



JÖNKÖPING UNIVERSITY

*School of Engineering*

# Designing for Web Sustainability: The Potential of Nudges and Sustainable Web Design in Reducing the Environmental Footprint of Communication Platforms

Development and evaluation of a fictional communication platform with a sustainability-focused approach

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## **Abstract**

Digital communication through communication platforms has increased and changed significantly during the last decade and recently not least because of the corona pandemic, which has shifted many face-to-face activities to the internet (Obringer R. , et al., 2021). This paper firstly contains a quantitative survey study that investigates human behaviour and their experience on digital communication platforms with a focus on media transfer of photos and videos. Afterwards the data sizes of various media after transfers through diverse communication platforms are explored in an experiment. This is followed by the development of a prototype in which sustainable design is implemented and aim to nudge the user to more sustainable-friendly digital behaviour relating data transfers of media and the settings of a communication platform. Finally, the prototype undergoes usability testing through which the user experience and positive environmental impact is evaluated. The findings reveal that the implementation of sustainability-focused nudges, features and design within a communication platform can lead users to more sustainable decisions in one or more areas of the platform and thus improve its environmental footprint.

## **Keywords**

Sustainable Web Design, Sustainable-Friendly Behaviour, Sustainability Nudging, Data Transfer, UX-Design, Communication Platform Design, Digital Nudging

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# 1 Introduction

Communication between humans takes place verbally and non-verbally, and throughout the last decade and with the rise of Web 2.0 and latest the corona pandemic there has been a meteoric evolution in digital messengers, enhancing written and visual communication (Alshenqeeti, 2016). Texts, emojis, memes, gifs, videos, and pictures contain the possibility to convey more information than a hundred spoken words. Visual communication via images and videos is part of everyday life for most people and the theoretical framework and survey of this research confirm that platforms like WhatsApp, Facebook Messenger, Instagram, and Snapchat are used daily for sending and receiving media. As the use of digital communication platforms and tools grows so does their consequential energy consumption and environmental footprint. According to Greenwood (2021) it is the duty of people who work in the digital field to see how close they can get to the ideal case, which is the elimination of an environmental footprint, while simultaneously being aware that one cannot achieve it fully. Certainly, this study will provide them with an idea of how to work towards this environmental responsibility. Given, the following report documents our final thesis work in Informatics, within the program of New Media Design, which aims to explore how the design of communication platforms can nudge users to more sustainable decisions, for example when sharing images and videos, and in turn improve their environmental footprint while considering what impact a sustainable design and sustainability-focused features have on the user experience without impairing it.

## 1.1 Problem statement

### 1.1.1 Environmental Footprint and Responsibility

Climate change and natural resource exploitation are critical issues due to exceeding human activity and a worse developing problem for all living organisms on Earth. A common issue with emission, exploitation and pollution is that their origins and magnitudes are hardly given enough attention, because their effect arises with a time lag as Berners-Lee points out (2020). Similarly, within the world of informatics, consumers, web developers and designers are unaware of the environmental footprint that their digital actions cause. All things that are done, bought, or created cost an emission, consumption or pollution, whether they are part of the real or the digital world (Berners-Lee, 2020). In an online article, Nicola Jones, also quoted by Greenwood (2021), raises awareness that the internet pollutes as much as whole countries, with annual emissions similar to those of Germany (Jones, 2018). Berners-Lee (2020) mentions that people are oblivious to environmental costs and have difficulty distinguishing the amount of impact of a certain product. Therefore, it is of utmost

importance to take responsibility when creating and consuming products and services, both digital and non-digital. Greenwood (2021) addresses it as follows in his book about sustainable web design: “[As people who work in digital] it’s our responsibility, as the people who build and maintain the hardware and software of the internet, to make sure our work creates the future we want”. This process starts with identifying the environmental footprint that comes from the usage of digital products and services that designers and developers make when creating the digital world. Obringer et al. (2021) raise awareness in their journal paper, that the newly developed digital lifestyle has major environmental benefits, including the reduction of travel-related CO<sub>2</sub> emissions. But as internet usage and data transfer increase through the consumption side and choices of the individual user, designers and web developers must consider their impact on the users’ choices to make the transition to a smaller environmental footprint of each users’ usage of digital products and services successful.

