policy recommendation
1. The human brain privileges experience over analysis	Highlight relevant personal experiences through affective recall, stories, and metaphors.	The National Park Service (NPS) gives concrete examples of how climate change has already harmed natural resources in specific parks.
2. People are social beings who respond to group norms	Activate and leverage relevant social group norms to promote and increase collective action.	Government climate science agencies could improve efforts to highlight descriptive norms (e.g., the scientific consensus on human-caused climate change).
3. Out of sight, out of mind: reduce psychological distance	Emphasize the present and make climate change impacts and solutions locally relevant.	NASA and The National Oceanic and Atmospheric Administration (NOAA) are supporting efforts to enable TV meteorologists to educate their viewers about current local climate change impacts.
4. Nobody likes losing but everyone likes gaining	Frame policy solutions in terms of what can be gained (not in terms of what is lost).	The Environmental Protection Agency's (EPA) "Clean Power Plan" focuses on cleaning up the nation's fuel supply, which will help clean up the nation's air and water, providing direct health benefits to all Americans.
5. Tapping the potential of human motivation	Leverage intrinsic motivation to support long-term environmental goals.	The President, Congress, and all federal agencies should be openly aspirational in designing climate policy initiatives that tap into citizens' deeply held motivations for building a better tomorrow.

Figure 2.1: The overview of psychological lessons and advice for policy-makers defined by Sander van der Linden. [VdLML15]

are generally communicated on a global scale it makes it sometimes hard for individuals to understand why the problem matters to them. Due to this, before scaling up to worldwide climate change effects it may be advantageous to address locally observable effects and possible changes. People care for what they love. Motivating people to spend more time in the nature on the one hand fosters the personal investment in environmental health but also improves physical and spiritual health of an. The researchers [PF15] demonstrated that that connectedness to nature is positively related to pro-environmental behaviours. Colin A. et al. [CPN+15] showed that connectedness with nature is important for human flourishing and well-being.

2.2.2 Build Social Norms

Social norms represent group beliefs that define how people should behave in a given situation [KS18]. As discussed in the previous section, people pay a lot of attention to what others around them do and what they could think of the action that one does. Besides that, individuals tend to follow and copy attitudes of others that seem to fall into the "normal" behaviour. Due to this phenomenon, it is obvious that establishing social norms, which show that it is "normal" to be green and that "everybody does that" can increase pro-environmental behaviour across individuals [KS18]. Showing examples that more and more people especially those within one's social network (family, friends, etc.) engage with climate change and perceive it as a risk that requires action, may trigger individual's own pro-environmental behaviour. A study revealed that individuals who had an insight into the energy consumption of their neighbors, tended to adjust their

own energy consumption in order to conform the group norm [NSC+08].

2.2.3   Inspire a Positive Vision

Even though fear and alarmism may catch attention in the short-term, empirical studies have shown little long-term effects; in the contrary, if the problem is not perceived as personally relevant it can have counterproductive effects [CRC+15]. Therefore, it is of great importance to build motivation for pro-environmental behaviour from a positive, rather than a negative perspective [MBB+19].

Studies have demonstrated that messages which address feelings of hope and self-efficacy can increase the willingness to engage in climate change issues [Oja12, BFL99, HFM+15, MBB+19]. Self-efficacy is often seen as the foundational element for environmental action and describes an individual's belief in their own capacity to take the needed action and complete it successfully [BFL99]. Therefore, instead of talking about possible loses from inaction, integrating messages that address gains from actions can better promote people's self-efficacy and increase their belief that their actions can mitigate negative climate change impacts [MBB+19]. For comparison, a positive message could be "If we act now, we can still mitigate the negative impacts that climate change will have on us and future generations" versus "If we do not act, the catastrophic effects of climate change for us and future generations cannot be prevented".

2.2.4   Emphasize Related Benefits and Address Solutions

Most of the pro-environmental behaviours are also beneficial to one's own physical and mental health. According to PLoS Medicine [PT18]: "obesity, diabetes, heart disease, and cancer, which are in part related to physical inactivity, may be reduced by a switch to low-carbon transport-including walking and cycling." Similarly, eating fewer meat and dairy products and buying more local and fresh food is beneficial to one's health.

Research indicates that people often perceive the problem as unsolvable. This indicates that the problem needs to be demonstrated in a more tangible way. Within this process the proposed solutions should always math the level of ability the audience can take action in. As EcoAmerica [MHH14] discusses in their article, the proposed solutions must be able to solve the problem and that those solutions are not just visions of the future. The available solutions that are presented should motivate people to start or further engage in climate activities and encourage one's friends and family to do the same [MHH14].

2.2.5   Use the Power of Storytelling and Visuals

"[Humans] are not thinking machines that feel; rather we are feeling machines that think." [Dam06] Research in psychological science has shown that the human brain relies on two processing systems that constantly interact with each other [LY15]. The first system relies on fast, emotion-based decision making; and the second system relies on thorough

analytical decision making [LY15]. In general people make their daily decisions based on the first system (fast emotion-based decisions) [LWHW01]. The way how one feels about a certain situation, often defines how one will interpret and respond to the situation/issue [LLVK15]. In this context, Niess and Diefenbach [ND16] demonstrated in their study that the "tone of voice" of a product, meaning the way how the product "talks with the user", has an significant impact on individual's psychological response and the motivation to use it. Images and videos are powerful tools in conveying emotions alongside the information. As research shows, especially images that involve people, groups and household items increase the memorability and easier interpretation of content. A study conducted by Goldberg et al. showed that using video as the representation medium is significantly more effective in conveying the issue than the text transcript with the same information [GvdLB+19].

2.2.6 Choosing the Right Messenger

Every human being interprets information in a different way, depending on their world-views and deeply rooted [MHH14]. In respect to that, it is plausible that every individual tends to trust different messengers and react to different types of data representation (e.g. pain scientific facts, video, audio, face to face, chat, etc.) in different ways. Usually, people tend to trust messengers who share similar views similar to their own [AKS18]. In general, it is important that the message communicated "speaks the same language" as the audience. Since scientific language often tends to be very complex, including hard to understand jargons and definitions [AKS18] it is important to break down the complexity and make the content more accessible for the audience [AKS18].

2.3 Intergenerational Communication

Communication is the central element to all human social behaviors [LF10]. Every social interaction between humans builds upon communication through shared symbols. An intergenerational communication refers to a social interaction between two distinct generations. The Center for Generational Kinetics defines a generation as "a group of people born around the same time and raised around the same place. People in this birth cohort exhibit similar characteristics, preferences, and values over their lifetimes."[3] As of today, five different generations can be distinguished in the society: Traditionalists (aged 75-83), Baby Boomers (aged 56-74), Generation X (aged 41-55), Generation Y or Millennials (aged 26-40) and Generations Z (aged 0-25). Each generation has gone through different life circumstances that evolved different characteristics across generations. Mainly differences in attitudes and mindsets but also in their communication goals, needs, and behaviors can be observed [Bio01]. These differences can often lead to unwilling conflicts and miscommunication. One common phenomenon that occurs during intergenerational communication is overaccomodation [Gil16].

Communication accommodation theory (CAT) [Gil16] elaborates human's tendency to adjust the behaviour to the communication partner during an interaction. According to CAT [Gil16], communication behavior with people from other age groups reflects the stereotypes one holds about those groups. In general, there are two main accommodation processes described by this theory: convergence and divergence. Convergence refers to strategies through which individuals adapt to each other's communicative behaviors, in order to reduce social differences. Divergence, on the other hand, refers to strategies in which individuals do not attempt to demonstrate similarities between each other. This strategy leads to an accentuation of speech and nonverbal differences between self and the communication partner. Although people may usually have good intentions when they use convergence behaviours in conversation, some individuals can perceive this patronizing and demeaning, hence negatively impact the communication [Gil16]. Typically, overaccommodation occurs when individuals try to converge what is perceived as partner's communicative need but "overdo it", making more adjustments than the person actually needs. This issue is often associated with the term "elder-speak" or "baby talk". However, overaccomodation does not only take place in young to elderly conversations. Also younger people are targets of this types of talk from older adults [GG11]. Giles et al. [GG11] identified three clusters of elderly-to-young overaccommodation: (1) non-listening, (2) disapproving/disrespecting youth, and (3) overprotective/parental.

Not long ago, the catchphrase "OK Boomer"[4] evolved in relation to climate change. This phrase aims to show that young people have had enough of the policies and politics that have got the word into the state as it is now. It addresses older generation's unwillingness to see that the world has changed and that not all the old rules still apply. Most world leaders are from the Boomer generation, both in terms of age and mindset.

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[3]https://genhq.com/FAQ-info-about-generations/
[4]https://www.nytimes.com/2019/10/29/style/ok-boomer.html

Ryan et al. [RMMO95] developed a communication enhancement model (see Figure 2.2) that is focused on enhancing the communication and quality of life for older people and their younger communication partners. The model was initially developed in a health care context but can be equally applied across other communication contexts. In an intergenerational context the term "provider" can be substituted with "younger person". This models offers younger people ways in which they can recognize older adults individual characteristics and modify the communication to suit individual needs and situations rather than emphasizing the role of negative stereotypes of both young and old.
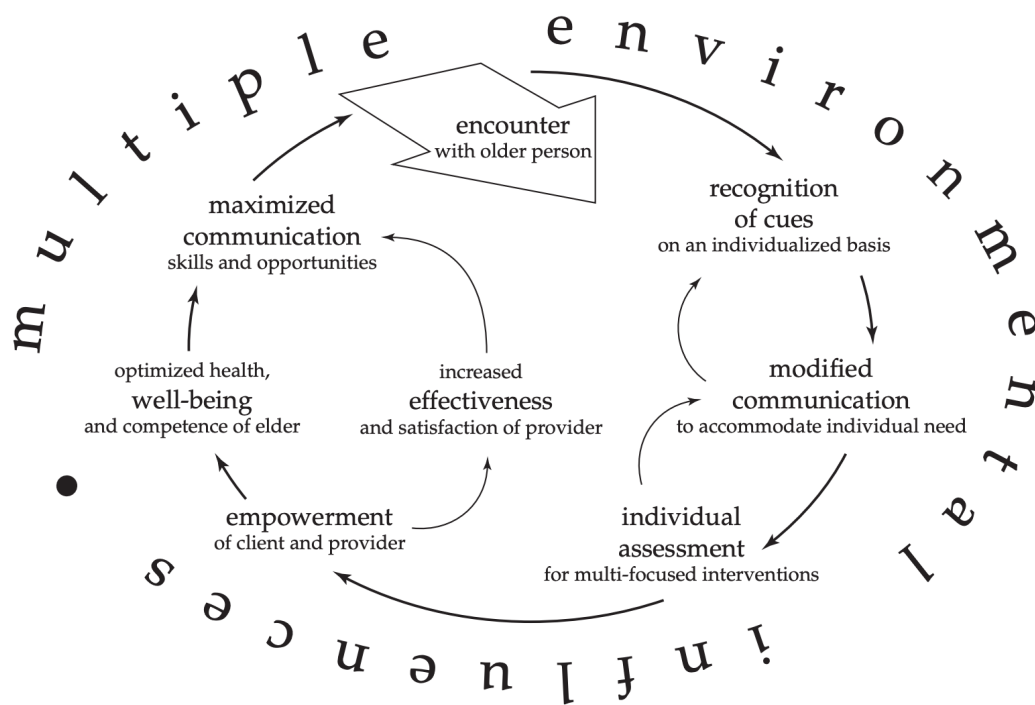

Figure 2.2: Communication enhancement model. [RMMO95]

2.3.1 Triggers of Intergenerational Communication about Climate Change

Since older adults have already strongly developed worldviews their anti-reflexive thinking is more clouded when it comes to controversial subjects [Gif11]; climate change being one of these. Studies demonstrated that in such cases children can act as agents transferring climate change concern [LSP+18].

Besides that, solely providing accurate information is not sufficient for effective engagement [CRC+15]. Instead, the message should be framed in a way that it "speaks" to the

audience by addressing their values and passionate interests that may be affected by climate change [CRC⁺15].

2.3.2 Importance of Intergenerational Communication about Climate Change

The number of Baby Boomers reaching their senior years is constantly increasing and reaching an ever-growing number in the society. Yet, climate change represents, as many studies show, dangerous threats especially to elderly people (future and present ones) [FFM12]. However, as Robert B. Hudson underlines in his report "Gray and Green Together: Climate Change in an Aging World", older generations play a crucial role in addressing climate change challenges [Hud17]. He states: "older adults possess both resources and perspectives that can be central features in advocacy and programmatic initiatives addressing the multiple dangers posed by a warming earth." Besides that, Lawson et al. proves that intergenerational learning is possible, and that it provides an effective pathway in engaging both to environmental change from which both generations can profit [LSP⁺18].

In order to preserve transfer of knowledge, competencies and values between different generations intergenerational learning is significant [LSP⁺18]. Researcher have shown that parents generally being good role-models for their children [SPB19]. Therefore, interventions that offer parents the opportunity to show off their knowledge and their best may result in a behavioural change for parents and children. Lawson et al. [LSP⁺18] discussed five key principles that can promote intergenerational learning of climate action: (1) education focused on local issues, (2) longer term and more in depth lessons, (3) hands-on projects, (4) enthusiastic teachers and (5) active parental participation [LSP⁺18].

Bel et al. [VBSI⁺09] shows in her study that a key factor to foster connectedness is being aware of each other's experiences and feelings [VBSI⁺09]. Researchers have shown that especially communication within the family has an impact on our beliefs and the way we interpret the world [Mee14]. Moreover, studies have shown that social interactions between older and younger people, who are not related to each other, can foster overall engagement, lifelong learning, and well-being of especially older adults.

2.4 Guidelines for Designing Intergenerational Interfaces (Inclusive Design)

Younger generations grew up with digital devices and are therefore very efficient and comfortable using it and keeping up with the fast-paced technological advancements. Older generations, on the other hand, integrated digital technology relatively late in their lives, which required special effort to adapt. In addition to that, around the age of 60, most individuals start experiencing first social (e.g., retirement) and health (e.g., physical and cognitive decline) changes that come along with the normal aging process. These limitations must be thoughtfully taken into consideration when designing systems which involve older adults. It is important to avoid the common mistake of solely focusing on the needs of younger audience; instead, also older adults' capabilities, limitations, and preferences need to be considered so that they do not feel disadvantaged [Coy03]. Besides that, this could also help to counterbalance the development of new technologies, which is otherwise mainly geared to the interests of young people [CFAQS09].

Abrantes et al. [AAB17] show in their research that different Information and Communication Technologies (ICTs) as well as social media are increasingly being used to support intergenerational communication among family members. Keeping that in mind and the fact that older adults are a growing consumer group in the digital world, it seems even more important to focus on applying the "design for all" philosophy while creating digital products. "Inclusive design", "universal design", "adoptable design", and "design for all" are all different names to concepts that pursue the same goal: assuring acceptance across the widest range of audience. Microsoft[5] defines inclusive design as "a design methodology that enables and draws on the full range of human diversity... it is for those who want to make great products for the greatest number of people." Accessibility or accessible design also have a similar concept, however, there is a difference: while inclusive design considers from the very beginning how something might be useful and enjoyable for as many individuals as possible, accessibility focuses on making special considerations for people with disabilities. In their book "Inclusive Design: Design for the Whole Population" Clarkson et al. mention that when it comes to inclusive design, "the focus is not on age or disability, even though these are very important issues, but on inclusivity on a social level" [CCKL13]. Besides that, it is important to note that good design for older people is often good design for everyone. For example, providing high-contrast setting was initially made to benefit people with vision impairments. Today, however, many people benefit from screens that have high-contrasts when they use a device in bright sunlight and other similar circumstances. Similarly, when designing for people who suffer from loss of upper extremities (e.g., arm), also people with temporary impairments (e.g., broken arm) or situational impairments (e.g., holding a baby). This shows that by designing digital systems for people with permanent disabilities can also benefit people with situational or temporary limitations.

Universally designed products, environments and communication consider needs and

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[5]https://www.microsoft.com/design/inclusive/

requirements of all possible users and customers. As Gassmann et al. [GR08] states, "it does not differentiate between disabled, normal, old, and young". The Center for Universal Design at the College of Design at North Carolina State University established seven overarching principles for universal design [Sto98]:

- **Equitable Use** - The design does not disadvantage or stigmatize any group of users.

- **Flexibility in Use** - The design accommodates a wide range of individual preferences and abilities.

- **Simple and Intuitive Use** - Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- **Perceptible Information** - The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities (e.g., color contrast).

- **Tolerance for Error** - The design minimizes hazards and the adverse consequences of accidental or unintended actions.

- **Low Physical Effort** - The design can be used efficiently and comfortably, and with a minimum of fatigue.

- **Accessibility** - The design is accessible for expected range of body size, posture or mobility.

The Nielsen Norman Group recently (2019) defined four main aspects that need to be considered when designing for older adults[6]:

- Ensure high contrast between text and the background

- Provide context cues

- Provide big tap targets (buttons and links should be large enough and there should be sufficient padding between them)

- Change global navigation only when necessary and it improves the user experience

In their book "Designing User Interfaces for an Aging Population" Jeff Johnson and Kate Finn defined detailed guidelines that address four age-related sensory changes that are part of the human aging process: (1) vision, (2) motor control, (3) hearing and speech, and (4) cognition [JF17]. Initially the authors grouped the guidelines by correlating sensory change. In context of this master's thesis the structure got adjusted and is now

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[6]https://www.nngroup.com/articles/usability-for-senior-citizens/(website accessed on: 20.03.2020)

represented by elements of visual, interaction, and information design. The guidelines mentioned in the sections below focus on touch-screen devices and everything was adapted from the aforementioned book [JF17]. The main goal of these guidelines is to support designers and developers to create digital products that can be used by the widest range of people.

2.4.1 Visual Design Guidelines

One of the earliest signs of aging is the impairment of near-focus. Therefore, the way how visual elements are represented needs to be carefully considered. Often simplicity is the key to visual presentation. The main guidelines per visual cue (font, color & contrast, composition & hierarchy, and others) are listed in the sub sections bellow:

Font

As people age their vision diminishes. Therefore, paying attention to how the system represents the text on any digital device is of great importance. The following guidelines assure a more accessible font representation:

- Font size at least 12 point; 14 point even better

- Use Sans-serif fonts especially for body text (e.g., Frutiger, Helvetica, Lucida, Universe, Verdana, or Tiresias)

- Avoid light-weight fonts

- Display body text in mixed case (all caps is harder to read)

- Make font-size adjustable (enlargeable)

Color & contrast

Color and contrast can be used to help users see and interpret the content as they should. In order to achieve that it is important to use color thoughtfully. In addition to that, it is important to consider that users can experience different vision impairments that may lead to different interpretation of content if it solely depends on color. The following guidelines should be taken into consideration when integrating color into a digital device:

- Use color sparingly (mainly for functional purposes)

- Provide sufficient contrast between text and background or at least make it adjustable (contrast ration at least 4,5:1 for normal text; 3:1 for bold text)

- Combine color with other indicators (e.g., patterns)

Composition & hierarchy

In order to help users to focus on the task they want to preform it is important to eliminate all irrelevant and potentially distracting visual elements and provide the users a clear structure. Some of the most important guidelines regarding composition and hierarchy of digital systems are the following:

- A clear hierarchy of importance (use clear labels and headings)

- Place important actions at the top or bottom of the screen

- Information is divided into small chunks (easier to scan)

- Key information that is discernable at a glance

- Group related elements

- Use sufficient white space (line-height at least 1.5)

- Limit calls-to-action to one or two per page/screen

- Maintain visual consistency (fonts, controls, icons, and color used consistently)

- Make controls prominent (links, menu, buttons stand out)

- Clear distinction between interactive and non-interactive elements

Other visual cues

- Use common icons

- Status and error messages should be obvious

- Indicate when users need to scroll

- Show at which step the user is and the current progress

- Mark visited links in a different color

2.4.2 Interaction Design Guidelines

With age but also temporal circumstances (e.g., riding in a bus and having to hold the phone only with one hand) can reduce peoples' motor control. These changes have impact on individual's ability to interact with the content. Special focus should be put on integrating suitable input gestures and usable controls [JF17].

Input gestures

- Gestures input preferred (minimize the need to use the keyboard)

- Use simple tap and swipe gestures

- Minimize vertical scrolling in general

- Avoid horizontal scrolling

- Avoid multi-finger gestures

- Minimize movement (place interaction elements near each other)

- Gestures should be easily memorable

Controls

- Big enough touch targets (according to *Google Material Guidelines*[7]: at least 48x48 dp)

- Maximize touch targets (example from the *Google Material Guidelines*: button height: 36dp → touch target height: 48dp)

- Mind sufficient spacing between touch targets (spacing depends on the size of tap targets; if tap targets are small at least 3mm)

- Big swipe targets (at least 17.5mm square)

- Place important touch targets near users' hand

- Place swipe targets at the bottom or right

Other interaction cues

- Do not rush users (avoid time constrains for actions)

- Provide return to a known starting place (links like home, back, next, and undo)

2.4.3 Information Design Guidelines

In order to enable users process information on a digital device as efficiently and effectively as possible there are several guidelines that need to be considered when defining the information and media. In the following subsection, several guidelines are listed:

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[7]`https://material.io/design/usability/accessibility.html`

Writing

- Terms should be used consistently

- Link label should equal the destination label

- Use verbs for buttons and links

- Keep it short

- Simple language (avoid jargons)

- Make language active, positive, and direct (e.g., "plan your trip" instead of "trip planning")

Sound

Gradual hearing loss is very common with increasing age. By age 60–65, the percentage is 45% and the percentage keeps constantly increasing with age. In order to address these changes, the following guidelines should be considered:

- Avoid distracting sounds

- Avoid high-frequency sounds (best range: 500–1000Hz)

- Ensure loud enough sound (at least 50-50 dB)

- Make alerts multimodal (audible, visual, tactile)

- Speed of a video play should adjustable

- Allow but do not require speech input

Guidance

- Provide text alternatives for non-text content

- Present one task at a time

- Provide in-app walkthroughs about possible interactions

- Lead users step-by-step

- Provide instant and obvious feedback

- Avoid burdening users' memory (do not assume knowledge)

- Provide reminders for habitual actions

- Help users with input (e.g., requirements, input examples, explanations, etc.)

2.4.4 Onboarding

The Pew Research Center[8] reports that when it comes to new technology, 77% of older adults indicate needing someone's assistance to walk them through the digital product. This can be attributed to the lack of appropriate or missing instructions, designed to accommodate a diverse user base to the new digital product. This can leave older adults, especially those who are not that familiar with technology, feeling insecure while using the product or even worse discourage them from using it at all. Therefore, including a proper onboarding on interface elements and key interactions of the digital product seems crucial. In general, an onboarding offers a simple way for new users to get familiar with the digital product. A swipe-through walkthrough/tutorial is very common approach in apps. An important rule for the onboarding is to keep it short by focusing on the main features and offering a "skip" option for impatient or tech-savvy users. Slack[9] provides a good onboarding for their first-time users (see Figure 2.3).
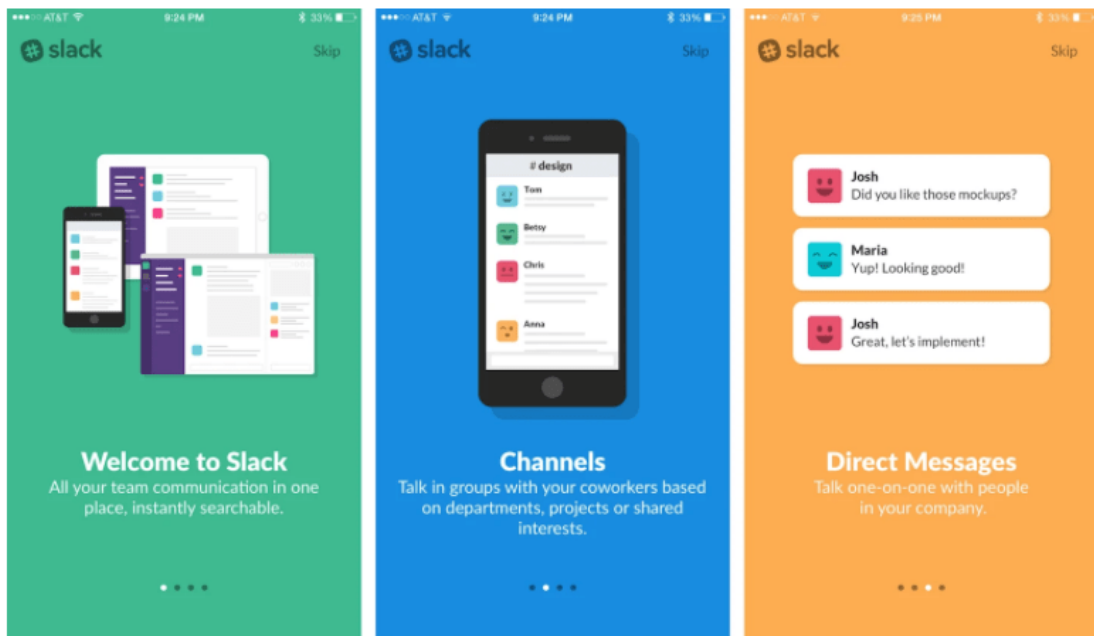

Figure 2.3: Slack's mobile onboarding process.

Findings from Rosales et al. show that older people do not want to use special technology designed for them [RFA16]. This indicates that older adults do not want to be excluded from the "popular stuff" just because of their age. This again underlines the importance of inclusive design and the ability to allow older adults to participate in the current happening without having to separately design different tools for them. Despite age-related limitations, most older adults of today are healthy, independent, and willing

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[8]https://www.pewresearch.org/internet/2014/04/03/older-adults-and-technology-use/
[9]https://slack.com/

to enjoy life [RFA16]. Even though age-related limitations can negatively impact the emotional state of older adults it is important to find ways to foster their emotional well-being. YourWellness [DOMK12] is an application that supports older people in managing their well-being. Over the last years the HCI (Human-computer interaction) field has increasingly focused on design for promoting mental health and well-being. This research area is entitled as "Positive Computing" and aims at integrating principles of well-being into the into the design of digital systems [CP14]. This concept will be described in more detail in the next section.

2.5 Positive Computing

Positive Computing refers to technologies developed and designed to foster well-being and human potential [CP14]. The goal of this approach is, firstly, to understand factors that enable and enhance deeper meaning, happiness, and human development in people's lives; and secondly to define ways how to apply that knowledge when designing new digital products. "Just as we design furniture and spaces ergonomically to support physical health, we should design digital spaces to support psychological health" [CP14]. In order to build a future in which digital experiences support human flourishing a multidisciplinary approach is required. Knowledge from different disciplines, e.g., psychology, education, neuroscience, and HCI need to be combined to adequately inform the design and development process. With careful forethought and stronger emphasis on design new enriching digital experiences can be created. The overreaching goal is that all tech-companies and product designers evaluate how their products affect psychological well-being as part of the iterative design cycle.

Peters et al. [PCR18] defined a framework for Motivation, Engagement and Thriving in User Experience (METUX). Since the authors that created the positive computing framework have a technical background, their work is especially applicable for understanding how well-being can be incorporated to enrich digital experiences. This model builds upon the self-determination theory [RD17] focusing on three core psychological elements/needs: (1) autonomy, (2) competence, and (3) relatedness. **Autonomy** refers to the concept of providing people the ability to self-regulate their experiences and actions that align with their own goals and values. For example, smartphones address autonomy by allowing users to decide when and how they want to receive calls and notifications. The second psychological need identified is **competence**, or the feeling of being capable and effective during an interaction. Especially games and educational applications regularly provide competence satisfactions by adjusting the level of difficulty to user's performance. Another important factor that technology needs to address and that has been shown to enhance people's well-being is **relatedness**. There are many ways to satisfy relatedness, one of them can be achieved by enabling people to feel more connected to others and build a sense of belonging. One of the most comprehensive longitudinal studies in history (75 years) on happiness reveals that "good relationships keep us happier and healthier"[10].

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[10]https://news.harvard.edu

Robert Waldinger reports that the quality of relationships is vital to the beneficial effect on happiness.

In order to achieve a broad sense of well-being (human flourishing) psychological needs have to be considered at different spheres of the interaction process. According to the METUX model, one can distinguish between six different spheres of experience (see Figure 2.4):
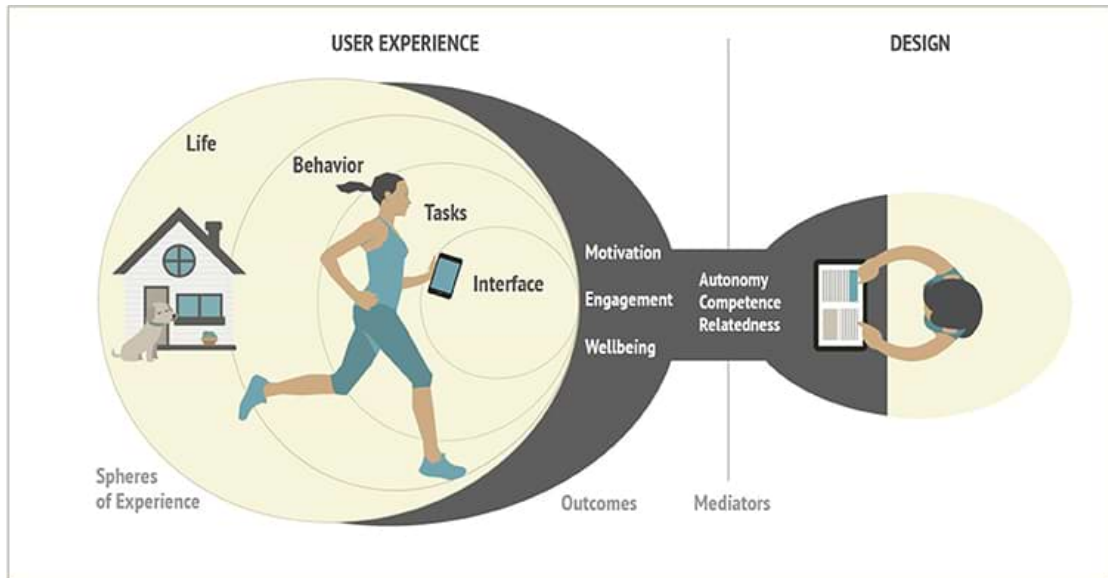

Figure 2.4: The METUX (Motivation, Engagement, and Thriving in User Experience) framework. [PCR18]

1. **Adoption** - decision-making experience of becoming aware of a new technology and eventually acquiring it, e.g., downloading an application

2. **Interface** - experience of interacting with a technology through its interface by e.g., tapping, sliding and pinching on a phone interface

3. **Task** - experience of engaging in a technology-supported task, e.g., sharing a photo, writing a message, tracking a sport activity, etc.

4. **Behaviour** - experience of engaging in a behaviour that the technology is trying to address, e.g., running, shopping, communicating, etc.

5. **Life** - the overall experience of life going beyond technology; every technology can deliberately or inadvertently impact the life of an individual in a positive (e.g., improving health, nutrition style, feeling of connection, etc.) but also in a negative way (e.g., addiction, sleep problems, etc.)

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6. **Society** - experiences of the entire society including those who are not using the technology at all; this includes impacts on the environment, politics, employment, child development, etc.

2.5.1 Approaches of integrating well-being into technologies

There are different approaches that can be applied to integrate well-being into technologies. This section introduces three different approaches defined by Peters et al. [PCR18]: (1) dedicated, (2) preventative, and (3) active technologies.

Dedicated technologies

Dedicated positive computing technologies are built specifically to foster one or more well-being aspects. These can be especially found in mindfulness apps like Headspace[11], Reflectly[12], Super Better[13], and other similar apps which help to build personal resilience, implement positive psychology, and encourage mindfulness respectively.

Preventative technologies

Preventative technologies treat obstacles to well-being as errors.

Active technologies

Well-being can be actively integrated into any sort of technology by adding components that can enhance well-being. Even though the overall goal of the digital product may not be to foster well-being, the integration of particular well-being aspects may result in richer experiences for users. For example, designers might choose to add a "thank you" button in an application because based on psychological evidence expressing gratitude increases overall well-being. Similarly, a four-week study [CMA16] showed that taking daily pictures with a smartphone of things that make an individual happy or something that make another person happy increases their own happiness and well-being. Over time participants reported to be more reflective and appreciative of the little things in their daily lives that make them happy.

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[11]https://www.headspace.com/
[12]https://reflectly.app/
[13]https://www.superbetter.com/

2.6 Methodological Approach (Design Thinking)

This chapter introduces the theoretical background of this thesis' methodological approach. First of all, a short introduction into Design Thinking and its different phases is provided. After that, each research method that was applied in the process of answering the research questions of this thesis is described in detail.

Being able to keep up with today's highly technological and competitive world requires a new set of skills and techniques [SB10]. Design Thinking is one of these skills that have proved to be effective in defining creative and delightful solutions to the problem at hand [KEL01]. Some of the world's most famous design-led companies, such as Apple, Google, Starbucks, and Nike have adopted the Design Thinking approach in their developments, leading them to outperform their competition. Design Thinking is also taught across top universities around the world including Stanford, Harvard and MIT[14]. Researchers at Stanford University (d.school) also created a Design Thinking Bootleg guide[15] where they describe all phases in great detail and introduce various research methods that can be used in each phase to collect and represent data. Design thinking can be defined as a creative solutions-based approach to problem solving. As Tim Brown, founder of the innovation and design firm IDEO, puts it: "Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success" [B+08]. It fosters user-centricity, creativity, innovation, and out-of-the-box thinking. In general, this methodology is extremely useful for tackling complex, "wicked" problems with the focus on challenging assumptions and exploring new pathways and ideas. Due to the complexity of problems that this thesis is dealing with (climate change and generational differences), Design Thinking seems to be the perfect tool for it.

The Design Thinking process consists of five stages: (1) empathize, (2) define, (3) ideate, (4) prototype, and (5) test (see Figure 2.5). It is noteworthy that those stages are not always sequential. Usually insights from one stage may require a revisit to a former stage to improve some shortcomings. The number of iterations between the stages can vary. Tim Brown [BK19] notes that this process involves two types of thinking: divergent (creating choices) and convergent (making choices). Figure 2.6 illustrates which type of thinking is present at which stage of the process.

2.6.1 Stage 1: Empathize

The first stage of Design Thinking is "Empathize". The main goal of this stage is to get to know the audience and understand their perspectives on life by stepping into their shoes. Empathy is seen as the foundation of human-centered design because it offers insights into human behavior and the ability to immerse into the problem field. There are different mainly qualitative methods that can be applied in this phase to gather the

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[14]Massachusetts Institute of Technology
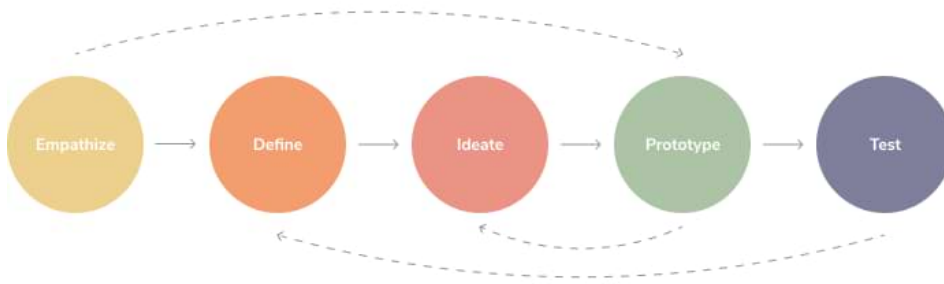[15]http://dschool.stanford.edu/resources/design-thinking-bootleg

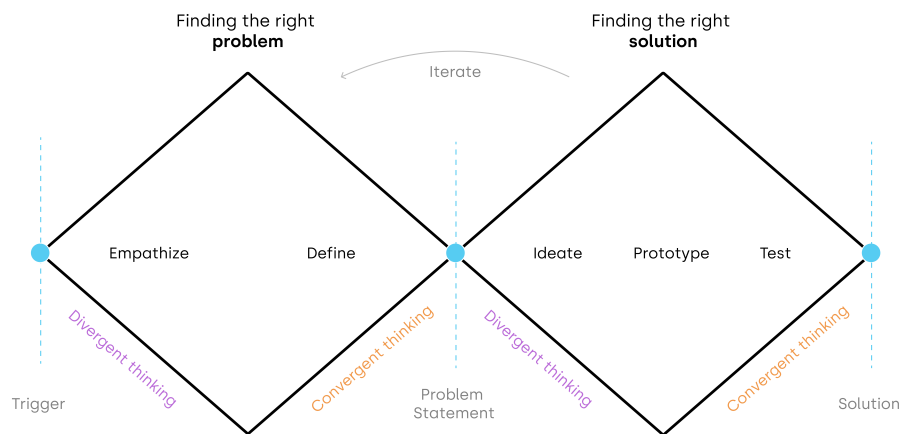Figure 2.5: The five stages of the Design Thinking process.

Figure 2.6: The double-diamond process of convergent and divergent thinking phases adapted by ICF International.

needed data about the target audience. Below several methods are listed that can be used in this phase:

- (Semi-structured) Interviews with empathy

- Diaries

- Online survey

- Observations

- Focus groups

- Assuming a beginner's mindset

- Asking 5 whys

- Engaging with extreme users

- Social media scarping

In context of this master's thesis two research methods from this list were used to collect data about the users, namely, semi-structured interviews and an online survey. Both research methods will be depicted in greater detail in Section 2.7.3 (online survey) and Section 2.7.2 (semi-structured interview).

2.6.2   Stage 2: Define

After gaining insightful knowledge about the target audience the next step is to define the core problem. During this stage the results from the empathy stage are synthesized and unpacked into compelling user needs and desires. The aim is to come up with an viable problem statement - the Point Of View (framed by the specific users of the first stage) that this thesis will follow. Eventually, the definition of the main design challenge should to be (1) human-centered manner, (2) broad enough for creative freedom but also (3) specific enough to make it solvable. Various data representation techniques can be applied to delineate the data. Some of the most common ones are mentioned below[16]:

- Empathy Map

- Affinity Map

- "How might we" Questions

- Point Of View Statements

- Why-How Laddering

2.6.3   Stage 3: Ideation

Now that the problem and needs are defined, it is time to brainstorm ways to address those needs. This stage marks the creative part where many different ideas are generated by applying insights from previous stages. Usually, the ideation phase is conducted in form of brainstorming sessions. During these brainstorming sessions generation and evaluation of ideas takes place. However, it is important to keep the generation and evaluation sessions separate from each other. During the idea generation phase the goal is to produce as many ideas as possible, without focusing on the quality or feasibility of the idea at that point of time. There is a variety of techniques that can be used during the idea generation[17]:

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[16]http://dschool.stanford.edu/resources/design-thinking-bootleg
[17]http://dschool.stanford.edu/resources/design-thinking-bootleg

- Brainstorming

- Sketching (e.g., 10 plus 10 method [GCMB11])

- Mind maps

- Story telling

- Scenes/Props/Roles

After having generated enough ideas, the evaluation process can start. During the evaluation state ideas are discussed and the best idea is selected. Usually, when conducted in a team, each team member votes for the best idea/s and the idea/s with most votes is chosen.

2.6.4 Stage 4: Prototype

In this section, the goal is to get ideas into the real world by giving them a physical form. The usability as well as the look and feel of the prototype are defined. The goal is to start with a low-fidelity, inexpensive prototypes and improve them over time based on user feedback from the test phase. At this point any type of material can be used to represent the idea. For example paper prototypes are an efficient tool to represent ideas quickly and with minimal effort. Some of the most common techniques are listed below:

- Wizard of Oz Prototype

- User-Driven Prototype

- Paper Prototype

- Digital Mock-ups

- Storyboards

A few of the widely used web and desktop prototyping tools on the market are:

- Figma[18]

- Sketch[19]

- Adobe XD[20]

- InVision[21]

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[18]https://www.figma.com/
[19]https://www.sketch.com/
[20]https://www.adobe.com/at/products/xd.html
[21]https://www.invisionapp.com/

2.6.5   Stage 5: Test

The final stage of the Design Thinking process represents the testing mode. At this stage various evaluation methods can be used to collect insightful feedback from potential users, prepare improvement suggestions and validate them against proposed objectives. In the test mode the prototype is iterated as the feedback comes in and then reintroduced to users for more feedback. Having an open mind is essential at this stage. In this context being able to accept failure and being prepared to start over if the prototype does not adequately solve the anticipated problem are part of the process. As encouraged in the Design Thinking Bootleg Guide[22] "prototype as if you know you're right, but test as if you know you're wrong".

2.7   User Research Methods

In general, there are two different approaches that can be applied to collect and analyze user data: qualitative and quantitative approach. The key difference between these two approaches is their level of flexibility. Whereas quantitative methods always have a predefined structure and a fixed set of closed questions, qualitative methods mainly consist of open-ended questions that "allow greater spontaneity and adaptation between the researcher and the study participant" [Mac05].

Qualitative research methods

Qualitative research is an exploratory, ethnographic approach that aims at gaining in-depth understanding of people and their [QFA17]. The goal is to collect answers on "How?", "Why?" and "What needs detailed examination?" based on the topic at hand [JC19]. The data that is collected in this context is descriptive and usually represented by words, images or objects. Due to the time intensity of this approach, qualitative research is usually conducted with a purposive, small sampling. Besides that, the main challenge of qualitative research is that answers cannot be measured objectively, but are always open to subjective interpretation.

The following are qualitative research methods that are frequently used [QFA17]:

- Observations (observing people in their natural settings)

- Interviews (conversation between a researcher and a study participant on a given topic)

- Digital ethnography (online research)

- Focus groups (moderated discussion about a given topic within a small group of 6-10 individuals)

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[22]http://dschool.stanford.edu/resources/design-thinking-bootleg

- Cultural Probes (small packages that can include any sort of artifact like a map, image, camera or diary that are given to participants along with tasks to accomplish)

- Diaries (participants self-report information about activities being studied over a given period of time)

- Literature research

When it comes to interpretation and analysis of qualitative data, several techniques can be applied to make sense of the data, such as grounded theory [SC94] or thematic analysis [BC06].

Grounded theory is an inductive approach with no a priori theory or hypotheses [SC94] . The main goal is to construct a theory that explains the data [SC94].

Thematic analysis focuses on finding patterns, connections, and relations in the data [BC06]. During the analysis process patterns are identified from the data and are coded into themes. In general, the process consists of six phases [BC06]:

1. Phase: Getting familiar with the data

2. Phase: Generating initial codes

3. Phase: Searching for themes

4. Phase: Reviewing themes

5. Phase: Defining and naming themes

6. Phase: Producing the report

Quantitative research methods

Quantitative research methods provide numerical data which can be analysed using mathematical and statistical methods [QFA17, JC19]. Researchers generally use quantitative research when they want to test hypotheses generated from previous qualitative research with a larger user group (random sampling) and generate conclusions [QFA17]. The focus is on answering questions like: "How many?", "How often?" and "How much?"[JC19]. Eventually, collected data can be validated and represented in form of tables, charts and graphs. The most common sources of quantitative data include [QFA17]:

- (Online) Surveys (list of closed or multiple choice questions that is distributed to a sample; online, in person, or over the phone)

- Simple observations (involves counting how many times the observed variable occurred, e.g., how many people enter a restaurant each hours)

- Records (numbers and statistics that can be used by institutions to track user activities, e.g., number of patients that enter a hospital)

- Structured interviews (strictly guided conversation with fixed questions between a research and a participant)

- Lab-based-studies (controlled setting for observations of tasks)

The two most commonly used analysis methods for numerical data are descriptive and inferential statistics. Descriptive analysis represents the first step of an analysis which helps the researcher to sum up data and find patterns. A few commonly used descriptive statistics are:

- Mean (average value)

- Median (middle value of a numerical set)

- Mode (most common value)

- Frequency (the number of reoccurring values)

- Range (the highest and lowest values)

- Percentage

The next, more complex step is the inferential analysis, which refers to identifying relation between multiple variables to generalize results. A few examples are:

- Correlation (relationship between two variables)

- Regression (describes how an independent variable is numerically related to a dependent variable)

- ANOVA - Analysis of variance (analyze the differences among group means in a sample)

2.7.1 Literature research

Literature research is a fundamental part of each scientific research and is usually conducted at several stages of a thesis. Among other things, literature research is essential for: (a) getting to know a research area and the current state of research, (b) identifying unresolved problems, (c) defining research questions, and (d) generating new questions and theories [PTJK15]. There are basically two methods how a literature research can be conducted: (1) systematic search and (2) snowballing[23]. The systematic approach can be characterized as a selective search over related topics, e.g., via keyword.

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[23]https://blog.hslu.ch/bibliothek/files/2009/05/skript-literaturrecherche.pdf

The "snowball system", on the other hand, refers to a search procedure with which bibliographies or references are explored for suitable literature. In this case the search and evaluation of literature happens simultaneously. One starts with a concrete source that is relevant for the research topic and in its bibliographies new interesting references can be found. Usually both methods are used in the process of the research.

When conducting a literature research it is important to set a binding end date to prevent endless searching. Besides that, defining a precise and not too comprehensive research question helps to achieve a less time-consuming research. Finding a good balance between gathering necessary information and filtering the relevant information is of great significance. The findings from the literature research may be documented by using a reference management software, e.g., Zotero[24], JabRef[25] and similar. Such tools offer the feature to organize literature in folders, write notes, highlight and use keywords.

2.7.2 (Semi-Structured) Interviews

An interview is generally a qualitative research method that focuses on "understanding experiences, opinions, attitudes, values, and processes" of the target audience [Row12]. This research method is similar to focus groups and surveys when it comes to gathering information about the target audience but the execution is preformed in a completely different style; focus groups are restricted to a small group of 6-10 individuals and (online) surveys collect quantitative data with a big number of participants. In contrast to that, interviews are always conducted as a one-to-one conversation between a researcher and a participant.

In general, there are three different types of interviews: (1) structured, (2) semi-structured, and (3) unstructured. These types solely differ in the freedom of questions and answers in the conversation. In the context of this thesis the semi-structured approach was chosen. The semi-structured approach suggests keeping the interview-guide in mind, but allows the researcher to deviate from the pre-defined set of questions and follow any idea that seems interesting. This often leads to insightful qualitative results. In order to make interviewees feel comfortable to open up and avoid confusion it is important to keep the questions open, neutral and as simple as possible. In the further process a lot of follow-up questions like "Tell me more about that", "Why?", "And what else?" can be used to encourage participants to go deeper and move past the obvious top of head answers, to think more.

The main advantages of interviews are: (a) rich and informative insights about participants can be collected, (b) non-verbal behavior of the participant can be observed, (c) flexibility, and (d) participant's answers are more spontaneous and direct [Opd06].

The biggest disadvantages of interviews are that: (a) they can be very time-consuming, (b) they can be costly, (c) comparing two different answers is difficult as the guideline for

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[24]http://www.zotero.org
[25]http://jabref.sourceforge.net

conducting interviews is not entirely followed and (c) anonymity or ethical matters may cause problems [Opd06].

2.7.3 Online survey

An online survey is a quantitative research method that mainly consists of closed questions and aims at gathering information about the target audience. Since this method strives for a vast number of participants it is important to make the survey "attractive" and take care of what makes someone willing to fill out a survey. To achieve this it is significant to keep the questions short, focused, clear and as simple as possible so that no misunderstanding can occur. To achieve a higher respond rate, it is important to ensure that each question has answer options that are easy to understand. This implies that open-ended questions should be used as little as possible and that the best types of questions are the following: closed questions including tick-boxes, items to be ranked, items to be selected and Likert-type scales (e.g., 1-5).

The major strengths of online surveys are [EM05]: (a) global reach, (b) flexibility and time independence for participants, (c) minimal costs, (d) speed and convenience, and (e) easier to compare answers with each other. Main weak-points are the following [EM05]: (a) time consuming definition of questions and analysis, (b) impersonality, (c) fraud, and (d) participants may misunderstand questions/answering options.

2.7.4 Empathy Mapping

Empathy Mapping is a common technique in the User Experience (UX) field used to cluster data from qualitative research methods. It is a useful tool to help better understand the target audience. In general, it captures the knowledge about user's behaviors and attitudes into four quadrants[26]: (1) says, (2) thinks, (3) does, and (4) feels.

- *Says*: represents what the user says out loud during the interview (e.g., verbatim, direct quotes)

- *Thinks:* captures what the user is thinking throughout the experience but may not be willing to vocalize; researcher should be answering following questions: what does the user think? What matters to the user?

- *Does:* capture user's specific behaviors and actions, e.g., riding with bike

- *Feels:* captures user's emotional state; represented by a feeling and a short sentence of the context (e.g., concerned - not enough time)

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[26]https://www.nngroup.com/articles/empathy-mapping/

CHAPTER 3

Empirical Research

This chapter depicts the empirical research that was applied to collect data about the target audience and answer some of the objectives of this scientific work. To recap, the main goal of this thesis is to develop an innovative system with a focus on intergenerational communication that offers people inspirations and meaningful options for changing toward a sustainable lifestyle. Based on that, the main objectives are to: (i) analyze the relationship between human activity and its impact on the climate from different perspectives, (ii) examine how intergenerational communication about climate change can be triggered, and (iii) to develop a technological solution (prototype) that enables intergenerational communication and in this way hopefully achieves the much needed behavioral shift toward a sustainable living.

This chapter outlines the procedure and the results of applied user research methods. Firstly, each method that was used to empathize with the target audience and collect valuable content for the thesis is described in detail. This represents the first step of Design Thinking (Empathize) including following user research methods: literature review, semi-structured interviews and online survey. Each method is introduced with its goals, main challenges, a detailed data collection procedure and other method-specific aspects. Secondly, the findings from user research methods are presented. In the next step, correlations and patterns between the data are analysed and discussed and finally the main design challenge is introduced. Those three steps represent the second stage of Design Thinking, namely the "Define" stage.

3.1 Applied User Research Methods (Empathize)

This thesis is following the Design Thinking process, in which the first step is to empathize with the target audience. In context of this thesis, the process of getting to know the user and understanding their perspectives on life was achieved by conducting three different data collection methods: literature research, semi-structured interviews and an online

survey. The fact that this thesis is dealing with an inter-generational approach on solving the problem the target audience is divided upon two different generations - Generation Z (ages 25 and under) and Baby Boomers (ages 56 - 74). In the following sections the procedure of each user research methods is depicted.

3.1.1   Literature Review

Goal

Since climate change is a multifaceted, complex problem it requires insights from different disciplines. Literature review was mainly used as a tool to build up theoretical and conceptual foundations, identify yet unresolved issues and answer the first research question of the thesis: "Which (psychological) barriers need to be considered when communicating about climate change and which strategies may help to remove these barriers and enhance the communication?". This method helped to identify, understand and make meaning of human contributions to climate change and the purpose of their inaction reasons from psychological and environmental perspectives. Findings from the literature review inform many aspects of the thesis including the building of hypotheses, research questions, interview guides and the questions for the online survey. All insights that were discovered throughout the literature review are summed up in Chapter 2.

Main challenges

Finding an effective evaluation method of selected documents as well as keeping a reasonable scope in mind (binding end date) were the biggest challenges of this research method. Since climate change is such a burning issue there was a lot of new information coming in day by day. Finding a good balance between gathering necessary information and filtering the relevant information was hard and made the research very time-consuming.

Procedure

Literature review has been conducted several times at different phases of the process. The initial research based on author's personal interests and curiosity concerning climate change. The main goal at this stage was to examine the current state of the area of interest in the HCI field and uncover potential gaps and unanswered problems. Results from this stage were still relatively broad but helped to define the direction of the thesis. In the next phase of the literature review the aim was to explore the area in more detail and define specific research questions that the thesis should follow and methods that would be used to answer these questions. Besides that, the bounds and the purpose of the thesis were fixed.

The Figure 3.1 represents first thoughts and questions formed around the topic. From this state the questions got wrapped up into three leading question per section (people, technology and data). These questions are visualised in the Figure 3.2.

People	Technology	Data (visualization)
Why are people not acting?	Which type of technology is most suitable? (tangible device,app, robot..)	Which data is needed?
How can we make people act?	Where should the device be used (public, private..)?	How to gather the data?
How can intergenerational communication be achieved?	Which interaction should be possibe?	How to visualise the data?
How to bridge generational differences?	Technology for younger and older people?	Which areas have the biggest impact on the climate change?
Understand the diff. on our views and our actions?	Persuasive technology	Which data raises awareness?
Which socializing agents have influence on our believes?		From datavis to data physicalisation

Figure 3.1: First results from the initial phase of the literature review.

From that output the final research questions were created (see Figure 3.3). As can be seen from the iterations, it took several refinement sessions to eventually formulate the main focus of the thesis. It was a rough time to formulate the main main problem that the thesis would focus on but as Albert Einstein states (paraphrased) "If I have one hour for solving the problem on which my life depends, than I will devote 40 minutes to study the problem, 15 minutes to analyse the ways how to solve it, and only 5 minutes to solve it" [Cou95]. After having defined the research questions a more focused literature review was possible. Two different methods (snowballing and systematic search) were used to collect and evaluate literature. Both methods are explained in greater detail in the second chapter in Section 2.7.1. During the research the literature management tool Zotero[1] was used to take notes, outline and keep track of collected literature. During the research process following literature databases were used as information source:
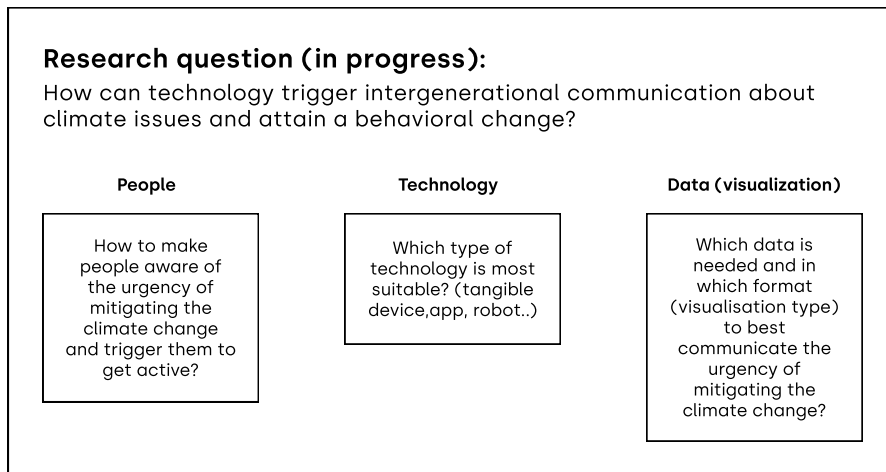
- Google Scholar

- ACM Digital Library

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[1]https://www.zotero.org/

Figure 3.2: Refined questions from the previously defined list of questions.

Figure 3.3: Final research questions linked with data collection methods.

- IEEE Xplore

- RRI Toolkit

Most of the keywords that were used to find suitable literature are the following:

- climate change

- global warming

- intergenerational communication and global warming

- intergenerational communication about climate change

- intergenerational transmission

- intergenerational play (pervasive games)

- raise awareness about climate change/global warming

- generational differences and its meaning

- how can technology help overcome the intergenerational barrier?

- using technology to connect generations

- technological prototype seeking to re-connect intergenerational relatives

- how to bridge generational differences

- generations conflict ("faule junge, fade alte", "OK Boomer")

- psychology behind climate inaction

- environmental concern

- environmental transmission

- communication patterns

- socializing agents for climate/environmental concerns

- intergenerational equality and climate change

- the dragons of inaction

- from apathy to action

- collective power

- positive computing

- storytelling

- re-imagining the change through positive stories

3.1.2 Semi-Structured Interviews

Goal

The aim of this qualitative research method was to gather first insights into the world of the target audience. The focus was on finding out how people feel about climate change, what they already know and what actions they take. Besides that, the results from this method should serve as a guide for the preparation of the online survey.

Main challenges

While creating the interview guide the main challenge was to keep the questions open, neutral and as simple as possible so that the participants could easily follow and feel comfortable to open up. The first question "Tell me whatever comes to your mind when you think about climate change" was intended to get participants into talking. In the further process a lot of follow-up questions like "Tell me more about that", "Why?", "And what else?" were used to encourage participants to go deeper and move past the obvious top of head answers, to think more. In order not to offend someone or make the participants feel like they are not doing sufficiently against the climate change the closing question was posed form a third person's view. The closing question of the interview reads, "When you think of a person who is not living an environmentally conscious life - what do you think could motivate this person to be more sustainable?".

Procedure

To make sure that the defined questions are good and understandable three **pilot-interviews** were conducted. After the pilot-interviews with the initially defined questions it was obvious that questions like "On a scale from 0 to 10 how much do you actively do against the climate change?" could not be asked without follow-up questions that determine what exactly the participant interprets as sustainable and what he/she believes to have an effect on the climate change. One example from the pilot-interview: the participant stated that he does not eat a lot of meat even though this meant eating meat three times per week. This in fact is not little meat consumption but from the user's knowledge/perception this was little. To avoid such misleading answers the questions had to be modified. After the pilot-interviews the questions got adjusted, and date and time got arranged with the voluntary participants.

The average interview duration per participant was twenty-six minutes. During the interview the participant first received a short briefing on what the study is about. After the short briefing, the participant was asked to sign the informed consent (attached at the end of this document). Each interview was a one-to-one conversation between the researcher and a participant. If approved by the participant the interviews were audio recorded. During the interview the researcher followed the interview guide and depending on the answers some questions were bypassed and some additional were asked. When participants opened up some interesting related topics the researcher allowed spontaneous user-guided conversations. This often led to very interesting insights into

participants thoughts and uncovered some of their behavior patterns. Besides that, the researcher payed attention to the general emotional responses of the participant during the interview. After the interviews all audio recordings were transcribed into an Excel file. Since interviews provide non-numerical data, it was not represented in tables but instead only key points got filtered, and eventually grouped by themes as they relate to the research questions.

Participants

A total of five participants were selected for the interviews. The participants were mainly people from a close social circle of the researcher. The only precondition was that the participant belonged to one of the two generations (Generation Z or Baby Boomers). Eventually, three participants were from the Generation Z and two from the Baby Boomers. Their age ranged from 21 to 60 years.

Final questions

The interviews were held in German. The original questions are attached at the end of the document (see Appendix A). The translated interview guide is the following:

Introduction: "I would like to talk about climate change with you. Would that be okay?"

1) Tell me whatever comes to your mind when you think of climate change.
   a) What feelings does this topic trigger in you?
   b) How affected do you feel? Impacts on your life?
   c) What do you think about the fact that young people are so committed to climate protection?

2) What was the last activity you did for the purpose of climate change?
   a) And what else do you do for it?
   b) Have you ever participated in a climate change event?
   c) What else do you think can we as a society do to stop climate change? What about politicians?

3) Do you feel sufficiently informed about climate change and what you can do about it?
   a) Yes → where do you get your information from; No → what is missing?
   b) Which sources of information do you trust most? (friends, doctors, family, media, government, scientists, ...)

4) How do you eat? (vegan, vegetarian, omnivorous)
   a) Omnivore → how often do you eat meat per week?
   b) What is especially important to you when choosing food? (tastes good, regional, cheap, organic, good for the environment, etc.)

5) How do you normally cover longer distances (over 1 km)?

6) How often do you fly per year?

7) Do you talk with your family about this topic?
   a) What was the conversation about?
   b) Do you feel a difference when talking with your parents/children?
   c) What do you think could motivate a person who is not so environmentally conscious to become more sustainable?

8) What do you think, is there a difference between the attitudes of older and younger generations toward climate change? $\rightarrow$ Why?

9) Is there anything else that concerns you about this topic that you would like to share?
   Thank you so much for your time! How old are you? + Note gender!

3.1.3 Online Survey

Goal

The goal of this quantitative research method was to collect insights about the target audience on a larger scale and test the hypotheses that evolved from interviews:

- **H1:** Active intergenerational communication about climate change in the close social circle fosters sustainable/environmental-friendly behaviour.

- **H2:** Intergenerational communication evolves better understanding of climate change, making individuals feel better informed about the topic.

- **H3:** Youth is considered to be more active and hopeful concerning climate change still being stoppable.

Theoretical facts about this research method are described in the second chapter in Section 2.7.3.

Main challenges

The main challenge during the creation of the online survey was to keep the questions short, focused, clear and as simple as possible so that no misunderstanding could occur. It was important to ensure that the individuals could not misinterpret the questions because otherwise this would not yield any information that is reliable or trustworthy. In total seven days (50h) were needed to select and phrase all questions and response items, divide them into suitable sections and write the motivational closing of the survey. It is worth mentioning that the data obtained from the interviews conducted beforehand were a great help for determining the overall topics of the survey and especially for defining the possible response options for the questions.

Procedure

First and foremost, a brainstorming of possible questions took place. The knowledge from literature research and interviews was used as a guide to phrase and organize the questions. After having defined plenty of questions the next step was to remove duplicates, and check the necessity and intelligibility of each question. In further process thematically related questions got grouped. The online survey was created with *Google Forms*[2]. Google Forms provides the option to create sections, whereby each section is shown on a new page. Within a section different types of questions can be added as well as videos and images. This survey consists of twenty-two questions (two open-ended questions and twenty closed questions) which are divided into nine sections. The structure of the online survey is depicted in greater detail below.

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[2]https://www.google.com/forms/about/

After having conducted several test-runs and proof-reads the survey was ready to go online. The next big step was to find the suitable channel where participants could be recruited. Since this survey is targeting different generations it was important to make it appealing for both target groups and think of a platform where both groups could be reached. Eventually, the survey got published on a Slack channel of the TU Wien and Facebook, where it got reposted by eight others. Apart from that, the author reached out to individuals via private messages (WhatsApp, Facebook and iMessage). The estimated time to fill out the survey was fifteen minutes. A few participants reached out to the author after conducting the survey being interested in further information on the topic. After two weeks of the survey being online and having reached a satisfactory number of participant the survey got closed. The next step was to start with the analysis of it. During the analysis process the author was looking for patterns and relationships between the collected data. The results of the survey mainly got visualized in form of graphs.

Structure

This survey is divided into nine sections. Apart the introductory and closing sections each of the remaining seven sections cover different climate change related information. The sections have the following sub-headings: (1) Introduction, (2) Mood, (3) Activities, (4) Consumption, (5) Climate change details, (6) Information, (7) Improvements, (8) General data, and (9) Food for thought (closing statement).

The first section is dedicated to the "(1) Introduction", where the purpose of the survey is explained and the estimated time is mentioned. The section "(2) Mood" is focused on finding out about the general feelings of the participant toward climate change. The survey starts off with an open-ended question so everybody feels free to describe whatever comes to their mind with no restrictions. The next section "(3) Activities" tries to find out how active the participants are and how much of the activities they do are for the purpose of climate protection/environmentalism. The section "(4) Consumption" examines how the participants ply with the natural resources in their daily lives. The topics that are addressed in this context include heating, meat and dairy goods and transportation. The next section "(5) Climate change details" aims to determine how affected the participants feel by climate change. It was noticeable during the interviews conducted beforehand that some participants tend to believe that for example avoiding plastic bags has a greater impact on the climate change than consuming less meat even though studies show that this is not correct [WN17]. To find out how the responses on that concern are on a larger scale the task to prioritize several countermeasures (avoiding plastic bags, living car-free, flying once less, etc.) by impact-factor on climate change were included in this section of the survey. Unfortunately, not all participants answered the question in the anticipated way. Even though they were requested to give each countermeasure a unique priority, participants often assigned the same priority to different countermeasures. The section "(6) Information" has the purpose to determine how satisfied the participants are by the amount of information they are provided around this topic and which information-sources

they trust most. The section "(7) General" collects personal data of the participant including age, gender and concludes with the following open-ended question: "What is the message that you would like to give to our society?". This enables the participants to sum up their thoughts and share their opinions on the topic of climate change. The final section thanks the participants for taking their time to fill out the survey and offers them some "food for thought". While phrasing the final message (food for thought) it became obvious how hard it is to communicate a message and decide on a perspective from which the message will be narrated. One and the same message can be framed from different perspectives (negative consequences, health, nature, possible positive changes, etc.). Each perspective may be disparately effective for different audience. The previously conducted literature research about strategies that help communicate climate change (see Chapter 2, Section 2.2) highlights the significance of keeping solutions and benefits front and center, making people feel like they can be part of the solution. Based upon these insights the author decided to put forward a inspiring, positive vision. The main goal was to fire participant's imagination of a more sustainable, better and healthier future.

Participants

The survey was online for sixteen days (27.03.2020 - 12.04.2020) and a total of 110 participants took part. Due to COVID-19 pandemic curfews and quarantines the survey most likely profited because participants were mostly at their homes and therefore the response rate was relatively high. 32 out of 36 participants that the author privately reached out to reported having completed the survey. Since not all participants have been contacted via private messages, but also over social media, it is hard to calculate the exact response rate.

Out of 110 participants, 66 (60%) were females, 42 (38,2%) were males and 2 (1,8%) did not want to reveal their gender. The Table 3.1 represents the age range and gender distribution of participants.

Age range	Age range distribution	Gender distribution
10-25	55 (50%)	36 female; 17 male
26-40	33 (30%)	16 female; 17 male
41-55	11 (10%)	7 female; 4 male
56-74	11 (10%)	7 female; 4 male
	110 (100%)	60% female; 38,2% male

Table 3.1: Age range and gender distribution of participants.

Final questions

The online survey was created in German especially because the survey was distributed in Austria and the target audience included older generations so English could not be

seen as given. The translated questions are attached at the end of the document (see Appendix B).

3.2 Findings (Define)

After gaining insightful knowledge about the target audience the next step was to define the core problem. During this stage the results from the empathy stage are synthesized and unpacked into compelling user needs and desires. In this chapter, the findings from the two user research methods are represented and the main design challenge for the ideation phase is formulated.

3.2.1 Semi-structured interviews

The findings from semi-structured interviews were analysed using thematic analysis and represented in form of empathy maps. Empathy mapping is one technique that can be used to represent qualitative data. In general, it captures the knowledge about user's behaviors and attitudes into four quadrants[3]: (1) says, (2) thinks, (3) does, and (4) feels. A more detailed explanation about this technique can be found in the second chapter in Section 2.7.4. Empathy maps that can be seen on the following pages were created using the online tool Miro[4].

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[3]https://www.nngroup.com/articles/empathy-mapping/
[4]https://miro.com/ux-tool/
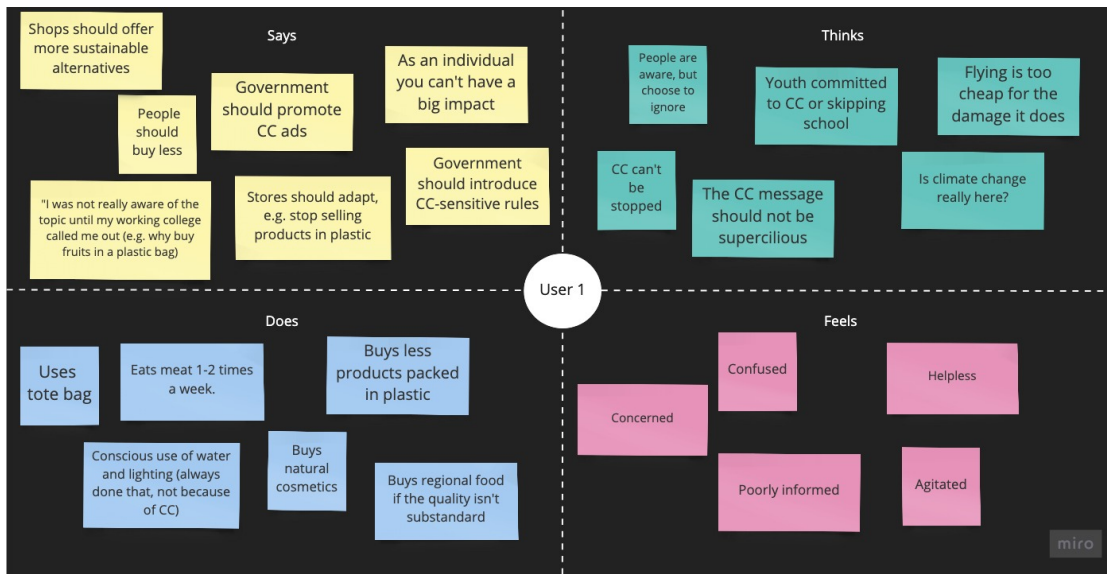
Figure 3.4: Empathy map: User 1
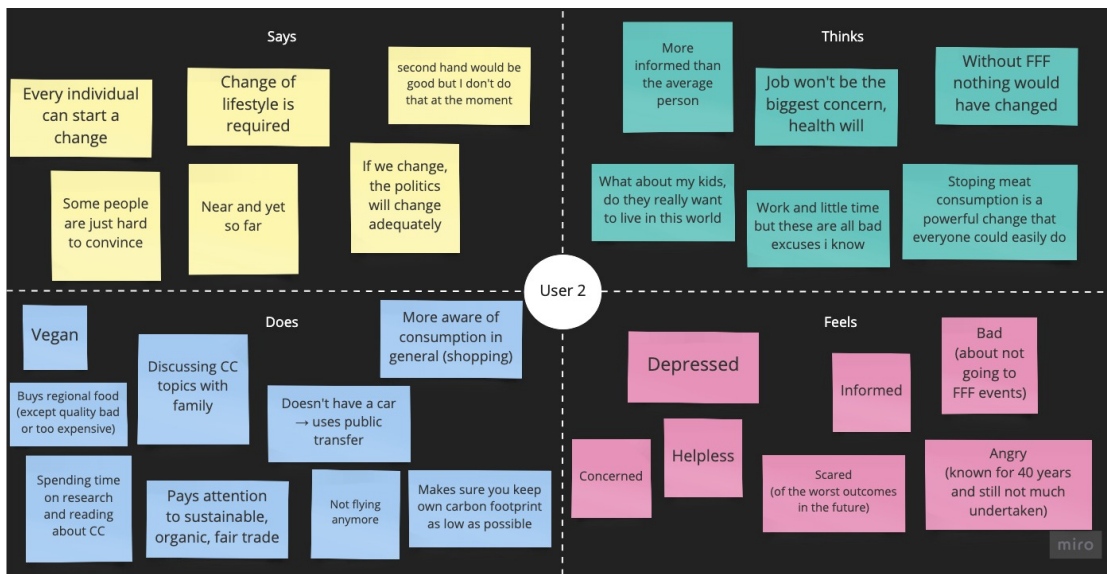
Figure 3.5: Empathy map: User 2
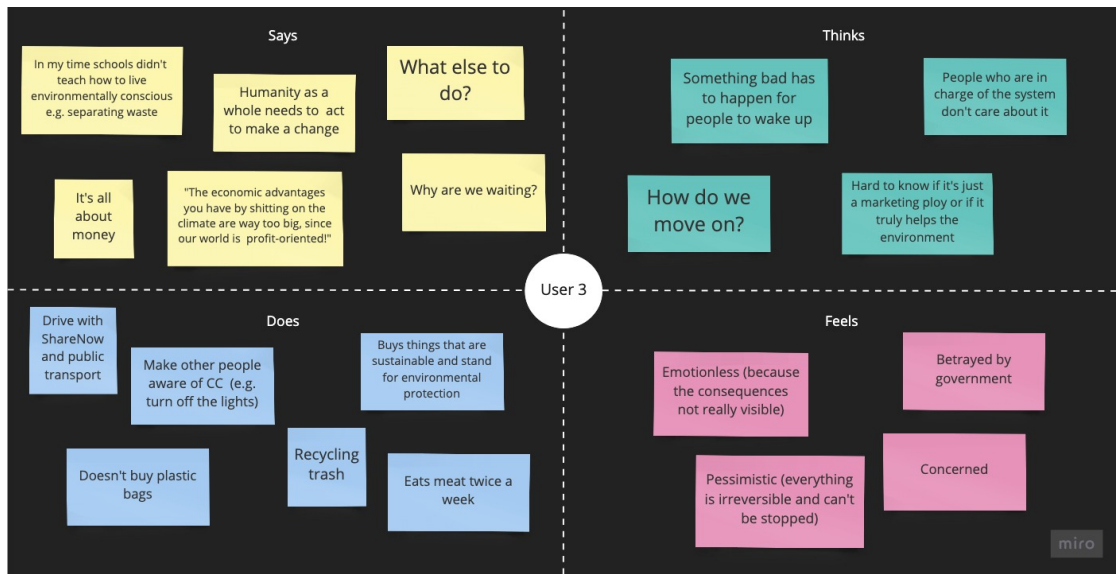
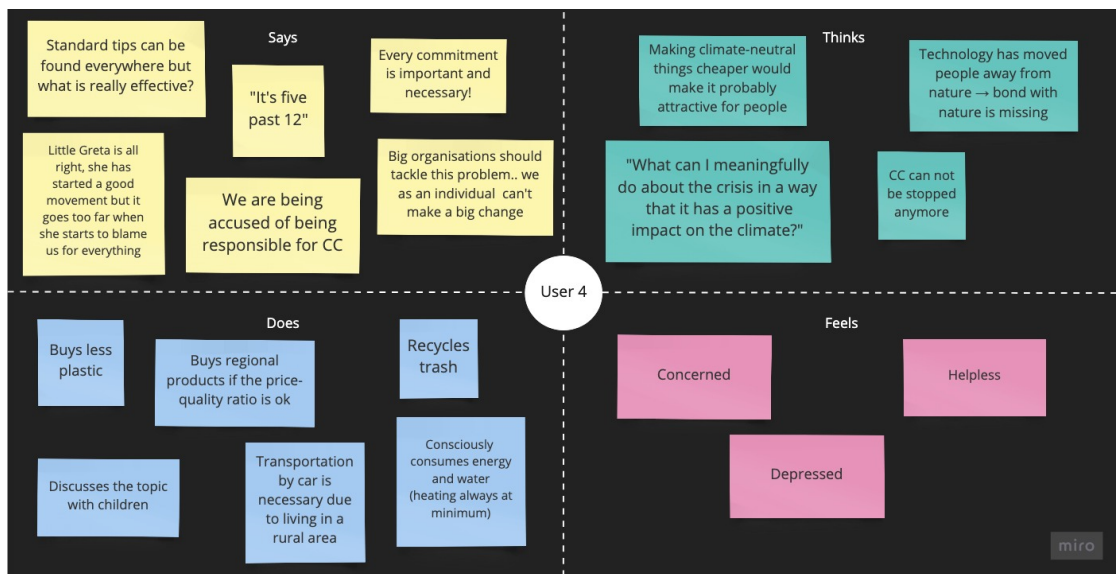Figure 3.6: Empathy map: User 3

Figure 3.7: Empathy map: User 4

In general, four out of five participants said at the beginning of the interview "I do not think that you selected the right person for this. I am not doing that much for the purpose of climate change". Besides that, all participants were sure that climate change is happening, that it is an important issue and that it puts our society at danger.

Negative emotions

Participants' feelings and first thoughts toward climate change were relatively negative. Often participants expressed being concerned, helpless, angry, poorly informed and pessimistic. Besides that, their first thoughts often included phrases like: "we're doomed", "too late", "too much CO2", "apocalypse", "downfall", "melting glaciers", "weather extremes", etc.

Barriers

Interesting insights could be gathered when the participants were asked if they have ever been to a climate event/demo. Since all participants answered that they have not attended any demo it was interesting to hear the reasons to it. Even though all participants stated that climate change is such a crucial topic and that it endangers their and the lives of others they would respond to the action of going to a climate-event (Fridays for Future) as follows: "I do not have time to do that" or "I believe there are other things that can be done instead of doing something like that". This represents a conflict between own personal goals and climate goals (see user 1 and 2 - Figure 3.4, 3.5). Also other barriers to inaction could be observed:

- Change unnecessary, e.g., "One individual can not really change something." (see user 1 and 4 - Figure 3.4, 3.6)

- Interpersonal relations, e.g., "My mum does not want me to be vegan → not healthy." (see user 3 - Figure 3.7)

- Lacking Knowledge, e.g., "I feel overwhelmed by the information overload → hard to find what is really effective." (see user 1 and 4 - Figure 3.4, 3.6)

- Tokenism, e.g., "I am paying attention to my consumption, so I don't think that I need to go to such [climate] events." (see user 1 - Figure 3.4)

- Blaming others, e.g., "Politicians and big companies are the ones who need to act." (see user 1 and 3 - Figure 3.4, 3.7)

Conflicts between generations

Furthermore, conflicts between the two generations, Generation Z and Baby Boomers, could be observed. Older participants (aged 56+) stated being blamed by the younger population for the current climate consequences and for leaving the world in such a bad state for other generations. The user 4, who is an older adult (see Figure 3.6) stated: "little Greta is all right, she has started a good movement but it goes too far when she starts to blame us [older generations] for everything". The participant also added "youngsters spend hours and hours on their phone that for sure is also not good for the environment".

Younger generations indeed often mentioned that they believe that older generations are not so after improving the current situation even though they were the ones that were part of the system construction. An interesting insight was that all of the younger participants stated that the opinions and actions toward climate change are the same within their families and that there are no big really differences between them, their parents and other family members. However, still when they would generally talk about older generations in relation to climate change they would state that they are not really into the topic and do not really care of what the result would be.

3.2.2 Online survey

Mood

The section represents participants' first impressions on climate change. Since the answers were relatively short and some answers occurred repeatedly it seemed suitable to use a word cloud[5] to represent the data. The Figure 3.8 visualizes the word cloud with participants' first thoughts on climate change.

Figure 3.8: Insights into participants' first thoughts on climate change.

The Figure 3.9 illustrate the feelings that the participants have toward climate change in comparison to the feelings they have toward COVID-19 pandemic.

Additionally to the predefined options participants added several more answers to describe their feelings. For climate change four additional feelings were noted:

- Lack of knowledge

- Grief

- Disappointment

- Challenging

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[5]https://www.jasondavies.com/wordcloud/

What feelings are triggered in you when you think of climate change/COVID-19?

Figure 3.9: Comparison of participants' feelings toward climate change and COVID-19 pandemic.

For COVID-19 pandemic the following feelings were mentioned in addition to the predefined options:

- Anger towards people who do not take it seriously

- Team-spirit

- Irresponsibility

- Frustration

- Serenity

- Amusement

- Confusion

- Guilt

- Nothing special

- Fooled

- Hard to grasp the whole thing

- Confused about what is gonna happen with the economy

- Eye-rolling sensation

- Stunned how easily people can be manipulated by their fears

Activities

The following subsection represents the personal measures that participants take to fight climate change. The results indicate that the participants are already involved in several climate-friendly actions. However, it can be seen that the reasons and motivations behind participants' actions vary.

The majority of participants stated that they switch off lights (79,09%) and turn off water (73,6%) when they no longer need it because they have always done that. In addition to that, almost half of the participants confirm that they switch off lights (41,82%) and turn off water (46,36%) to protect the environment. Besides that, saving money was another relatively often mentioned reason for switching off lights (37,27%) and turning the water off (26,36%). A small percentage also mentioned that they do it because others have inspired them to do so (water - 8,18%, lights - 4,55%). In comparison to that more than a half of participants (52,73%) states not to turn down the heating when leaving the house for more than two hours. Those participants that turn down the heating name following reasons - to save money (28,18%), to protect the environment (26,36%), inspired by others (4,55%) and for health reasons (1,82%).

60% of participants stated to separate waste because they have always done that and even a higher percentage of participants (65,55%) stated to do that to protect the environment. 13,64% state that they got inspired by others to separate waste. A very small percentage of participants declare that they separate waste to save money (4,55%), for their health (3,64%) and 2,73% state that do not do it at all.

Regarding food consumption, almost half of the participants (44,55%) state that they deliberately buy regional food to protect the environment. Others note that they do it for their health (29,09%), out of habit (25,45%), others have inspired them to do so (20,91%) and 18,18% state that they do not do it at all. Similarly, 34,55% participants state that they eat less meat to protect the environment. On the opposite, 34,55% participants stated that they consume meat more than two times per week.

Among participants, the choice of environmentally friendly transport (bike or public transport) appears to be relatively common. Half (45,5%) of participants say that they have always done that and/or that they do it to protect the environment. Other smaller percentages state to do it because of following reasons: to save money (25,45%) and for their health (25,45%). Only 15 participants (13,6%) do not choose environment-friendly transportation.

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Besides that, two thirds of participants (69,1%) stated not being politically committed for climate policy. The involvement in politics related concerns, in fact, increases with age. Half of the participants of older age groups (54,5%) state to be committed in climate policy, whereas in case of younger participants (<25 years) the percentage sinks to 18,2%.

A total of 24 participants (21,8%) state having participated in a climate change event or demo like Fridays for Future. Surprisingly, the number of younger participants attending a climate change demo/event in percentage is the lowest (15% compared to approx. 27% across other generations).

Besides that, the results reveal that participants are actively discussing the topic of climate change in their close social circle. The Figure 3.10 reflects participants' answers on how often they discuss about climate change related topics.

How often do you discuss climate change related topics with people from your social circle?
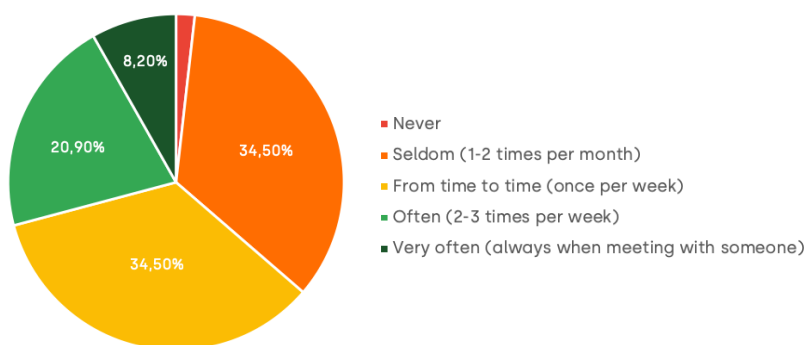
Figure 3.10: Frequency of discussions about climate change related topics in social circles.

Within this context, two thirds (63%) of the youngest participants (< 25 years) state to usually discuss about climate change solely with peers (people of same age +/- 3 years). Unlike the youngest group of participants, almost two thirds of the older age groups state to discuss with both younger as well as older people. Besides that, the remaining one third of the oldest age group (56+) say that they usually discuss with younger people.

Besides that, participants were also asked to reveal which climate-friendly activities they will start or continue to do in the next six months. The results show that participants are widely willing to participate in climate-friendly activities. The highest percentage of participants stated to be willing to separate and recycle waste (87,3%), avoid plastic

products (80,9%) and buy local and seasonal food (77,3%). These activities are followed by the ones below:

- Consume less meat (61,8%)

- Use a bicycle - more often, instead of a car (58,2%)

- Use public transport - more often, instead of a car (57,3%)

- Consume less in general (57,3%)

- Reduce waste in general (57,3%)

- Lower energy consumption (42,7%)

- Reduce air travel (35,5%)

- Inform myself more on the topic (34,5%)

- Procure green energy (26,4%)

Consumption

While observing different consumption patterns (energy, shopping and food) of participants several insights could be collected. All in all, 10 participants (9%) reported eating no meat. Remaining participants who agree consuming meat and other animal-based products do that to varying degrees. The Figure 3.11 represents the distribution of answers.

Climate change details

This section depicts participants' perception of climate change and its countermeasures. Based on a 5-point Likert-scale[6] the participants stated that they agree (average score of 3,96) to feel affected by climate change. The statement that the process of climate change is stoppable reached an average score of 3,14 (neither agree nor disagree). The results do not show major differences between genders and the different age groups. Furthermore, participants were asked to prioritize given climate change countermeasures by impact strength. On average the participants ranked the countermeasures as following (descending order): (Prio A) live car free, (Prio B) no meat consumption, (Prio C) buy regional and seasonal food, (Prio D) fly once less, (Prio E) procure green energy and (Prio F) avoid plastic bags. According to a study by Wynes et al. [WN17] the correct prioritization would be: (Prio A) live car free, (Prio B) fly once less, (Prio C) no meat consumption, (Prio D) procure green energy, (Prio E) buy regional and seasonal food and (Prio F) avoid plastic bags.

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[6](1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree
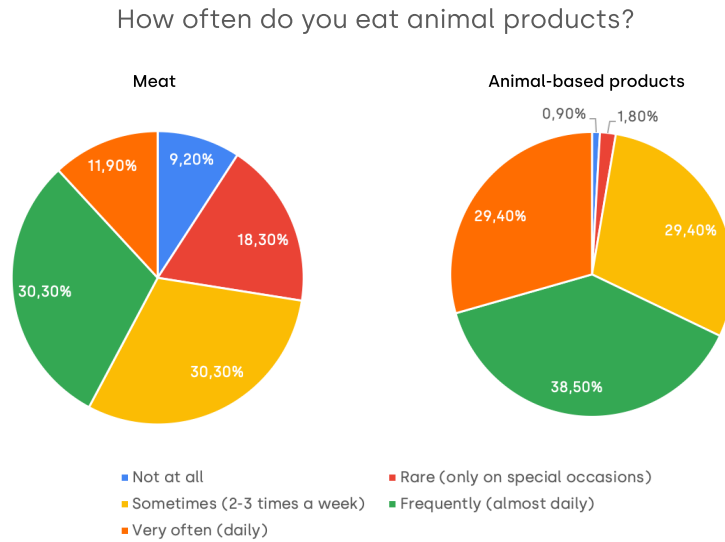
Figure 3.11: Frequency of meat and animal-based products consumption.

The results across different generations are visualized in the Figure 3.12. When looking at the figure it can be seen that several aspects are estimated differently across generations. Unlike all other age groups who gave the countermeasure "living car free" the highest priority, the group of older respondents (aged 56+) gave this countermeasure the lowest priority. Besides that, older respondents (aged 56+) gave the countermeasure "avoid plastic bags" with the same priority as "procure green energy".

Moreover, participants believe that everybody should be doing something to combat climate change. (1) International or global organizations, (2) companies and large organizations, and (3) the government are considered to be the most important entities for this purpose. On a 5-point Likert scale[7] those three entities reached an average score of 4,7. Closely followed by the remaining two entities "citizens" and "teachers and professors" with an average score 4,3.

Information

Participants were asked to rate two statements on their level of information on a 5-point Likert-scale (1 - "not applicable" and 5 - "very applicable"). On average participants stated to be moderately to well informed about climate change and its countermeasures. The average value for the statement "I feel sufficiently informed about climate change" is 3,46 (including 15 participants who stated to feel very well informed). Interestingly, older participants stated to be better informed than the younger generations (3,4 compared

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[7](1) Not important at all; (2) Not important; (3) Moderately important; (4) Important; (5) Extremely important
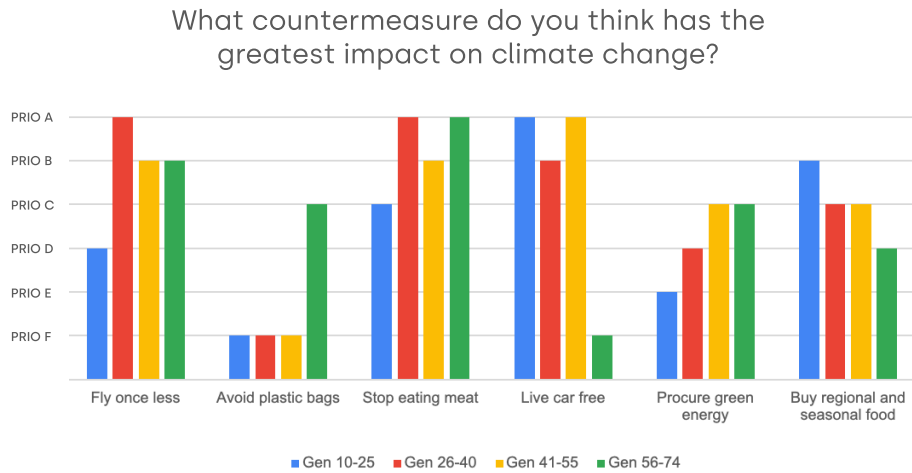
Figure 3.12: Comparison between different age groups' ranking of countermeasures by impact of strength on climate change. (Prio A - highest impact; Prio F - lowest impact)

to 3,8). The answers on the second statement "I feel sufficiently informed about the possibilities on combating climate change" result in a average value of 3,27 (including 12 participants who stated to feel very well informed).

Besides that, when looking at the total aggregate of respondents' answers to what they consider to be the most trustworthy social agent for climate change information they rank scientists the highest and environmental organizations are on the second place. The Figure 3.13 visualises the results of all social agents based on a 5-point Likert-scale[8].

Improvements

This section discusses the results from the survey that tackle participants' most preferred ways to learn about climate change and its countermeasures. The results indicate that participants' most preferred ways to learn more about climate change involve: (1) (together with) others, (2) hearing, (3) interactive elements, and/or (4) reading. The Figure 3.14 visualizes the results.

Comparing results separately per generation revealed that the top four categories ("together with others", "hear", "interactive" and "read") retain highest popularity. Interestingly, however, younger participants tend to prefer "speaking" as ways to learn more about climate change much more than older participants (9% compared to 35%).

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[8](1) Strongly distrust; (2) Distrust; (3) Moderately trust; (4) trust; (5) Strongly trust
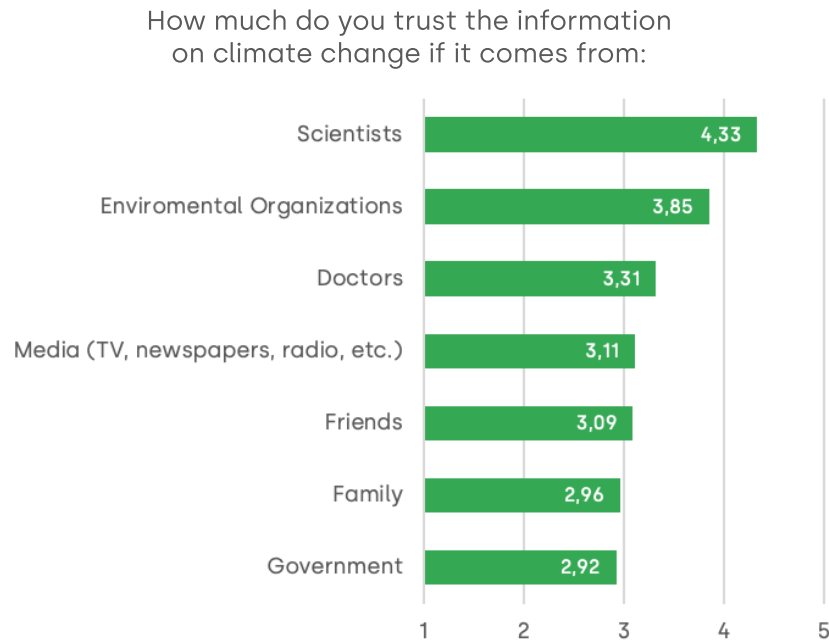
Figure 3.13: Trusting sources for climate change information represented in a descending order by their mean score based on a 5-point Likert-scale.

Inspiring messages to the society

In the final part of the survey participants were asked to leave a message to the society ("What is the message that you would like to give to our society?"). This section represents some inspiring answers that participants gave on that question. The reason why the author asked this question is due to the interest of how the society would communicate about climate change and figure out which they would most likely address during a communication. The resulting messages can be thematically clustered into the following categories: (1) reduce resources, (2) individual action, (3) collective power/action, (4) harmony with nature, (5) system change, (6) self-reflection, (7) critical thinking, (8) big picture, (9) positive outlook, and (10) empathy for future generations. The Figure 3.15 visualises the process of the thematic analysis. During the analysis it was tracked how the answers and attitudes differed per generation. Therefore, the Figure 3.15 also includes the counting of messages per generation that fall into the given category. Unlike individuals from younger generations, who mainly framed a message that addressed different types of individual and collective actions, the older generation motivated self-reflection. Their messages fostered a reflection of own behaviour and a change of it. Besides that, and interesting minor characteristic that could be observed throughout the messages it that answers of the two older generations, Generation X (aged 41-55) and Baby Boomers (aged 56+), were significantly shorter than in case of younger generations.

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In what way would you like to learn more about
climate change and its countermeasures?

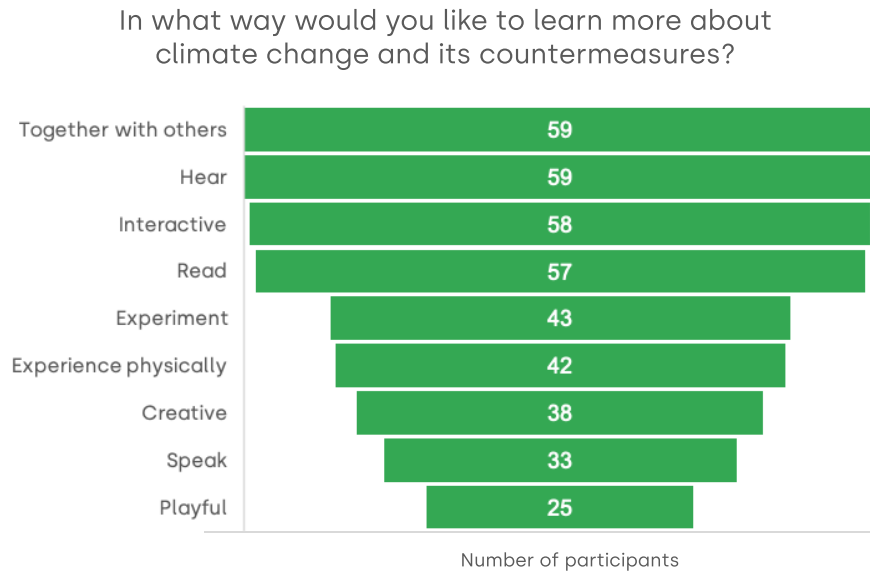|	
Together with others	59
Hear	59
Interactive	58
Read	57
Experiment	43
Experience physically	42
Creative	38
Speak	33
Playful	25

Number of participants

Figure 3.14: Comparison of different techniques for dissemination of information represented in a descending order.

All messages that were mentioned by the participants have been translated in English and are listed below (structured in thematically related clusters). Each quote begins with a number and a letter that represents the corresponding generation: Z - Generation Z (aged < 15), Y - Generation Y (aged 26-40), X - Generation X (aged 41-55) and B - Baby Boomers (aged 56+). The original quotes can are attached at the end of the document (see Appendix C).

Reduce resources
Q1-Z: "Consume less meat"
Q6-Z: "Stop buying unnecessary stuff!"
Q10-Z: "What about spending hours on electronic devices, always needed to be new, etc. that is not really sustainable and also harmful for the climate"
Q14-Z: "Avoid disposable plastic as far as possible, improve bicycle paths and public transport."
Q17-Z: "Climate change is unavoidable, but it can be massively slowed down by avoiding cruise ships, air traffic and cargo ships and by boosting the regional economy."
Q19-Z: "Reduce meat consumption, live more down to earth and close to nature again"
Q20-Z: "Be more aware of resources and consumption"
Q25-Z: "Climate change affects us all, because our living space is affected. We must make a greater effort to create awareness in the population and in the economy so that we can stop climate change together! Everyone should make a contribution in their everyday life,
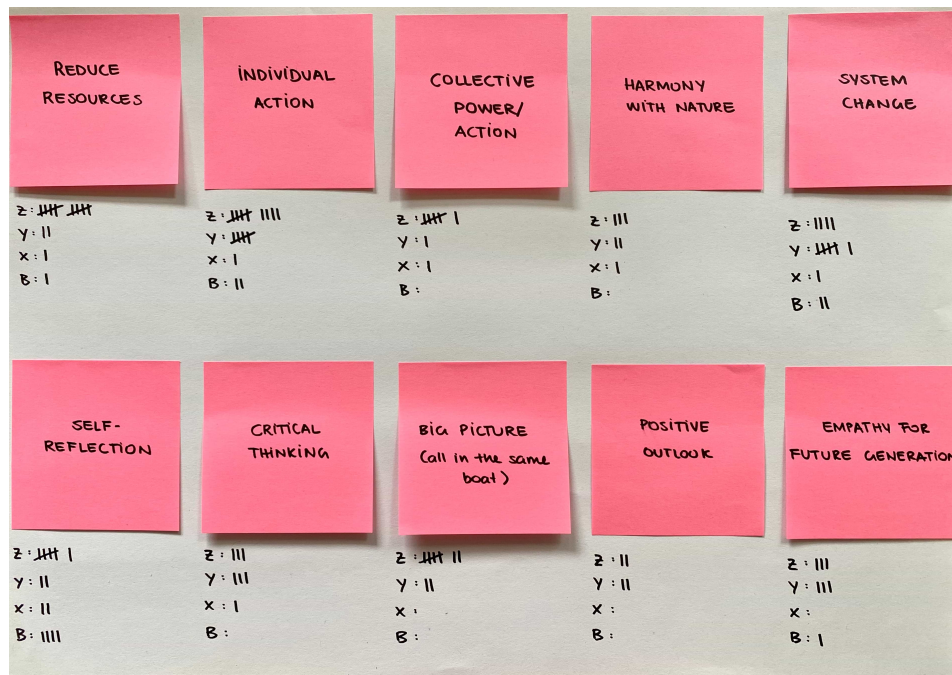
Figure 3.15: The analysis of participants' messages to the society.

e.g., by using public transport or reduce meat consumption, and finally start acting."
Q32-Z: "Paper or cardboard boxes need very long wood fibres to carry the weight of our purchases, to make them profitable you need an unreasonable amount of water and wood material, no matter if paper or plastic - disposable is always shit"
Q38-Z: "Companies could reduce climate change by having less employees fly to customers and offer more online meetings (as could be seen in the times of Corona this is possible)."
Q4-Y: "If society is meant to be an association of people and not an organisation: That you can cover small distances by bike instead of by car. On the way to and from work in general makes a great deal of CO2 savings over the year."
Q17-Y: "More care and less consumption"
Q1-X: "More aware attitude towards the environment"
Q4-B: "Walking or cycling, preferring goods without plastic packaging, regional and seasonal shopping"

Individual action/impact
Q4-Z: "We don't need to experience a catastrophe to start living healthier. Small changes by each individual can turn the world into a better place for everyone"
Q11-Z: "Every little action can make a change"
Q13-Z: "I believe that if each individual incorporates a little more environmental awareness into their own lifestyle, a lot of positive things can be created"
Q23-Z: "Waste recycling is important"

Q24-Z: "Do what you can."

Q26-Z: "I think that only together something can be done against climate change, but each individual must make a contribution"

Q27-Z: "Everyone can contribute to it"

Q31-Z: "Also small steps can make a big difference"

Q34-Z: "Each individual can contribute in reducing the consequences of climate change, and this must finally get into people's heads! A lot is about individual behaviour, and more needs to be done to educate people about this & convey the seriousness of the issue."

Q1-Y: "Climate change affects us all and should be seen by society as the most important problem to be solved. Solutions need to be found that are both environmentally and economically sound. Even if the main impetus should come from politics, each individual can make a contribution and should not underestimate the impact of their own actions."

Q11-Y: "Inform yourself more about climate change."

Q13-Y: "Every individual can and must do something to counteract climate change"

Q14-Y: "Keep on informing people"

Q21-Y: "Everyone should make an effort to live more sustainable"

Q4-X: "It all starts with your own change"

Q3-B: "Every commitment is important and necessary!!!!"

Q6-B: "Pay attention to what you can do and do it"

Collective power/action

Q2-Z: "We, the willing, must clean our own mess and the mess of the unwilling."

Q26-Z: "I think that only together something be done about climate change, but each individual must nevertheless make his/her contribution."

Q35-Z: "We can do this!"

Q36-Z: "The entire world has to work together, it's no use if, for example, only Europe is addressing the issues"

Q37-Z: "If we all make an effort and pull together we can move a lot and save our future."

Q40-Z: "We are all in the same boat. Let's make a change!"

Q27-Y: "Together we can do this - from small farmers in the south to big company leaders in industrialized countries."

Q7-X: "Strengthen the sense of connectedness!"

Harmony with nature

Q19-Z: "Reduce meat consumption and live more down-to-earth and close to nature again"

Q25-Z: "Climate change affects us all, because our living space is affected by it. We have to do more to create awareness in the society and in the economy, so that we can stop climate change together! Everybody should make a contribution in their everyday life by, e.g., using public transport or reducing meat consumption, and finally take action"

Q42-Z: "Mankind is not above nature just because we are supposedly more intelligent

than the rest of living creatures."

Q8-Y: "More awareness for the nature."

Q18-Y: "Living in harmony with nature."

Q6-X: "We need to feel and understand that we are connected to nature in an ecosystem and cannot place ourselves above nature."

System change

Q9-Z: "I would like to see the society and especially the government act and react as drastically and raise awareness about climate crisis as they did during the corona crisis"

Q17-Z: "Climate change is inevitable, but it can be massively slowed down by starting with cruise ships, air traffic and cargo ships and by boosting regional economy."

Q28-Z: "The abolition of capitalism"

Q38-Z: "Companies could reduce climate change by having less employees fly to customers and offer more online meetings (as could be seen in the times of Corona this is possible)."

Q1-Y: "Climate change affects us all and should be seen as the most important problem to solve. Solutions must be found that are both environmentally and economically sound. Even if the main impetus should come from politics, each individual can make a contribution and should not underestimate the effects of his/her own actions."

Q7-Y: "Climate change is at its core a socio-economic structural problem of capitalism. Growth can only happen through exploitation (whether in the form of labour or natural resources) and inevitably generates higher emissions -> this is already laid down in Marx's formula G-W-G. It remains open what this implies."

Q9-Y: "The greatest resistance to sensible measures to mitigate climate change is caused by neoliberal approaches. Capitalism, like climate change, must be combated creatively, only then do we have a chance to force a major rethinking at the political level."

Q10-Y: "The energy from the fight against the Corona crisis needs to be taken into the fight against climate change"

Q12-Y: "It is time to change something"

Q20-Y: "Money makes ugly"

Q2-X: "Transparency and measures regarding climate are needed"

Q5-B: "We must find the right way to stop climate change and at the same time ensure that the economy is not disadvantaged. If some things are really harmful they should be banned and not just talked about."

Q7-B: "The change to a democratic socialism"

(Self-) Reflection

Q7-Z: "It affects all of us and not just the next generation or even the generation after next"

Q8-Z: "Pay more attention to the environment and objectively question own lifestyle"

Q15-Z: "More awareness and understanding of the fact that we are all affected by climate change and that we must act accordingly"

Q18-Z: "Everyone should at least make an effort to deal responsibly with the available

resources and not just think in their own small frame"
Q29-Z: "Change always starts with oneself."
Q45-Z: "Try to act more aware and sustainable."
Q3-Y: "A little more modesty would not hurt anyone."
Q20-Y: "Money makes ugly."
Q4-X: "Everything starts from your the transformation of oneself"
Q5-X: "Live more aware and shop food from local farmers"
Q1-B: "Start thinking!"
Q2-B: "Living more consciously"
Q9-B: "There is enough for everyone, but not for our greed"
Q10-B: "We should do more"

Critical thinking
Q16-Z: "One should take a closer look at the whole situation. For example, cars are presented as the scapegoat for bad climate because of their emissions, although the emissions of modern cars through filters and catalytic converters are often already of the same quality as the air we breathe. Furthermore, electric cars or battery-powered cars are not the solution to climate problems, on the contrary."
Q22-Z: "The society should orient itself more towards scientific publications."
Q22-Y: "Critically question statements (what motivation does this person have?)"
Q23-Y: "Research the origin of the article in the media - what is author's motivation? Who pays him/her?"
Q24-Y: "Think for yourself and form an opinion"
Q8-X: "Look beyond your own nose and try to see how everything is connected to everything else."

Positive outlook
Q3-Z: "Let's do things now and pay more attention to how we handle with the resources! Let us create a new future in which we want to live! Create new spaces where we can create things together and be inspired."
Q35-Z: "We can do this!" Q5-Y: "A more sustainable, decelerated and fairer world would benefit us all"
Q27-Y: "Together we can do this - from small farmers in the south to big company leaders in industrialized countries"

Empathy for future generations
Q21-Z: "Thinking also about other people - thinking about the future of our children"
Q33-Z: "Climate change is not just something that affects us, it also affects the generations to come. We have to wake up and finally understand what the earth provides us and that not only we but also the developing countries suffer from climate change. WAKE UP PEOPLE!"
Q39-Z: "Hope for our own children"

Q6-Y: "Think about the environment for our children and grandchildren"

Q15-Y: "I read a saying the other day that said something about how much solidarity is being shown towards COVID-19 in relation to older and weaker people and how little is being shown to the younger generation in relation to climate change. This saying made me very thoughtful and I would like to pass it on."

Q28-Y: "I pray for us and our children."

Q8-B: "Think of all and take responsibility."

Big picture (we are all in the same boat)

Q7-Z: "It affects all of us, not just the next or even the generation after next"

Q12-Z: "Climate change affects all of us, even if we are sometimes unaware of it."

Q30-Z: "Better safe than sorry"

Q40-Z: "We are all in the same boat. Let's make a change!"

Q41-Z: "Act less selfishly"

Q43-Z: "Take care about others"

Q44-Z: "In order for 10 people to make trillions of dollars, trillions of people and animals are suffering, and they are not the ones to blame for."

Q16-Y: "Climate change affects us all."

Q19-Y: "Think more about the community than individuality."

3.3 Design Challenge (Define)

To address the aims of this thesis and be able to develop a possible solution the following design challenge was defined to guide the ideation phase:

How might we design a technology that encourages older and younger generations to communicate with each other about climate change (focus on related benefits and positive outcomes)?

Focus on:

- intergenerational communication

- enabling reflection and imagination (re-imagination of our needs)

- related benefits

- human flourishing

- interactive digital future

- open-ended exploration

- together with others

- emotional

- storytelling

- compassion

- move from apathy to action

- system change

- notice, validate, envision and concertize

- introducing climate change as an issue that we can do something about

- overcoming apocalypse fatigue

- make both generations feel being part of the solution

- compassion

Intended outcome: younger and older generations benefit from their diverse values and get better understanding of climate change and its possibilities. As could be observed in the outcomes of the survey an increased communication about climate change could eventually lead to more sustainable behaviours.

CHAPTER 4

Implementation (Prototype)

Insights from previous steps, literature review and empirical research, were applied to build the final prototype. This chapter describes the procedure of the implementation part. First the extensive ideation phase is described (Ideate). After that the process of bringing the best idea into the real world by giving it a physical form is depicted (Prototype). The final section of this chapter represents results from the testing phase of the prototype where feedback from end users was collected (Test).

4.1 Ideation (Ideate)

Continuing on the defined design challenge in the previous chapter the ideation phase launched. To recap, the design challenge was: *How might we design a technology that encourages older and younger generations to communicate with each other about climate change (focus on related benefits and positive outcomes)?* At this step the author focused on the process of converting problems into potential solutions. The goal was not to develop a refined solution, but rather collect as many ideas as possible. So, this phase opened the thinking spectrum again with the aim to find as many alternative ways as possible to improve cross-generational communication around climate change.

An extensive brainstorming took place where ideas that came up were shortly documented and sketched. First, the method "Crazy 8" was applied to get into the topic and generate different ideas within a short period of time (see Figure 4.1).

Besides that, one ideation session was conducted following the *10 plus 10 method* [GCMB11]. This method starts off with quick sketching of around ten ideas (see Figure 4.2). The best idea from those is selected as a starting point for the next round. In the second round ten variations are made from the selected idea.

After the second round again the best idea/solution is selected and can be represented in a more detailed manner.
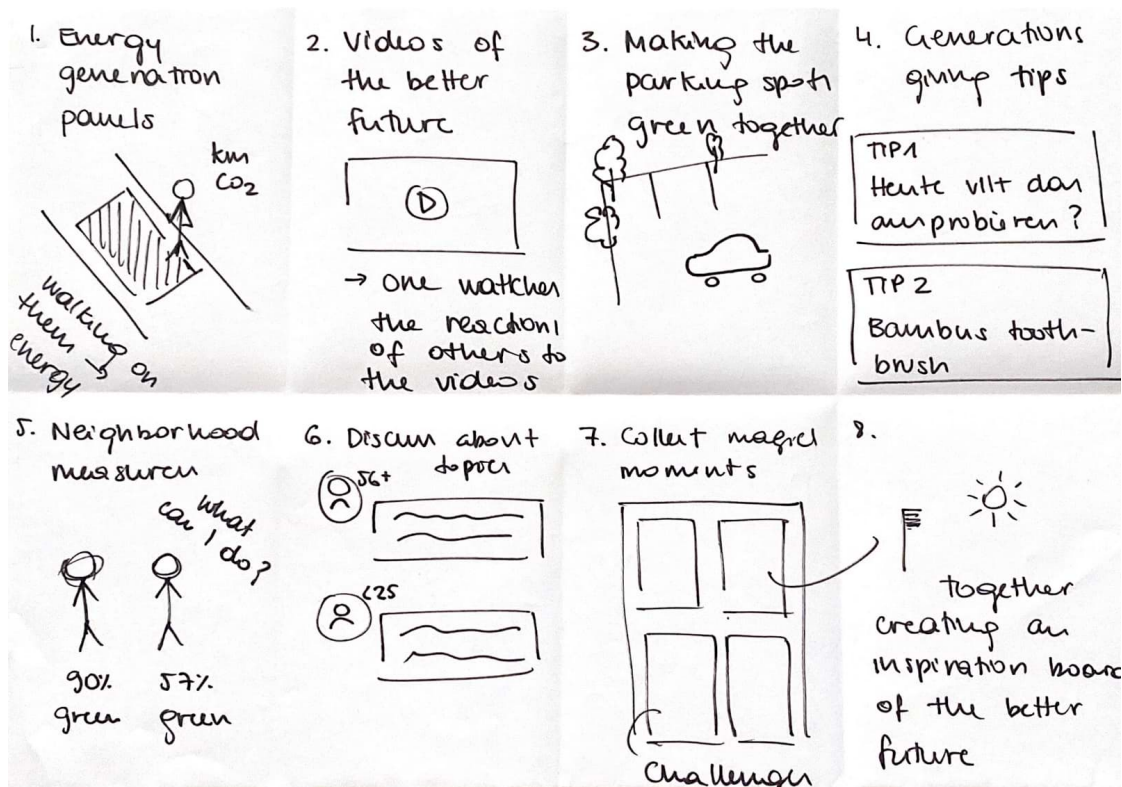
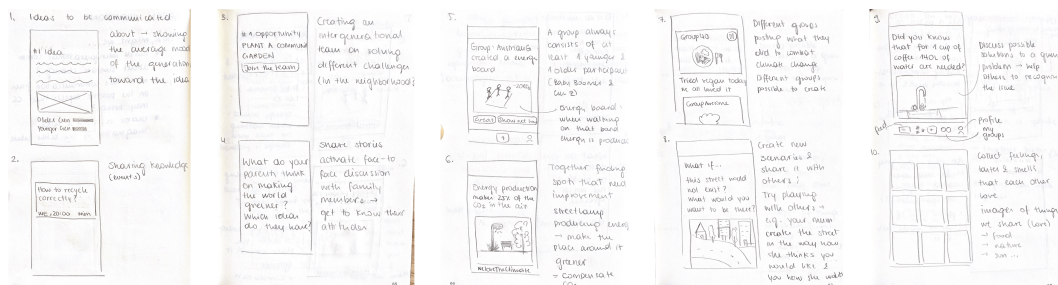Figure 4.1: One of the ideation phases conducted with the "Crazy 8" ideation method.

Figure 4.2: First part of the 10 plus 10 method during ideation.

4.2 Prototyping (Prototype)

In the prototyping stage the elaborated idea from the ideation phase was brought into the real world and made testable by transforming it into a digital prototype. In this section, first, a detailed description of the idea is provided and then the creation process of the prototype is depicted.

4.2.1 Definition of the Idea

The final idea that evolved from the ideation phase is focused on intergenerational communication around climate change and tries to boost individual's imagination around solutions and opportunities for creating a better future. The goal is to move mindsets away from fear, problem conflict to solutions, possibilities and collaboration. The reason why this positive approach with the focus on well-being was chosen, bases on findings from literature review and empirical research that indicated that people currently show mainly negative emotions toward climate change and that framing the climate story from a more positive perspective may trigger people to get active. Besides that, integrating positive computing aspects can boost well-being of individuals in general. The main idea is the following: individuals create stories of the better future within cross-generational teams of any size, consisting of at least one youngster (aged <25) and one older adult (aged 56+). The team member that starts creating a story is the so called story-master, who sets the title/topic of the story and adds her/his first frame to it. A frame can be anything from photos, facts, text and sound. After that the story is sent to the team and each team member has to either add one additional frame to it or react to any of the frames by liking or commenting. By default, a team has two weeks time to finish the story except the story-master defines it differently. The story is marked as done when each team member actively added something to it or reacted by liking/commenting. When the story is done it can be published publicly so that others can get inspired from it as well. Besides that, this platform offers the possibility to check the mood of the team members about climate change and what makes the team members happy.

4.2.2 Low-Fidelity Prototype

First a low-fidelity prototype was created to allow a quick possibility to test and validate the idea. The goal was to make a prototype that is just real enough to get an authentic response from potential users. The prototype was represented by using simple shapes of elements, basic visual hierarchy and only grey colors in order to keep the users focused on the main functionality and enable a discussion around the concept without the distraction of detailed elements like colors etc. (see Figure 4.3). This clickable low-fidelity prototype was created using Figma[1].

During the creation of the low-fidelity prototype it was important to consider several guidelines of inclusive design (see Chapter 2 in Section 2.4) and prioritize simplicity.

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[1] https://www.figma.com/

Figure 4.3: Low-fidelity prototype of the final idea from the ideation phase.

The main design considerations made at this stage involve reflections about interactions, information representation and onboarding procedure. These elements are summarized in the following subsections:

Interaction Design

Simple input gestures and thoughtfully considered controls (e.g., size of buttons) play a crucial role in enabling users to smoothly interact with the app and perform tasks with ease. Following elements were considered in the prototype:

Only simple and familiar tap, scroll and swipe gestures were applied. Additionally, wherever there was a swipe or scroll gesture expected a visual cue was added, e.g.,

pagination dots or arrows. Furthermore, touch targets were designed to be big enough (according to the inclusive design guidelines: 48x48 px) and were always placed near users hand with enough spacing between the targets (at least 16px). Besides that, the author took care of providing users an option to always return to a "known place". This meant that during each interaction that was either divided upon more steps (e.g., registration process) during an editable state (e.g., creation of stories) a "back (to home screen)" or "undo" button are provided.

Information Design

Furthermore, the author payed attention on representing the written information in an understandable and attractive manner. Hence, keeping the language as simple as possible and really trying to address users by using direct, active language (e.g., create your story instead of story creation) were some of the main considerations.

Besides that, the author provided guidance whenever a new feature was introduced and gave a step-by-step explanation of more complex procedures like story creation. When using the app for the first time a short onboarding is provided that introduces the main features of the app and possible interactions. Another important aspect that was considered when designing the app was instant and obvious feedback.

4.2.3 High-Fidelity Prototype

After gaining sufficient feedback on the low-fidelity prototype form target audience several refinements were made and eventually the creation of the high-fidelity prototype started. The main focus during this step was on ensuring that the design visually conveys app's functionalities and in general making the prototype look and feel like a real app. To achieve this all interface elements, interactions, spacing, and graphics were created in a more realistic and detailed way. This prototype was also created using Figma.

Visual Design

The first step of creating the high-fidelity prototype was to figure out the mood of the prototype. This was approached by creating a Moodboard (see Figure 4.4) and then defining a style guide. A Moodboard usually consists of images, text, and objects in a composition.

From there on a general style guide was generated. In a style guide is usually defined in order to maintain visual consistency (fonts, controls, icons, and color used consistently).

1. Colors
Colors play a significant role in defining the mood of the app. In general, colors can be divided into warm colors (reds, oranges, and yellows), cool colors (blues and purples), and neutral colors (black, white, gray). Each color can have a different psychological effect and evoke different emotion, which are mostly cultural based. Since in the context of this Master's thesis the prototype aims at addressing hope and individuals' well-being
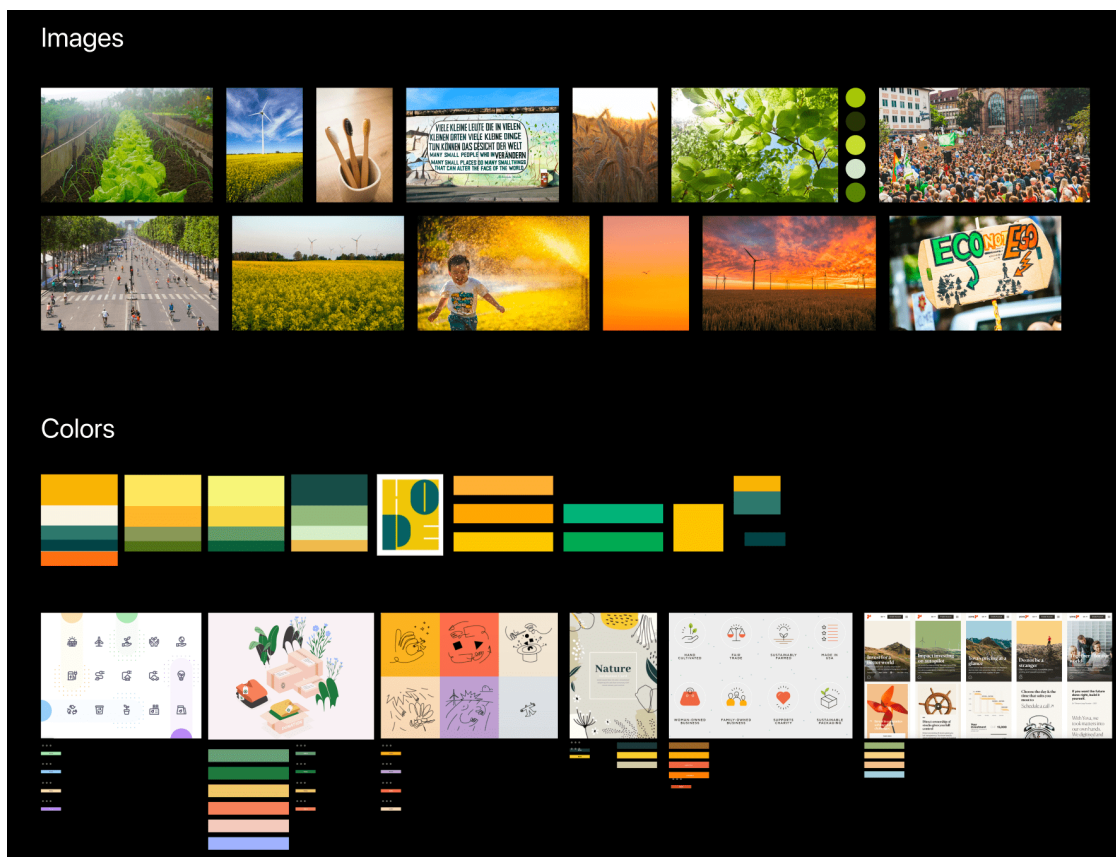
Figure 4.4: Moodboard of the design process.

around the topic of climate change it was important to choose colors that can address these aspects. The following colors were selected based on their suitable meaning and emotional correspondence [Cer12][2]:

- Green: nature, growth, harmony, freshness, safety, healing

- Orange: joy, enthusiasm, happiness, creativity

- Yellow: sunshine, joy, happiness, energy, hope

Green was chosen as the primary and orange as the secondary color. Yellow is solely used for some accents and in illustrations. In general, green and orange are complementary colors in the color wheel which ensures color harmony across the platform. The colors are mainly distributed according to the 60–30–10 rule (60% + 30% + 10% proportion) which is meant to keep the colors balanced. Besides that, all colors were tested on

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[2]https://www.smashingmagazine.com

accessibility to assure that they are only used when enough contrast is provided between the background and text (at least 4,5:1 for normal text; 3:1 for bold text). The Figure 4.5 represents the color palette of the final high-fidelity prototype.

Colors

Primary Shade 2
#1A4344

Primary
#42766C

Primary Shade 1
#719891

Secondary
Shade 2
#FE6034

Secondary
#FF785C

Secondary
Shade 1
#FEA085

Tertiary
#FFC857

Font-dark
#12121F

Font-lighter
#4F4F4F
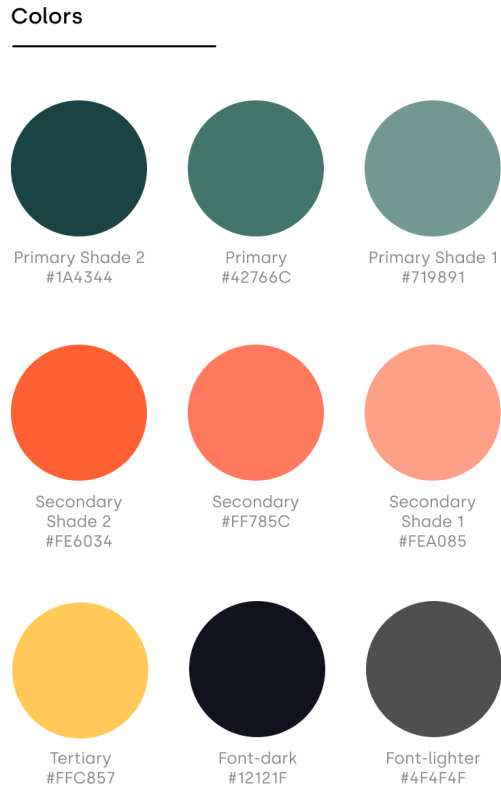
Figure 4.5: Colors used in the final high-fidelity prototype.

2. Font

The sans-serif Google Font *Poppins*[3] was used across the entire prototype. The smallest font size used in the prototype is 12 point. As mentioned in the Inclusive Design guidelines in Chapter 2 in Section 2.4 this is necessary to assure that the text is readable for the greatest amount of users. The Figure 4.6 represents the font styles used across the platform.

Figure 4.6: Text styles used in the final high-fidelity prototype.

2. Composition & Hierarchy

The author payed attention in keeping a clear hierarchy to help users to focus on the task they want to preform and eliminate all irrelevant visual elements by using providing clear labels and headings and distinctive controls. In order to better differentiate headings and body text, a bigger font size and a bolder font style was used for the headings. The main actions (buttons) were designed to stand out from the rest and were placed at the bottom of the screen so that they are easily accessible.

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[3]https://fonts.google.com/

4.2.4 Final prototype - features description

Branding

The author named the app *re:*future. The name refers to *our* [society's] reply to the future. The first part of the name *re:* is an abbreviation for reply as known from e-mail communication. The reply that this app motivates is focused on a positive vision for the better future and engagement of individuals in shaping it. The Figure 4.7 represents the logo and first impression of the app.

Figure 4.7: Final prototype: re:future logo.

Onboarding

When using the app for the first time a short onboarding into the main features of the app are introduced. Figure 4.8 illustrates the onboarding process. As described in Section 2.4 about inclusive design, this is important to offer first-time users the possibility to get familiar with the app. In re:future the onboarding process consists of three screens explaining the main features and offers on each screen a "skip" option for impatient or tech-savvy users.
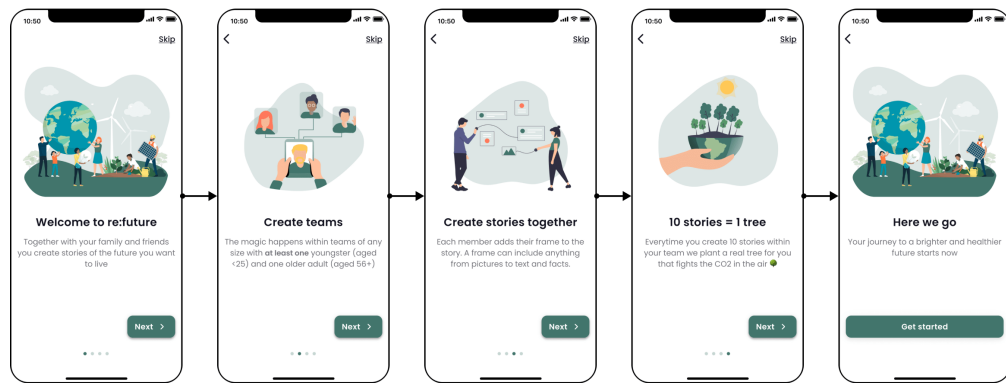
Figure 4.8: Final prototype: onboarding process.

Registration

After a short onboarding the user can decide if he/she wants to register or login. Figure 4.9 depicts the entire registration process including both empty and filled states of the screens. By tapping on the "Register now" button the 5-step registration flow begins. First, the user is asked to enter his/her name and select his/her age range. Age range is a mandatory information needed form the user because the goal is to create cross-generational teams. Since entering own age is often a burden for some users because it reveals sensitive personal data, the author added a description of why the app needs this information. In the next step the user is asked to add a username and a photo to be easier recognizable by team members. After that, the user is asked to select (max. three) his/her feelings toward climate change. On this screens the user is offered several feelings to choose from (based on the most often mentioned feelings in the online survey) in order to avoid keyboard writing. The options are the following: concerned, hopeful, powerless, motivated, uncertain, eager for change, angry and confused. Since there are only eight feelings represented there may be the case that a user can not identify himself/herself with any of the options, therefore, one option is offered to say "Others" and one option is reserved for "Rather not say" for those user, who do not want to give that information. Besides that, in a description on this screen which explains that the user can change this information anytime later: "Select max. 3 and don't worry, you can always change this later in your profile ;)". The next screen is structured in the same way as the previous screen, asking the user to answer what makes him/her happy. The aim of this question is to address positive computing and focus on what makes a person happy and share this with other team members. In the final step of the registration process the user is asked to enter an e-mail and a password to save the profile. If the profile is successfully created the user lands on a success-screen that provides that feedback and offers a button to go to the landing-page. During the entire registration process the user is addressed by using an active, positive and direct language e.g., "Hi Johanna, great to have you! I bet your team can't wait to have you on board. Let them know who you are by adding a photo
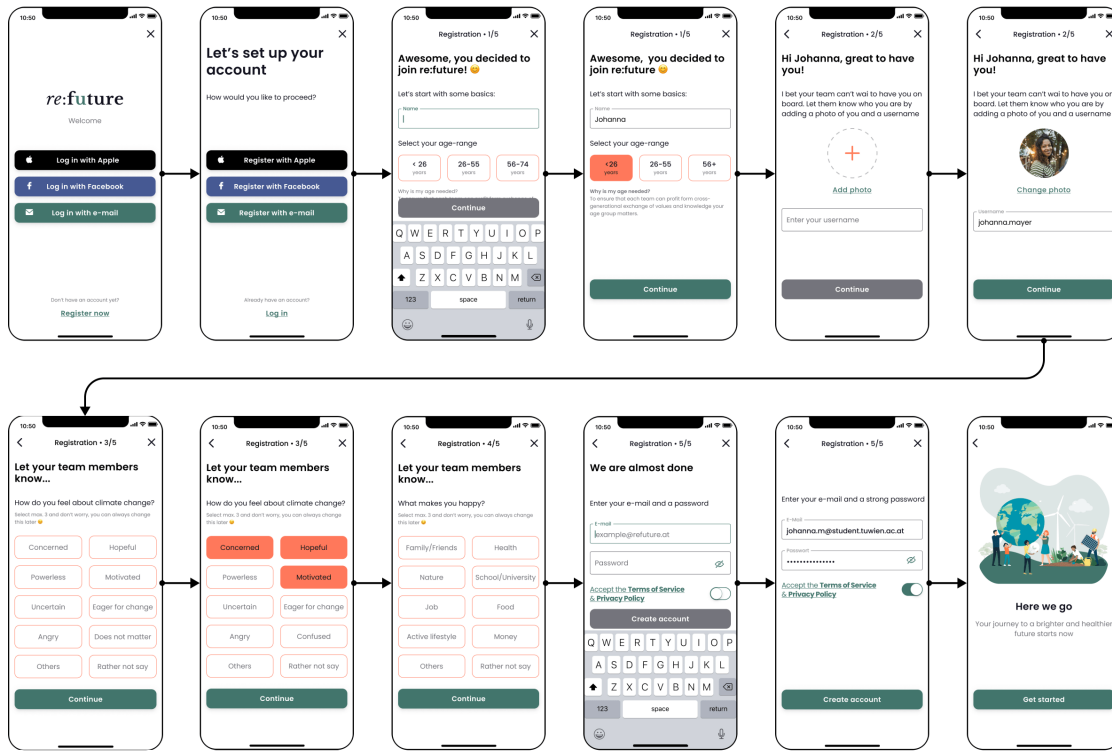
and a username."

Figure 4.9: Final prototype: registration process.

Navigation

In general re:future consists of following five main sections:

- **Home:** represents publicly published stories of any team across the app and suggests climate change related events (e.g., Fridays for Future, Together planting trees, etc.)

- Search: in this section the user can search users, teams and stories by name

- **Add (plus icon):** this section allows to start creating a new story or adding a frame to an existing story

- **Teams:** section where the team/teams are represented; if a user is still not part of any team, she/he is able to join or create a new team (main feature for this thesis)

- **Profile:** all personal data that was entered during the registration can be modified here (name, age range, feelings, etc.); besides that here is also an overview of notifications

Figure 4.10 visualizes the "Home" screen on which at the bottom the main navigation can be seen (with the elements mentioned above).
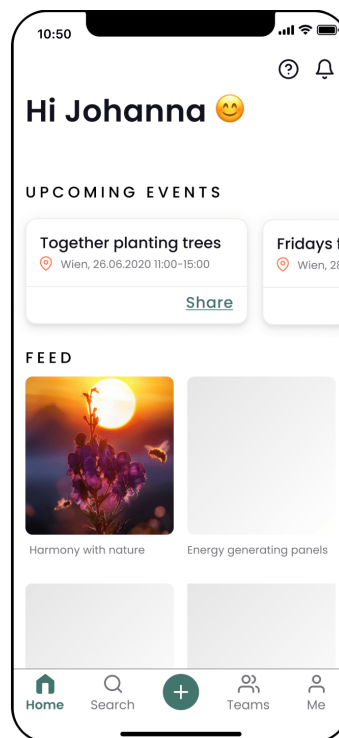

Figure 4.10: Final prototype: navigation (home screen).

Teams

The main focus during this thesis was put on the "Teams" section because this is where the intergenerational communication takes place. It is the place where users can see detailed information about their teams. To recap, each team consists of at least one youngster (aged < 25) and one older adult (aged 56+). Within teams stories are created which can be seen in this section. Besides that, this section also provides the information about how the whole team feels about climate change and what makes them happy. If the user is not part of any team the user first receives an explanation of what this section is about and what the goal of it is. Besides that, there are two calls to action provided, namely, "Create a new team" and "Join an existing team". The Figure 4.11 represents the case in which the user is still not part of any team and decides to create a new one. In this flow the user is asked to name the team and add team members. When adding
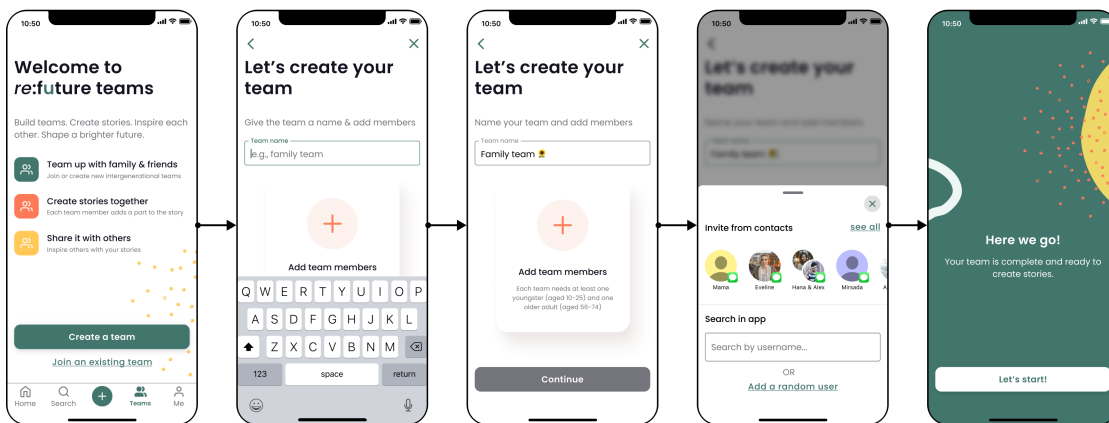

Figure 4.11: Final prototype: Teams section - stories and attitudes.

team members the user has the option to invite from contacts, search users in app or add a random user. Eventually, when done, the user gets a feedback that the team was successfully created and that as soon as the team is complete (at least one youngster + one older adult) the team can start creating stories.

Inside a team the user can see:

- Name of the team, small images of team members and a button to add additional members

- Stories created inside the team

- Attitudes (overview of teams feelings toward climate change and what makes the team happy)

- Achievements

- Chat (this is the place where the team members can start story related or other discussions)

- General settings

Figure 4.12 represents screens of the "Teams" section. The left screen represents the empty state of stories with a text in the middle that triggers the user to start a new story. The right screen represents the "Teams" section with teams attitudes including a button "change my feelings". This section plays an important role in the exchange of values and can trigger possible communication around climate change.

Figure 4.12: Final prototype: Teams section - stories and attitudes.

Figure 4.13 represents the flow of the story creation. With regard to the feedback from users during the testing phase a short explanation of how the story is created was added. Therefore, the process of the story creation starts with a short step-by-step explanation of how to create a story and what the main feature are. In general, the team member that is the first to start a story sets the topic/name of the story. The user has the possibility

to give the story a name or choose from several inspirations (suggestions). After that, a base for the story is set. This can be anything from a photo, video or plain color. In the next step the user can tune up the frame by adding extra elements to it, e.g., text, facts, drawings, graphics or sound. The last step is to save the frame and let the team continue the story.
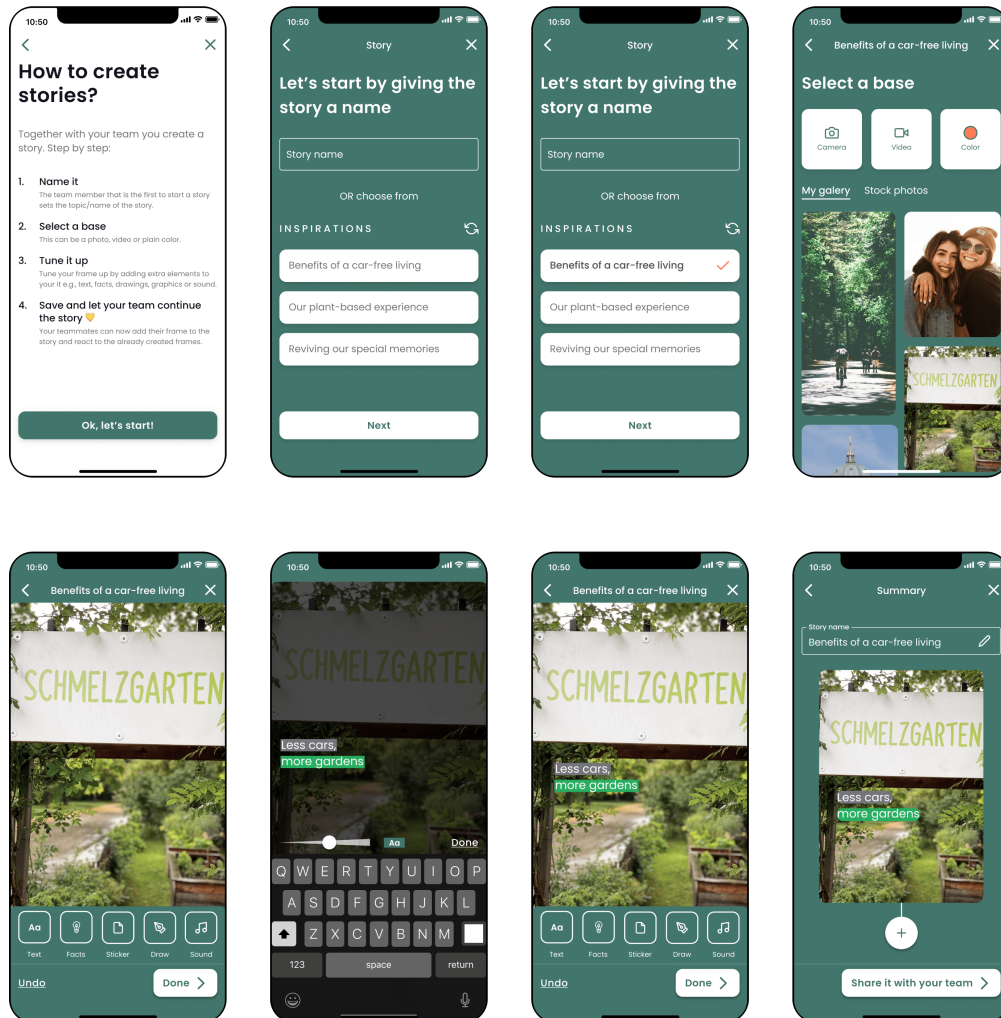

Figure 4.13: Final prototype: Teams section - story creation.

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Finally, when the first member added a frame to the story that frame can be seen by others in the "Teams" section (see Figure 4.14). Here the status of the story can be seen and changes can be made when the three dots are pressed.
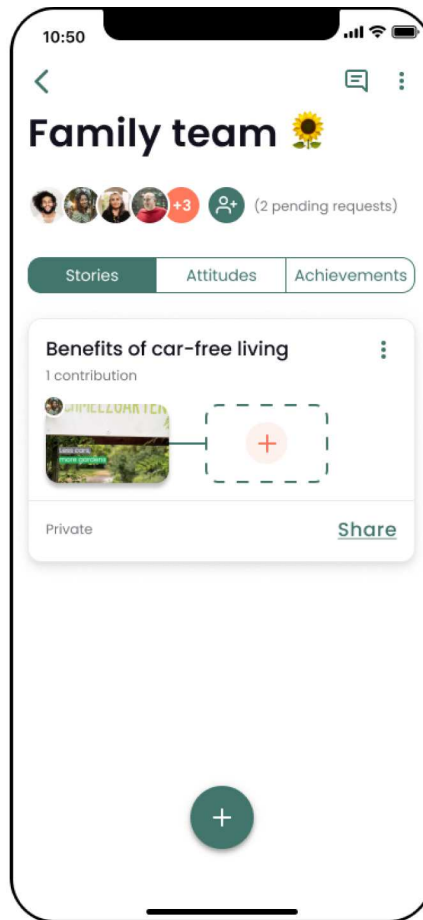

Figure 4.14: Final prototype: Teams section - frame added to the story.

Now other team members can start adding their frames to the story. Figure 4.15 represents one possible story outcome. The main focus of a story is to evoke imagination and emotions about the bright future and trigger intergenerational communication. It is to be expected that not all team members will always share the same opinion about things, therefore, per story the option is offered to start a conversation about a frame. This discussion would be displayed in the chat bubble that can be seen on the "Teams" detail page (see Figure 4.14) in the top left corner. Besides that, the users can see how many members saw the story and offers the possibility to react to the story by a heart.
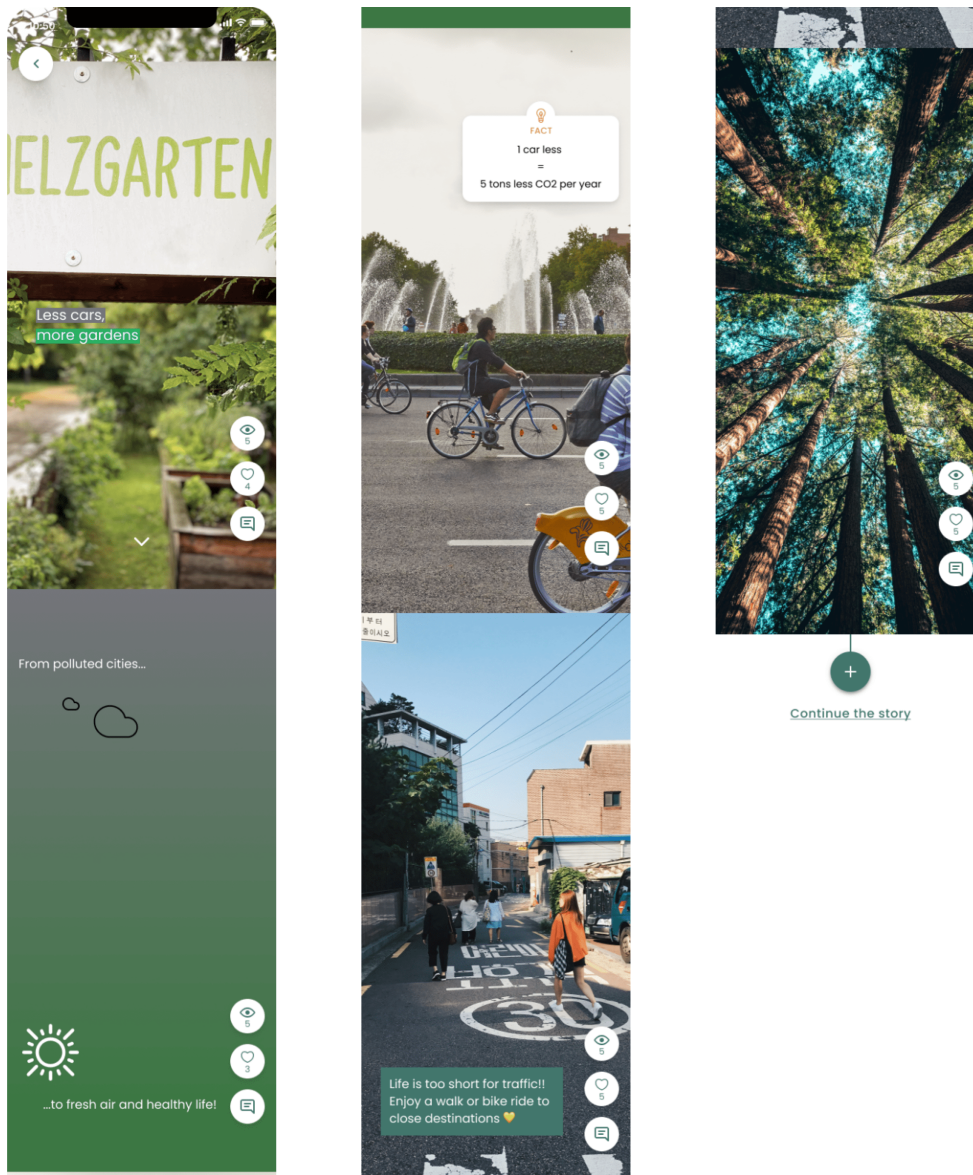
Figure 4.15: Final prototype: Teams section - story experience.

4.3 Test (Test)

Both, low- and high-fidelity prototypes were iteratively tested in order to gain feedback from the target audience and incrementally improve the concept and prototype in general. The author payed attention to include in each testing round at least one user from the Generation Z (aged < 25) and one individual aged 56+.

4.3.1 Testing Procedure

The researcher reached out to the voluntary participants and tested the clickable prototypes with them either in person or sent the participant a link to the Clickdummy and observed the user during the test over Zoom[4]. The participants were mainly people from author's close social circle (friends and family). Before the test started the researcher shortly explained the aim of the test and how it is structured. The next two sections quote what the researcher said to the participants:

Aim of the user test

The aim of the user test is (1) to check the comprehensibility and usability of the prototype and (2) find out how interesting the selected features are. I just mentioned the term prototype. Do you know what that means? In general a prototype is a sample of a product created to test a concept or process. This means this is not a fully functional application but many features are already working. I just wanted to mention this beforehand so that you are not surprised if some features may not work.

The structure of the test

Before we start with the test, I'm gonna ask you a few questions about your general thoughts about intergenerational communication around climate change. Then we will go through the prototype together and I will ask you some feature-related questions. Afterwards I would like to ask you to give your general opinion about the prototype. In total the test should last about 20 minutes. Please keep in mind that it is not you being tested, but the usability of our prototype. So, when interacting with the prototype, I would ask you to think aloud. Please comment and justify anything you think during the interactions. This helps to better understand your experience and figure out possible shortcomings. Furthermore, I would like to point out that this test will be logged and the data will be used exclusively for the purpose of evaluation.

Questions

Opening questions:

- What do you think about climate change?

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[4]https://zoom.us/

- Do you often communicate about this topic within your close social circle?

- Who do you mainly communicate with and where (online/offline)?

The following questions were asked repeatedly during the testing process:

- Tell me what you see on the screen?

- Is everything clear? Is all necessary information provided?

- What do you expect from this specific feature?

- Did any ambiguities arise during this process? If yes -> which?

- Is there anything missing?

Team and story related questions:

- Is the process of the story creation clear?

- If you had to create a team now -> who would you add?

- Would you mind adding random users to your team?

Closing questions:

- What is your general opinion about this app? (Improvements?/Suggestions?)

- Would you use it?

Thank you for your for feedback it helps a lot!

4.3.2 Testing Results

Low-fidelity prototype

The low-fidelity prototype was tested with seven participants (4 from Generation Z; 3 from Baby Boomers). The main issues that were addressed are:

- Not really clear what a story is at the point where the story should be created.

- An additional motivating factor was mentioned by several users (e.g., adding achievements, planting trees). In this case users have an additional motivation to use the app.

- Adding random users in case one can not find someone from the close social circle.

- Teams wording is very generic.

- Offer the option that the user does not have to give the information about their feelings around climate change and offer the option to be able to change the feelings.

- Send notifications when a story was not created for a longer time.

High-fidelity prototype

The final feedback received on the high-fidelity prototype (re:future) was very positive:

- "It is very visually pleasing"[5]

- "I think it's great that this topic is finally told from a more positive point of view, which motivates one to do more and visualises the good change than just hearing how bad it will be"[6]

- "Cool idea, I would definitely use the app"[7]

- "The process of story creation was clear and straightforward"[8]

- "I believe this can help maintain communication with my family on this topic and get to know their views better"[9]

- "Such a beautiful and useful app" [10]

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[5]Original quote: "Es ist visuell sehr ansprechend!"

[6]Original quote: "Ich finde es toll, dass dieses Thema endlich aus einem positiveren Blickwinkel erzählt wird, der zu mehr motiviert und die gute Veränderung sichtbar macht, als nur zu hören, wie schlecht die Welt sein wird wenn man nichts tut"

[7]Original quote: "Coole Idee, ich würde die App auf jeden Fall nützen"

[8]Original quote: "Der Teil wo die Geschichte erstellt wird ist klar und unkompliziert"

[9]Original quote: "Die App kann helfen, die Kommunikation mit meiner Familie über dieses Thema aufrechtzuerhalten und deren Ansichten besser kennenzulernen"

[10]Original quote: "so eine schöne und brauchbare App"

CHAPTER 5

Analysis and Discussion

Climate change represents one of the biggest challenges that our humanity has ever been faced with, affecting all life forms on the planet. Due to its complexity it requires understanding of various disciplines including environmental and psychological sciences. This work therefore takes a comprehensive approach by covering social aspects and the natural responses to that and combining them with the power of intergenerational communication. This chapter discusses the results of the thesis establishing a connection between the results of the empirical research and the literature. The structure of the discussion is aligned with the research questions of this master's thesis. Firstly, psychological barriers to inaction are discussed. This is followed by a discussion about strategies that should be applied to improve communication about climate change. Furthermore, it is examined how intergenerational communication can be triggered and its benefits highlighted. Finally, the chapter concludes with a discussion about the proposed technological solution that integrates the insights from previous steps.

5.1 Barriers to Inaction and Improvement Strategies to Climate Communication

This section focuses on answering the first research question, namely *Which (psychological) barriers need to be considered when communicating about climate change and which strategies may help to remove these barriers and enhance the communication?*

5.1.1 Barriers to Inaction

Despite most people knowing that climate change requires urgent action, still a relatively small number of people is undertaking active steps to mitigate the problem [COD+16]. As literature review shows, this is mainly attributable to psychological factors, the so called "dragons of inaction" which hinder individuals to take action [Gif11]. These inner

dragons help to explain why humans often agree that "there is a problem but" still do not manage to act against it. Barriers that were discovered during literature review (see Chapter 2 Section 3.2.1) were all observed and confirmed during the empirical research and one additional barrier was added. Each barrier that could be identified throughout the research is listed bellow and supplemented with a saying form the interviews:

- Change unnecessary, e.g., *"One individual can not really change something."*

- Interfering with personal goals, e.g., *"I do not have time to do that [go to Friday for Future events] because of my job."*

- Interpersonal relations, e.g., *"My mum doesn't want me to be vegan, she thinks that's not healthy."*

- Lacking knowledge, e.g., *"I feel overwhelmed by the information overload it is hard to find what is really effective."*

- Tokenism, e.g., "I am paying attention to my consumption, so I don't think that I need to go to such [climate] events"

- Blaming others, e.g., *"Politicians and big companies are the ones who need to act."*

- Negative emotions, e.g., *"It's too late to make a change now."*

I would like to discuss the barrier on *negative emotions* in further detail, because this barrier was observed and repeatedly confirmed throughout the entire research of this master's thesis, and strongly influenced the direction in which the final prototype was developed. Referring to insights from literature research, emotions represent powerful drivers to how people interpret and respond to a situation/issue [LWHW01, LLVK15]. Research in psychological science has shown that daily-life decision making is mainly a fast, emotion-based process [LY15]. This highlights the importance of emotions on this topic as a whole. Feeling more positive about the topic may increase the willingness to take corresponding actions [Oja12, BFL99, HFM+15, MBB+19].

Most sources across the media that currently address climate change focus their communication around negative environmental impacts of climate change. Since media plays an influential role in reinforcing public attitudes on a wide range of issues, clearly it also influences the way climate change is perceived [Bur19, SIS13]. Being that most of the communication about climate change is mainly framed from a perspective that addresses possible losses it constantly leaves the society being exposed to dramatic information about how climate change is becoming more extreme and terrifying, creating negative feelings toward the issue. Findings from the empirical research reflect those widely spread negative emotions towards climate change.

The examination of both empirical research methods (interviews and online survey) revealed that people have predominantly negative feelings toward climate change. Participants in the interviews reported feeling depressed, concerned, angry or helpless. Similar

results were observed throughout the responses of participants in the online survey. Participants stated being concerned (72%), uncertain (52%), helpless (40%) and angry (30%). Only a relatively small percentage of participants (22%) stated feeling hopeful. Besides that, it was noticeable that participants were relatively pessimistic about climate change being stoppable.

Moreover, the findings from the online survey demonstrate that participants' first thoughts on climate change are also very negative. Participants repeatedly used words like "too late", "too much CO2", "apocalypse", "downfall", "melting glaciers", "weather extremes", etc. to describe their fist thoughts on the topic. To give a few more examples:

- *It is almost too late: the situation is hopeless, but not serious :-)*[1]

- *Our planet is being successively destroyed and this will have severe consequences for future generations.*[2]

- *We're doomed.*

Often also individual's ignorance is addressed:

- *I don't understand how large corporations and the government can so shamelessly ignore this.*[3]

- *Idiotic climate change deniers.*[4]

- *Egoism and stupidity of the people.*[5]

- *Failure and ignorance of politics, economy and society to stop it.*[6]

- *Most people don't care.*[7]

- *All knowledge about it is suppressed.*[8]

As discussed in the theoretical part of this thesis, prior research has shown that people tend to disengage when they start having feelings of fear or guilt [ONC09]. Even though fear and alarmism may catch attention in the short-term, empirical studies have shown little long-term effects; in the contrary, if the problem is not perceived as personally

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[1]Original quote:"Es ist schon fast zu spät: die Lage ist hoffnungslos, aber nicht ernst :-)"

[2]Original quote: "Unser Planet wird sukzessive zerstört und dies wird schlimme Auswirkungen für zukünftige Generationen haben."

[3]Original quote: "Ich versteh nicht wie große Konzerne und die Regierung das so schamlos wegignorierten können."

[4]Original quote: "Idiotische Klimawandelverneiner."

[5]Original quote: "Egoismus und Dummheit der Menschen."

[6]Original quote: "Versagen und Ignoranz von Politik, Wirtschaft und Mitmenschen es aufzuhalten"

[7]Original quote: "Es ist den Meisten egal."

[8]Original quote: "Das ganze Wissen daran wird verdrängt."

relevant it can have counterproductive effects [CRC⁺15]. Acknowledging this, indicates that the issue should be addressed from a more positive narrative in order to raise individuals' hope and motivation toward the topic. Nobody would want to invest time into something that is completely hopeless. The following section will touch upon this issue again and will highlight the importance of positive message framing.

5.1.2 Strategies for Improved Communication about Climate Change

There are different strategies that can be applied to improve the communication about climate change and remove possible barriers to inaction. The following section discusses the findings from both literature and empirical research and analyses them together.

Keeping the message simple, social and positive

Three key aspects that could be identified during literature review and were directly or indirectly recognized during empirical research can be summed up as follows: keep the message simple, social and positive.

As discussed in the theoretical part of this thesis, messages that address feelings of hope and self-efficacy can increase individual's willingness to engage in climate change issues [Oja12, BFL99, HFM⁺15, MBB⁺19]. During interviews participants were asked to share their opinion on what they believe would be the best way to approach a person who may not be environmentally conscious about the topic of climate change. Repeatedly participants stated to keep the message focused and easy to understand, avoid preachy or guilt-inducing language and focus on suggesting solutions and actions that the person could do. Quoting one of the participants: the message should "not be so preachy about what you have to do instead talking about what you can do and give useful tips on how to get things done"[9].

Even though participants' first thoughts on climate change were relatively negative the final messages that they gave to the society at the end of the survey were very motivational and focused on mitigation actions and change. The messages were framed and focused on possible actions, solutions and positive outcomes (the full list of the messages can be found in Chapter 3 in Section 3.2.2). Messages that focus on the gains from actions can better promote people's self-efficacy and increase their belief that their actions can mitigate negative climate change impacts [MBB⁺19]. With an exception of five individuals all of the remaining 105 participants left an inspiring message to the society. This represents a big potential for a platform where people could exchange their opinions on the topic of climate change. A platform where individuals could mutually motivate and inspire each other about possible solutions and daily actions that can help mitigate climate change. To give some examples, the participants addressed the following aspects in their messages:

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[9]Original quote: "Nicht so oberlehrhaft was du tun musst sondern nur eine kurze Info was man machen kann und nützliche Tipps geben wie man Sachen erreichen kann und welche Möglichkeiten es dafür gibt"

- Reduction of resources, e.g., "Be more aware of resources and consumption."[10]

- Individual action, e.g., "Every individual can and must do something to counteract climate change."[11]

- Collective power/action, e.g., "If we all make an effort and pull together we can move a lot and save our future."[12]

- Harmony with nature, e.g., "We need to feel and understand that we are connected to nature in an ecosystem and cannot place ourselves above nature."[13]

- System change, e.g., "I would like to see the society and especially the government act and react as drastically and raise awareness about climate crisis as they did during the corona crisis."[14]

- Self-reflection, e.g., "It all begins with your own change." [15]

- Critical thinking, e.g., "Research the source of the article in the media - what is author's motivation? Who pays him/her?" [16]

- Positive outlook, e.g., "Together we can do this - from small farmers in the global south to big company leaders in industrialized countries." [17]

- Empathy for future generations, e.g., "Climate change is not something that only affects us, it also affects the generations that will come after us. We have to wake up and finally understand what the earth offers us and that not only we but noticeably developing countries suffer from climate change. WAKE UP PEOPLE!" [18]

- Big picture, e.g., "We are all in the same boat. Let's make a change!"[19]

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[10] Original quote: "Bewusster mit den Ressourcen umgehen."

[11] Original quote: "Jeder Einzelne kann und muss etwas tun um dem Klimawandel entgegenzuwirken."

[12] Original quote: "Wenn wir uns alle Mühe geben und an einem Strang ziehen können wir viel bewegen und unsere Zukunft retten."

[13] Original quote: "Wir brauchen wieder mehr das Gefühl davon und Verständnis darüber, dass wir mit der Natur in einem ökosystem verbunden sind und uns nicht über die Natur stellen können."

[14] Original quote: "Ich würde mir wünschen, dass die Gesellschaft und insbesondere die Regierung bei der Klimakrise genauso drastisch handelt bzw. reagiert & Bewusstsein schafft wie bei der Coronakrise."

[15] Original quote: "Das Alles beginnt, mit dem eigenen Wandel."

[16] Original quote: "Bei Medien den Ursprung des Artikels recherchieren - Welche Motivation verfolgt der Autor? Wer bezahlt ihn?"

[17] Original quote: "Zusammen können wir es schaffen, vom Kleinbauern im globalen Süden zu den großen Firmenchefs in den Industriestaaten."

[18] Original quote: "Der Klimawandel ist nicht etwas was nur uns betrifft, sondern es betrifft auch die Generationen die nach uns kommen. Wir müssen aufwachen und endliche begreifen was uns die Erde zur verfügung stellt und das nicht nur wir aber merkbar Entwicklungsländer unter dem Klimawandel leiden. WAKE UP PEOPLE!"

[19] Original quote: "Wir sind alle im selben Boot. Let's make a change!"

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Besides that, the results from empirical research indicate that participants would most prefer to learn about climate change *together with others* (for more details see Section 3.2.2). This highlights individual's interests in collective actions and openness for collaboration and mutual exchange. Since humans are known to be social animals this is not astonishing. Besides that, this can open up ways to include intergenerational communication and in this way benefit from further cross-generational knowledge, value and skill exchange.

The world is currently at a critical turning point where feelings of anxiety and concern are understandable; however, this critical moment can be used to inspire a positive vision for a better future and engage individuals in shaping it, instead of leaving the society watch how their future of loss unfolds.

Importance of the Right Messenger

Being that climate change represents such a complex issue, scientific language around this topic often comes along with complicated jargons and processes [AKS18]. Nevertheless, in order to achieve a successful communication around climate change it is of great importance to align the language to people's level of understanding [AKS18]. If the chosen messenger represents the desired identity in people's mind, it allows the messenger to more easily speak to people's values and priorities and in this way establish a stronger connection between the messenger and the audience [MHH14]. The findings from both empirical research methods revealed that participants express biggest trust in scientists and environmental organizations to provide accurate information about climate change. Doctors and media (and to a bit lesser extent family and friends) were seen as the next trustworthy voices. Politicians were seen as by far the least trustworthy messengers. In interviews the importance of family members as trustworthy messengers was empathized much more. All in all, this indicates that choosing the right messenger is relevant to how the audience will perceive a message.

5.2 Triggers of Intergenerational Communication about Climate Change

This section aims at answering the second research question of this thesis, namely: *How can intergenerational communication be triggered and which benefits are expected?*

Despite relatively little prior research on intergenerational communication about climate change several findings can be concluded. Literature review underlines that due to older adults' anti-reflexive thinking on controversial topics, often children are seen as main agents for transferring climate change concern [LSP$^+$18, Gif11]. Interviews confirmed these findings. Most Older adults that participated in the interviews revealed that younger family members (in most cases their children) often trigger a conversation about climate change related topics based on something they recently viewed or read about on different media channels (e.g., cheap flights, growing amount of plastic and packing, etc.).

As older participants stated, this usually led to a wider exchange of knowledge around climate change. Interestingly, when younger participants were talking about older adults general attitudes towards climate change, they would state that they do not perceive them being very much aware of the climate issue, however, when talking about older adults from their families, they would show that they are aware of the

Interviews showed that people mainly discuss climate related topics within their families. This results could also be proved in the online survey, with the difference that here most participants stated communicating with younger and older people.

5.2.1 Address Aspects that Both Generations Value

Even though differences between the two generations, Generation Z and Baby Boomers, could be observed it was interesting to see that both generations were aware of the climate issue and already involved in climate-friendly actions. Even though most of younger interviewees believed that older generations are not doing much to stop the climate change, the findings from both empirical research methods showed that older adults are active and being aware of the urgency of the problem. This indicates that a more active communication and exchange may help individuals see that also others are concerned and taking action.

When designing new technologies that should foster intergenerational communication it is important to address topics that both generations. Referring to the communication enhancement model which was discussed in the theoretical part of this thesis, in order to achieve a successful communication it is needed to address the needs and values of both young and old [RMMO95]. Besides that it is necessary that the conversation happen on a frequent basis. This aspect will be discussed in the following section.

5.2.2 Active Communication Matters

In general, results show that people who actively communicate about climate change (more than once a week) tend to show more visible sustainable behaviour patterns in their daily lives than those who communicate less (max twice per month). Figure 5.1 visualises the differences in behavioural patterns between those two groups. From the figure reasons for individual's climate friendly behaviour can be compared. As climate friendly actions the following actions are understood: "I turn off lights when not necessary", "I turn the heating down when leaving the house for 2+ hours", "I separate waste", "I turn the water off when it's no longer needed", "I deliberately buy regional vegetables and fruits", "I consume little or no meat (max. 1-2 times per week)", "I use public transport or a bicycle", "I have reduced my air travel" and "I am politically committed for climate policy". Besides that, distinctions could be observed in consumption patterns as well. Regarding meat consumption, the findings underlined that participants who talk often about climate change mainly eat meat 1-2 times per week, whereas individuals who generally talk less about climate change eat meat 3-4 times per week. Similar observation could be made about the consumption of animal products like eggs, milk, cheese, etc;

"often (almost daily)" compared to "very often (daily and at almost every meal)". Besides that, the group of participants that stated actively talking about climate change, reported *always* checking products for sustainable labeling (Fairtrade, UTC, FSC, Ecolabel, MSC, etc.); compared to others, who mainly reported doing it sometimes. Regarding flying the results were relatively similar. Both groups of participants reported flying less than 10 hours per year.

Influence of climate change communication on individual's actions/behaviour
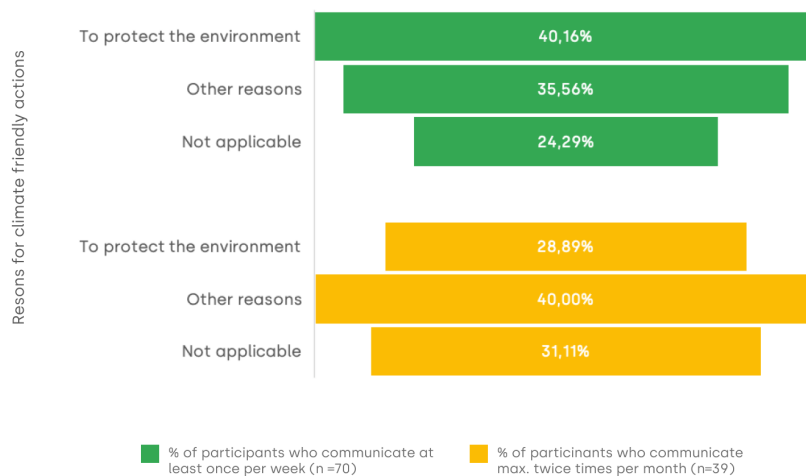
Figure 5.1: Influence of the frequency of climate change communication (with others) on individual's climate friendly action/behaviour.

5.2.3 Expected Benefits

The expected benefits of intergenerational communication about climate change can be summed up as follows:

- Knowledge, competencies and value exchange between generations [GT09]

- Deeper and broader understanding of the climate change issue [LSP+18]

- Positive contributions to socio-environmental issues [LSP+18]

- Involvement of older adults in the current happenings, preventing isolation [Ken17]

5.3 Technological Solution Used to Enable Intergenerational Communication about Climate Change and its Key Features

This section discusses findings that relate to the the third research question: *What technological solution can be used to enable intergenerational communication about climate change and which key features should be considered for such technologies?*

Being that climate change comes along with mostly invisible, intangible aspects, e.g., distant impacts, invisible causes, delayed or absent gratification for taking action, etc. mediated communication plays an important role to increase the understanding of the issue [Mos10]. For example insightful visualisations may show possible future scenarios depending on taken actions and in this way providing help in understanding abstract and hard to understand scenarios. Van den Homberg shows that technology plays a crucial role in addressing climate change impacts and retaining, reducing or transferring climate concern [vdHM19].

Referring to the insights that could be found during empirical research people mainly show negative emotions toward climate change; thus it is important that technology addresses the issue in a way that it can increase the well-being of individuals. This can be achieved by following a *Positive Computing* approach during the design and development of the technological solution. In general, *Positive Computing* refers to technologies deliberately developed and designed to foster well-being and human potential [CP14].

Even though to the best of author's knowledge no technological solutions exists that explicitly focus on enabling intergenerational communication about climate change and in general very little information on this topic can be found, the importance of this approach can be derived from other scientific evidence. Several researchers have shown intergenerational communication, especially within the family, has beneficial impacts on shaping climate change perception [GT09, VPS18]. Moreover, Abrantes et al. [AAB17] showed in their research that different Information and Communication Technologies (ICTs) as well as social media are increasingly being successfully used to support intergenerational communication among family members. Furthermore, as discussed in Chapter 2 in Section 2.3 intergenerational communication about climate change pays a crucial role for exchanging knowledge, increasing social connection and, as the empirical research shows, boosting sustainable behaviour. Despite its urgency, not enough people talk about climate change on a regular basis. The empirical study of this thesis shows that the number of people talking less than twice per month is still around 35%. Technology can help in such cases to keep up the communication possibilities and get people into discussions about climate change.

In general, when designing technological tools that integrate cross-generational audience several aspects need to be considered. Above all, it is of great importance to avoid the common mistake of solely focusing on the needs of younger audience; instead, also older adults' capabilities, limitations, and preferences need to be thoughtfully considered so

that they do not feel disadvantaged. In this context it is important to consider *Inclusive Design Guidelines* (for detailed information see Chapter 2 Section 2.4) during the design of new digital products.

5.3.1 Features of the Technological Solution

Based on the results from literature and empirical research the technological solution that aims at enabling intergenerational communication about climate change must consider the following features:

- Well-being should be actively integrated into the technology by adding components that can enhance well-being (Positive Computing). Based on psychological evidence taking daily pictures (with a smartphone) of things that make an individual happy can increase the overall well-being [CMA16]. Also color has an effective psychological effect and can evoke different emotions. Warm colors like yellow and orange can be used to evoke feelings of happiness and energy.

- The design of such a technological solution needs to integrate the Inclusive Design Guidelines (as discussed in Chapter 2 Section 2.4). These guidelines assure that the developed digital product is usable and enjoyable by the widest diversity of people, including older adults [CCKL13]. A few examples from the list of guidelines are: sufficient contrast, big enough touch targets, clear hierarchy, etc.

- Pictures should be used as the main medium because they are easy to create and have the ability to effectively communicate something and invoke emotions [LY15]. This aspect is central in this context especially because the focus lies on fostering individual's imagination about the brighter future.

- The interaction and creation of the content should be made easy so that also older adults which may be less tech-savvy feel confident to create and interact with the content. There should also be an onboarding for the first-time users provided which describes the main features and interactions of the digital product.

- The language used in the technological system should be kept simple, social and positive. The communication should focus less on the natural disasters that are usually addressed in the context of climate change and much more offer elements that boost individuals imagination around solutions and opportunities for creating a better future.

- Values of both generations should be addressed.

5.3.2 Proposed Technological Solution

The proposed prototype *re:future* integrates all aforementioned features to assure a wide acceptance and enable intergenerational communication about climate change. *re:future* combines intergenerational communication with positive computing aspects. In order to

move past the negative mood that could be observed across the participants and enable a intergenerational communication, this app involves users to create visual stories of the better future within cross-generational teams. Each team consists of at least one youngster (aged <25) and one older adult (aged 56+). Besides that, this platform offers the possibility to check the mood of the team members about climate change and what makes the team members happy. This aspect should help individuals to empathize with the members of the team and realize their values.

The testing sessions helped to iteratively improve the concept and interaction challenges. Users gave insightful feedback and inspiring ideas that could enrich the prototype. Besides that, the evaluation of the app showed how different age groups dealt with different challenges. Therefore, it was testing sessions helped to avoid misunderstandings between different generations. It was important to include people from both target groups (Generation Z and Baby Boomers) because this helped to uncover diverse challenges and so that it is usable for both target groups.

Test users repeatedly pointed out that they like the novel approach toward climate change because it does not talk about like other sources about "how ugly the world will get" makes them feel more willing to act if they see what others did and what can be done. Besides that also the aspect of being able to share the ideas with others and how they feel about the climate change issue was seen as very helpful and interesting.

The final feedback received on re:future was very positive:

- "It is very visually pleasing"[20]

- "I think it's great that this topic is finally told from a more positive point of view, which motivates one to do more and visualises the good change than just hearing how bad it will be"[21]

- "Cool idea, I would definitely use the app"[22]

- "The process of story creation was clear and straightforward"[23]

- "I believe this can help maintain communication with my family on this topic and get to know their views better"[24]

- "Such a beautiful and useful app" [25]

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[20]Original quote: "Es ist visuell sehr ansprechend!"

[21]Original quote: "Ich finde es toll, dass dieses Thema endlich aus einem positiveren Blickwinkel erzählt wird, der zu mehr motiviert und die gute Veränderung sichtbar macht, als nur zu hören, wie schlecht die Welt sein wird wenn man nichts tut"

[22]Original quote: "Coole Idee, ich würde die App auf jeden Fall nützen"

[23]Original quote: "Der Teil wo die Geschichte erstellt wird ist klar und unkompliziert"

[24]Original quote: "Die App kann helfen, die Kommunikation mit meiner Familie über dieses Thema aufrechtzuerhalten und deren Ansichten besser kennenzulernen"

[25]Original quote: "so eine schöne und brauchbare App"

<div align="right">CHAPTER 6</div>

Conclusion & Future work

6.0.1 Conclusion

To sum up, this scientific research analysed an intergenerational approach toward mitigating climate change by answering the following three research questions:

- **RQ1:** Which (psychological) barriers need to be considered when communicating about climate change and which strategies may help to remove these barriers and enhance the communication?

- **RQ2:** How can intergenerational communication surrounding climate change be triggered and which benefits are expected?

- **RQ3:** What technological solution can be used to enable intergenerational communication about climate change and which key features should be considered for such technologies?

In general, this Master's thesis followed the Design Thinking methodology that consists of five stages: empathize, define, ideate, prototype and test. To answer the research questions three data collection methods were applied: (1) literature review, (2) semi-structured interviews and an (3) online survey. Literature review helped to build the general theoretical foundation base around related models and theories. The two user research methods (semi-structured interviews and online survey) helped to get to know the users and dive into their feelings, thoughts and needs toward climate change. Research proved that different barriers exist across individuals that hinder them from taking action (e.g., lacking knowledge, climate goals interfere with personal goals, etc.) there are several strategies that can be applied in order to achieve a more successful communication: (1) build social norms, (2) address solutions, (3) emphasize related benefits, (4) inspire a positive vision and (5) use the power of storytelling and visuals. Besides that, this

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research work provides empirical support on the feasibility of increasing users' sustainable behaviour through active communication. Results indicate that participants who actively talk about climate change (more than once a week) tend to show more visible sustainable behaviour patterns in their daily lives than those who talk less (max twice per month). This suggests that fostering intergenerational communication may help to increase sustainable behaviour. Findings also show that younger as well as older generations (Generation Z and Baby Boomers) prefer learning more about climate change "together with others" and in an interactive way. When designing technologies that should be used by different age-groups and especially if older adults are (part of) the target group, it is important to avoid the common mistake of solely focusing on the needs of younger audience; instead, also older adults' capabilities, limitations, and preferences need to be considered so that they do not feel disadvantaged. The final step of this scientific work was to put all of the insights into a prototype. This process included a thorough research on necessary guidelines of inclusive design and positive computing to assure that the final product is usable and enjoyable by the widest possible audience. The final prototype, named re:future, represents an iOS application that aims at fostering intergenerational communication about climate change framed by positive vision. The goal is to connect people through the creation of stories within their intergenerational teams. To date, climate change is usually communicated from an environmental perspective and is focused on negative impacts. That attitude toward climate change could also be widely observed across participants. Generally, participants mainly addressed possible negative impacts on the environment due to climate climate change. In order to increase well-being of individuals around climate change this thesis focuses on a comparatively positive personal perspective. It is all about enabling imagination of the better future by shaping it together with others in intergenerational teams. As Charles F. Kettering [1] said "our imagination is the only limit to what we can hope to have in the future". The app (prototype) developed in context of this thesis, named re:future, integrates following main aspects: (1) intergenerational team focused communication through storytelling, (2) creative freedom, (3) positive computing aspects (inspiring vision to change the world by changing the stories that shape our collective destiny) and (4) knowledge and value exchange. The final feedback from the participants were very positive; all participants (n = 4) stated being willing to use the app and liked the new approach of tackling climate change together with others aiming for a positive vision.

6.0.2 Limitations/Future work

As with the majority of scientific research, the design of the current thesis is subject to limitations. First of all, only publications that the author could access (online or digital) during the research period (20 October 2019 - 1 June 2020) and which were written in German or English could be taken into consideration. Besides that, since only very little research has been done in investigating technological solutions around climate change that

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[1] https://lemelson.mit.edu/resources/charles-f-kettering (website accessed on 20 June 2020)

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focus on intergenerational communication, especially between people who are not bound with family ties, it was hard to find suitable research papers in this area. Furthermore, the online survey that was conducted during empirical research was written in German (due to the fact that the survey was distributed in Austria) and in this way excluded people who spoke another language. Being that this thesis follows an intergenerational approach it was important to collect information from both generations (Baby Boomers - aged 65+ and Generation Z - aged < 26). This could be achieved, however, there is an discrepancy between the number of participants from different generations; from a total of 110 participant 55 were from the Generation Z and only 11 participants form the Baby Boomer generation. Besides that, due to the COVID-19 pandemic most of the user testings of the final interactive prototype had to be conducted online over Skype or similar tools. This minimized the effect of having a real phone application in the hand and was harder for the author to directly observe usability issues. Also the sample size was limited to only five testers on the final version of the prototype. Another limitation that should be mentioned is based on the focus that this thesis took, namely basing the communication about climate change on positive vision.

Due to scope limitations further adaptations, additional tests, and experiments have been left for future work. Future work may address deeper analysis of particular elements by conducting longitudinal studies, applying different methods, or new interactions.

The first suggestion for future work would be to conduct testings with a bigger sample size with participant from both target generations (Baby Boomers - aged 65+ and Generation Z - aged < 26) and eventually conduct a longitudinal test to prove if the app re:future can achieve what it aims at: enabling intergenerational communication and in this way also increasing the well-being of users. Additional tests and experiments could be conducted by observing individuals possible behavior change over time. Since the current implementation of re:future offers the possibility to observe feelings of the entire team and the possibility that each individual can change their feelings over time. It would be interesting to analyse how and if the app could lead to a behaviour change of how an individual feels about climate change.

Secondly, future research could more closely examine the interactions of the story creation process. Figuring out the best possible novel interaction that are usable by older and younger audience. Due to feedback of participants during the testing phase, a step in which the user selects how their content should be experienced was taken out because it was not really clear to the audience what it really does and why this would be important. Nevertheless, this aspect could be examined in more detail to enrich the experience while using re:future.

Lastly, it could be investigated how the intergenerational communication would be executed during the use of re:future. Besides that, also completely other or similar approaches that focus on enabling intergenerational communication can be proposed and evaluated.

Original interview guide

Einleitung: "Ich möchte mit Ihnen über den Klimawandel sprechen. Wäre das in Ordnung?"

1. Erzählen Sie mir mal was Sie über den Klimawandel denken.

   a) Was ist das erste was in Ihren Kopf kommt wenn Sie an KW denken?

   b) Welche Gefühle löst es in Ihnen aus?

   c) Wie betroffen fühlen Sie sich? Auf was hat es große Auswirkungen?

   d) Wie finden Sie das,dass sich die Jugend so für den Klimaschutz einsetzt?

2. Was war die letzte Aktivität, die Sie für den Zweck des Klimawandels unternommen haben?

   a) Was machen Sie sonst dafür?

   b) Haben Sie schon einmal an einem Event für den Klimawandel teilgenommen?

   c) Was denken Sie können wir als Gesellschaft noch machen um den Klimawandel zu stoppen? Was ist mit Politiker?

3. Fühlen sie sich ausreichend über den Klimawandel informiert und was Sie dagegen tun können?

   a) Ja → wo beziehen Sie Ihre Infos her?; Nein → was fehlt Ihnen?

   b) Welchen Informationsquellen vertrauen Sie am meisten? Freunde, ärzte, Familie, Medien, Regierung, Wissenschaftler, etc.)

4. Wie ernähren Sie sich? (vegan,vegetarisch,allesesser)

   a) Allesesser → wie oft essen Sie Fleisch in der Woche?

  b) Was ist dir bei der Auswahl von Lebensmitteln besonders wichtig? (schmeckt gut, regional, billig, bio, gut für die Umwelt, etc.)

5. Wie legen Sie längere Wege (über 1 km) normalerweise zurück?

6. Wie oft fliegen Sie pro Jahr?

7. Reden Sie mit der Familie über dieses Thema?

  a) Worüber haben Sie letztes Mal geredet?

  b) Spüren Sie Unterschiede wenn Sie mit Ihren Eltern/Kindern reden?

  c) Wenn Sie an eine Person denken, die nicht so umweltbewusst lebt - was denken Sie könnte diese Person motivieren nachhaltiger zu sei?

8. Was denken Sie, gibt es einen Unterschied zwischen der Einstellung der älteren und der jüngeren Generation zum Klimawandel? Warum?

9. Gibt es noch etwas was Sie hierzu beschäftigt?

10. Wie alt sind Sie? + Geschlecht notieren!

APPENDIX B

Online survey questions

Section 1: Introduction

Hello,

I appreciate you taking your time to support us in defining new innovative solutions to mitigate climate change and shape a healthier and more sustainable future.

The goal of this anonymous survey is to help us understand how we as individuals perceive climate change and which challenges we currently face. The results of the survey will be used in the course of a master's thesis at the University of Technology Vienna.

Duration: approx. 15 minutes; Answers also possible in English

Thank you for your support!

Hana Salihodzic

Section 2: Mood

1. What is the first thought that comes to your mind when you think about climate change? (open-ended question)

2. What feelings are triggered in you when you think of climate change? (multiple answers possible)

   - Concern
   - Anger
   - Powerlessness

- Uncertainty

- Hope

- Shame

- Fear

- Indifference

- Joy

3. What feelings are triggered in you when you think of COVID-19? (multiple answers possible; same answer options offered as in the previous question)

Section 3: Activities

1. This is a list of activities you might do. For each activity you do regularly, please indicate the reason why you do it. (Multiple answers are possible per question) List of activities:

   a) I turn off lights when they are not necessary

   b) I turn the heating down when leaving the house for longer than 2 hours

   c) I separate the garbage (recycling)

   d) I turn the water off when it's no longer needed

   e) I deliberately buy regional vegetables and fruits

   f) I consume little or no meat (max. 1-2 times per week)

   g) I use public transport or a bicycle

   h) I have reduced my air travel

   i) I am politically committed for climate policy

   For each of the activities following reasons could be matched:

   - I've always done that

   - To protect the environment

   - To save money

   - For my health

   - Others have inspired me

   - Not applicable

2. Have you ever participated in a climate change event or demo (e.g., Fridays for Future)? (yes/no)

3. How often do you discuss this topic with people from social circle?

a) Never

b) Seldom (1-2 times per month)

c) From time to time (once per week)

d) Often (2-3 times per week)

e) Very often (whenever meeting someone)

f) On a daily basis

4. Which age are the people with whom you most often discuss around climate change?

a) Same age (+/- 3 years)

b) Younger

c) Older

d) Mixed

5. Which of the following climate-friendly activities will you start or continue in the next 6 months?

- Waste separation/recycling
- Buying local and seasonal products
- Reduce waste
- Avoid plastic products
- Consume less meat
- Pay attention to my electricity consumption
- Use public transport (more often, instead of the car)
- Use a bicycle (more often, instead of the car)
- Use renewable energy (e.g., green offers from electricity providers)
- Generally consume less
- Reduce air travel
- Inform me more about the topic
- None of the things

Section 4: Consumption

1. On which level do you set your heating in winter?

a) Heating level 1-2

b) Heating level 3-4

c) Heating level 5

2. Do you look for trustworthy sustainability labels when buying products (clothes, cosmetics, food, etc.)? (e.g., FSC, Fairtrade, Fair Wear Foundation, UTZ, etc.)

   a) Always

   b) Sometimes

   c) Never

3. How often do you eat meat?

   a) Daily

   b) Often (3-4 times per week)

   c) Sometimes (1-2 times)

   d) Seldom

   e) Never

4. How often do you eat animal products (eggs, milk, cheese, etc.) per week?

   a) Daily

   b) Often (3-4 times per week)

   c) Sometimes (1-2 times)

   d) Seldom

   e) Never

5. How much do you fly on average per year?

   a) Not at all

   b) <10 h

   c) 10 - 20 h

   d) 21 - 40 h

   e) > 40 h

Section 5: Climate change details

1. How much do the following statements apply to you? On a scale from 1 (not applicable) to 5 (very applicable).

   • I feel affected by climate change.

   • I believe that climate change can still be stopped.

2. What do you think how much should each of the following entities do to combat climate change? On a scale from 1 (not applicable) to 5 (very applicable).

- Citizens (every individual should get involved and pay attention to low carbon activities in their daily lives)

- International or global organisations (e.g., EU, UN, World Bank)

- Companies and large organizations

- Government

- Teachers and professors

3. What countermeasure do you think has the greatest impact on climate change? [Prioritisation: priority A (greatest impact) and priority F (minor impact)]

- Fly once less

- Avoid plastic bags

- No meat consumption

- Live without a car

- Procure green energy

- Buy regional and seasonal food

Section 6: Information

1. How much do the following statements apply to you? On a scale from 1 (not applicable) to 5 (very applicable).

- I feel sufficiently informed about climate change.

- I feel sufficiently informed about the possibilities on how to combat climate change.

2. How much do you trust the information about climate change when it comes from the following people:

- Family

- Friends

- Media (TV, newspapers, radio, etc.)

- Doctors

- Environmental organizations

- Scientists

Section 7: Improvements

1. In what way would you like to learn more about climate change and its counter-measures? (multiple answers possible)

- Playful
- Speak
- Creative
- Experience physically
- Experiment
- Read
- Interactive
- Together with others
- Hear

Section 8: General data

1. How old are you?

   a) 10-25

   b) 26-40

   c) 41-55

   d) 56-74

2. What is your gender?

   a) Female

   b) Male

   c) Prefer not to say

3. What is the message that you would like to give to our society? (open-ended question)

Section 9: Closing (Food for thought)

Food for thought:

Most of us are already aware of the consequences climate change can have if we do not change the way we use the resources the world offers us. Increasing weather extremes, pollution of the air we breathe, health problems, extinction of species, acidification of the oceans, rising sea levels and many other problems cannot be reversed if we already give up now and do not try to build up a common vision for a better future.

What if we used the current crisis as an opportunity to rethink our daily activities and attitudes, to work on a better, more sustainable future that is not profit-driven but leads to better, healthier food and deeper interconnection to our fellow human beings and nature? A future with free public transport, regional products from home-grown food, meat alternatives and new initiatives for collective success. Let us try to make our daily activities an integral part of the solution. Let's start doing it NOW, because taking care of ourselves means taking care of our climate.

Initiatives such as CATL in Belgium, or the energy turnaround in Ungersheim, France, show that alternatives exist, and are even more profitable than widely spread approaches.

If you would like to know more about this topic or would like to receive the results of this scientific work, feel free to contact me via e-mail hanasali-hodzic@hotmail.com!

Original quotes from online survey (messages to the society)

Reduce resources

Q1-Z: "Weniger Fleisch konsumieren"

Q6-Z: "Hört auf unnöutiges Zeug zu kaufen!"

Q10-Z: "Wie ist es mit konsum vieler elektronischer geräte, dauernd neu usw. das ist ja nicht wirklich nachhaltig und auch für das klima belastend"

Q14-Z: "Einwegplastik bestmöglich vermeiden, Radwege und öffentlichen Verkehr besser ausbauen."

Q17-Z: "Der Klimawandel ist unvermeidbar, aber man kann ihn massiv verlangsamen indem man bei Kreuzfahrtschiffen, dem Flugverkehr und Frachtschiffen ansetzt und die regionale Wirtschaft ankurbelt."

Q19-Z: "Fleischkonsum reduzieren, wieder mehr bodenständig und naturverbunden leben"

Q20-Z: "bewusster mit den Ressourcen umgehen"

Q25-Z: "Der Klimawandel betrifft uns alle, denn unser Lebensraum ist davon betroffen. Wir müssen uns verstärkt dafür einsetzen Bewusstsein in der Bevölkerung und in der Wirtschaft zu schaffen, damit wir den Klimawandel gemeinsam stoppen können! Jeder sollte einen Beitrag im Alltag leisten zB Nützung öffis oder Reduzierung des Fleischkonsums und endlich handeln."

Q32-Z: "Papier oder Kartontüten benötigen sehr lange Holzfasern um das Gewicht unserer Einkäufe tragen zu können, um diese zu Gewinnen benötigt man ein unvernünftig hohe Menge an Wasser und Holzmaterial, egal ob Papier oder Plastik Einweg ist immer Scheiße"

Q38-Z: "Firmen könnten den Klimawandel reduzieren indem sie Mitarbeiter weniger zu Kunden zb fliegen und mehr online Meetings halten (wie man vor allem in diesen Zeiten von Corona sieht)."

Q4-Y: "Wenn die Gesellschaft als Verbund von Menschen und nicht einer Organisation

gemeint ist wsl: Das man kleine Wege mit dem Rad anstatt mit dem Auto zurücklegen kann. überhaupt auf dem Weg zur Arbeit und wieder zurück Macht über das Jahr sehr viel CO2 Einsparung aus."

Q17-Y: "mehr achtsamkeit und weniger konsum"

Q1-X: "Bewusster mit der Umwelt umgehen."

Q4-B: "Zu Fuß gehen oder Fahrrad verwenden, Waren ohne Plastikverpackung den Vorzug geben, regional und saisonal einkaufen"

Individual action/impact

Q4-Z: "Wir brauchen nicht eine Katastrophe zu erleben um gesunder zu leben. Schon kleine Veränderungen von jedem Einzelnen können für alle einem besseren Ort zum Leben machen"

Q11-Z: "Jede Kleinigkeit trägt dazu bei."

Q13-Z: "Ich denke, wenn jede Person nur etwas mehr Umweltbewusstsein in den eigenen Lifestyle einbaut kann bereits viel Positivies errichtet werden."

Q23-Z: "Mülltrennung ist wichtig"

Q24-Z: "Do what you can."

Q26-Z: "Ich denke, dass nur gemeinsam etwas gegen den Klimawandel unternommen werden kann, aber dennoch jeder Einzelne seinen Beitrag leisten muss."

Q27-Z: "jeder kann was beitragen"

Q31-Z: "Das auch kleine Schritte viel bewirken können"

Q34-Z: "Jeder Einzelne kann dazu beitragen die Folgen des Klimawandels zu reduzieren, das muss endlich in den Koepfen der Menschen ankommen! Es geht viel um das individual behaviour, es muss diesbezüglich mehr aufgeklärt werden & die Ernsthaftigkeit vermittelt werden."

Q1-Y: "Klimawandel betrifft uns alle und sollte von der Gesellschaft als das wichtigste Problem angesehen werden, dass es zu lösen gilt. Es müssen Lösungen gefunden werden, die sowohl ökologisch als auch wirtschaftlich sinnvoll sind. Auch wenn die Hauptimpulse aus der Politik kommen sollten, kann jeder Einzelne einen Beitrag leisten und sollte die Auswirkungen des eigenen Handelns nicht unterschätzen."

Q11-Y: "Mehr über den Klimawandel informieren"

Q13-Y: "Jeder einzelne kann und muss etwas tun um dem Klimawandel entgegenzuwirken"

Q14-Y: "Macht ihr weiter an der Informierung der Menschen"

Q21-Y: "Es soll sich jeder bemühen bewusster zu leben"

Q4-X: "Das Alles beginnt, mit dem eigenen Wandel"

Q3-B: "Jedes Engagement ist wichtig und notwendig!!!!"

Q6-B: "Achte auf das was dir möglich ist und mache es"

Collective power/action

Q2-Z: "We, the willing, must clean our own mess and the mess of the unwilling."

Q26-Z: "Ich denke, dass nur gemeinsam etwas gegen den Klimawandel unternommen werden kann, aber dennoch jeder Einzelne seinen Beitrag leisten muss."

Q35-Z: "Wir schaffen das!"

Q36-Z: "Die ganze Welt muss miteinander arbeiten, es nützt nichts wenn bspw. Europa alleine daran arbeitet"

Q37-Z: "Wenn wir uns alle Mühe geben und an einem Strang ziehen können wir viel bewegen und unsere Zukunft retten."

Q40-Z: "Wir sind alle im Selben Boot. Let's make a change!"

Q27-Y: "zusammen können wir es schaffen, vom Kleinbauern im globalen Süden zu den großen FIrmenchefs in den Industriestaaten"

Q7-X: "Das Gefühl der Zusammenhänge zu stärken!"

Harmony with nature

Q19-Z: "Fleischkonsum reduzieren, wieder mehr bodenständig und naturverbunden leben"

Q25-Z: "Der Klimawandel betrifft uns alle, denn unser Lebensraum ist davon betroffen. Wir müssen uns verstärkt dafür einsetzen Bewusstsein in der Bevölkerung und in der Wirtschaft zu schaffen, damit wir den Klimawandel gemeinsam stoppen können! Jeder sollte einen Beitrag im Alltag leisten zB Nützung öffis oder Reduzierung des Fleischkonsums und endlich handeln."

Q42-Z: "Die Menschheit steht nicht über der Natur nur weil wir vermeintlich intelligenter sind als die restlichen Lebewesen."

Q8-Y: "Mehr Bewusstsein für die Natur."

Q18-Y: "Im Einklang mit der Natur leben"

Q6-X: "Wir brauchen wieder mehr das Gefühl davon und Verständnis darüber, dass wir mit der Natur in einem ökosystem verbunden sind und uns nicht über die Natur stellen können."

System change

Q9-Z: "Ich würde mir wünschen, dass die Gesellschaft und insbesondere die Regierung bei der Klimakrise genauso drastisch handelt bzw. reagiert & Bewusstsein schafft wie bei der Coronakrise"

Q17-Z: "Der Klimawandel ist unvermeidbar, aber man kann ihn massiv verlangsamen indem man bei Kreuzfahrtschiffen, dem Flugverkehr und Frachtschiffen ansetzt und die regionale Wirtschaft ankurbelt."

Q28-Z: "die abschaffung des kapitalismus"

Q38-Z: "Firmen könnten den Klimawandel reduzieren indem sie Mitarbeiter weniger zu Kunden zb fliegen und mehr online Meetings halten (wie man vor allem in diesen Zeiten von Corona sieht)."

Q1-Y: "Klimawandel betrifft uns alle und sollte von der Gesellschaft als das wichtigste Problem angesehen werden, dass es zu lösen gilt. Es müssen Lösungen gefunden werden, die sowohl ökologisch als auch wirtschaftlich sinnvoll sind. Auch wenn die Hauptimpulse aus der Politik kommen sollten, kann jeder Einzelne einen Beitrag leisten und sollte die Auswirkungen des eigenen Handelns nicht unterschätzen."

Q7-Y: "Klimawandel ist in seinem Kern ein sozioökonomisches Strukturproblem des

Kapitalismus. Wachstum kann nur mittels Ausbeutung (sei es in Form von Arbeitskraft oder eben der natürlicher Ressourcen) geschehen und erzeugt dabei zwangsläufig höhere Emissionen → das ist schon in der Marx'schen Formel G-W-G' festgeschrieben. Was das impliziert sei mal dahingestellt."

Q9-Y: "Größter Widerstand gegen sinnvolle Massnahmen um den Klimawandel abzuschwächen verursachen neoliberale Zugänge. Kapitalismus muss genauso wie der Klimawandel kreativ bekämpft werden, nur dann haben wir eine Chance, auf politischer Ebene grosses Umdenken zu erzwingen."

Q10-Y: "Die Tatkraft aus der Corona-Krise mit in den Kampf gegen den Klimawandel mitzunehmen"

Q12-Y: "Es ist an der Zeit, was zu ändern!"

Q20-Y: "Geld macht hässlich"

Q2-X: "Transparenz und Massnahmen bezüglich Klima"

Q5-B: "Wir müssen den richtigen Weg finden um den Klimawandel zu stoppen und gleichzeitig dass die Wirtschaft nicht benachteiligt wird. Wenn manche Dinge wirklich schädlich sind sollten diese wirklich gestoppt werden und es sollte nicht nur darüber geredet werden."

Q7-B: "Den Wandel in einen demokratischen Sozialismus"

(Self-) Reflection

Q7-Z: "Es betrifft uns alle und nicht erst die nächste oder gar übernächste Generation"

Q8-Z: "Mehr auf sein Umfeld achten & auch mal seinen Lebenstil objektiv zu hinterfragen."

Q15-Z: "Mehr Achtsamkeit und Verständnis dafür, dass wir alle vom Klimawandel betroffenen sind und handeln müssen"

Q18-Z: "Jeder sollte zumindest bemüht sein, mit den zur Verfügung stehenden Resourcen verantwortungsvoll umzugehen und nicht nur im eigenen kleinen Rahmen denken"

Q29-Z: "Veränderung beginnt immer bei einem selbst."

Q45-Z: "Sie zu bewussterem und nachhaltigerem Handeln verleiten."

Q3-Y: "Etwas mehr Bescheidenheit würde niemanden schaden."

Q20-Y: "Geld macht hässlich"

Q4-X: "Das Alles beginnt, mit dem eigenen Wandel"

Q5-X: "bewussster leben bzw. einkaufen beim Bauern"

Q1-B: "Fangt endlich an um zu denken!"

Q2-B: "Bewusster Leben"

Q9-B: "es ist genug für alle da, aber nicht für unsere Gier"

Q10-B: "wir sollten mehr unternehmen"

Critical thinking

Q16-Z: "Man sollte die gesamte Situation genauer betrachten. Bsp.: Autos werden wegen der Emissionen als Sündenbock für schlechtes Klima dargestellt, obwohl die Emissionen moderner Autos durch Filter und Katalysatoren oft schon die selbe Qualität wie die

Atemluft haben. Des weiteren sind Elektroautos bzw. Batterie betriebene Autos nicht die Lösung der Klimaprobleme, im Gegenteil."

Q22-Z: "Die Gesellschaft soll sich mehr an wissenschaftlichen Publikationen orientieren."

Q32-Z: "Papier oder Kartontütten benötigen sehr lange Holzfasern um das Gewicht unserer Einkäufe tragen zu können, um diese zu Gewinnen benötigt man ein unvernünftig hohe Menge an Wasser und Holzmaterial, egal ob Papier oder Plastik Einweg ist immer Scheiße"

Q22-Y: "Behauptungen kritischer hinterfragen (welche Motivation hat die Person?)"

Q23-Y: "Bei Medien den Ursprung des Artikels recherchieren - Welche Motivation verfolgt der Autor? Wer bezahlt ihn?"

Q24-Y: "Selber denken und eine Meinung bilden!"

Q8-X: "Schaut mal über den Tellerrand und versucht zu sehen, wie alles mit allem zusammenhängt..."

Positive outlook

Q3-Z: "Lasst uns die Dinge jetzt angehen und mehr darauf achten wie wir mit den Ressourcen umgehen! Eine neue Zukunft zu gestalten in der wir leben wollen!!! Neue Räume zu schaffen wo wir gemeinsam Sachen kreieren können und uns inspirieren können."

Q35-Z: "Wir schaffen das!" Q5-Y: "Eine nachhaltigere, entschleunigte und gerechtere Welt würde uns allen zu gute kommen."

Q27-Y: "zusammen können wir es schaffen, vom Kleinbauern im globalen Süden zu den großen FIrmenchefs in den Industriestaaten"

Empathy for future generations

Q21-Z: "auf andere menschen rücksicht nehmen, an die zukunft unser und unsere kinder denken"

Q33-Z: "Der Klimawandel ist nicht etwas was nur uns betrifft, sondern es betrifft auch die Generationen die nach uns kommen. Wir müssen unsere aufwachen und endliche begreifen was uns die Erde zur verfügung stellt und das nicht nur wir aber merkbar Entwicklungsländer unter dem Klimawandel leiden. WAKE UP PEOPLE"

Q39-Z: "Hoffnung für die eigenen Kinder"

Q6-Y: "Schaut auf die Umwelt für unsre Kinder und Enkelkinder"

Q15-Y: "Ich habe letztens einen Spruch gelesen, der ungefähr ausgesagt hat wieviel Solidarität momentan doch im Hinblick auf COVID-19 gegenüber älteren und Schwächeren gezeigt wird und wie wenig der jüngeren Generation im Hinblick auf den Klimawandel. Dieser Spruch hat mich sehr nachdenklich gemacht und würde ihn deshalb gerne so weitergeben."

Q28-Y: "Ich bete für uns und unsere Kinder."

Q8-B: "Denkt an alle und übernehmt Verantwortung"

Big picture (we are all in the same boat)

Q7-Z: "Es betrifft uns alle und nicht erst die nächste oder gar übernächste Generation"

Q12-Z: "Klimawandel betrifft uns alle, auch wenn uns das manchmal nicht bewusst ist."

Q30-Z: "Vorsicht ist besser als Nachsicht"

Q40-Z: "Wir sind alle im Selben Boot. Let's make a change!"

Q41-Z: "weniger egoistisch handeln"

Q43-Z: "Mehr auf das gegenüber achten"

Q44-Z: "Um 10 Personen Billionen \$ zu verdienen, leiden Billionen Menschen und Tiere, die selbst nicht schuld sind."

Q16-Y: "Klimawandel betrifft uns alle."

Q19-Y: "Mehr an die Gemeinschaft denken als jedes einzelne Individuum"

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