### **1.1.2 Digital Communication and Mass Media**

The Covid-19 pandemic caused an increase in internet usage by 40-100 per cent with rising data transfers, resulting in higher energy consumption levels as Jiang et al. explain (2021). Communication technology is estimated to use 14 per cent of global electricity by 2040 (Belkhir & Elmeligi, 2018) compared to 4 per cent in 2020 (Greenwood, 2021). The current most popular communication platforms for digital communication are WhatsApp and Facebook Messenger, each of them daily processing over 100 billion text messages (Statista, 2021) and Snapchat with globally 375 million daily active users, transferring over 5 billion shared photo and video files (SnapInc, 2022). Thus, the exponential growth of data transfers in our daily communication reveals an emerging issue of the environmental footprint of our communication as more data transfers equal an increase of necessary energy for the data transfers, but also to powering servers, databases, and personal devices (Greenwood, 2021). Greenwood (2021) mentions data transfer as one of the two indicators of how to measure sustainability on a website. Roughly 50 per cent of the data transfer that occurs when opening a website originates from containing images that need to load. The same process of data transfer is found when uploading and downloading images and videos on communication platforms as the sender uploads the media to the server, while the receiver downloads the media from the server. The smaller the media size, the less data runs through the process of uploading and downloading (Burian, 2004). This demonstrates the impact of the size of media in daily data transfer and clarifies that a reduced media resolution, which concludes a smaller media size, could positively impact the energy consumption that follows each data transfer. Information Technologies can help to provide solutions towards this sustainable development in energy consumption and emissions and thereby impact human behaviour long-term.

This research, therefore, focuses on the potential of sustainable development on the web within Human-Computer Interaction.

## 1.2 Purpose and research questions

We propose to investigate the implementation of sustainability-focused nudges in the features and design of a communication platform and to explore how a sustainability-focused approach impacts the user experience.

Concerning that aim, the following research questions have been formulated:

1. *How can the design of communication platforms nudge users to select more sustainable application settings relating to data size reductions when sharing images and videos?*
2. *How does a sustainability-focused approach in the design and features of a communication platform impact the user experience and its adoption?*

## 1.3 Scope and limitations

The research aims to answer the above-listed research questions in the thematic field of digital environmental sustainability within User Experience Design (UX-Design) from a front-end perspective. It will not investigate the back-end perspective.

Furthermore, we will focus on holding a more holistic view of the environmental impacts of digital communication platforms. The research will not be based on its own calculations and exact numbers of environmental footprints, but instead rely on pre-existing studies and measurements about the environmental impact of human-computer interaction and data transfers of media within the web. Admittedly, this is secondary knowledge, and the numbers of environmental footprints are only accurate to a certain extent as there does not exist a perfect environmental footprint calculation method to be found, as is widely known by acknowledged researchers. The measurement for the methodology will hereby be the users' sustainability-friendliness within the digital before and after being nudged and introduced to new sustainable options.

Concerning sustainability, this study focuses only on the environmental dimension and not the economic or social sustainability which users can aim for improving within the digital.

## **1.4 Disposition**

The paper begins with a topic introduction, in which a problem and research gap are identified that leads towards the purpose of the study and the two research questions. The introduction is followed by a theoretical framework that serves as a foundation for the relevant topics within the study where existing data and knowledge are summarized. The chosen methods, their pre-studies and implementation for answering the research questions follow right after. The findings of the multi-method approach are evaluated, and an analysis is performed. The analysis is then discussed regarding the purpose of this paper and its research questions. The research paper is finalized with a conclusion and discussion of further research opportunities.

## **2 Theoretical framework**

### **2.1 Environmental Footprint of Digital Communication**

Communication has been an important driver for humans, ever since their existence. The purpose of communication, meaning sharing information, has remained the same, whereas the channels and mediums of communication have changed a lot. Place-independent, direct communication became accessible with the invention of the phone and the start of the Internet, enabling digital mass media and information production through visual and written communication. As of importance for this research, the focus lies on digital visual communication through images and videos that are used as communication mediums when transferring information from one sender to one receiver.

#### **2.1.1 Digital Communication**

Humans have developed and adapted to diverse communication channels over time. While some channels only allow the usage of a few distinct communication types, such as a book only allows for visual and written communication, the internet has made a big change allowing a phone device or laptop to make use of all communication types. Texting can transfer written information, voice mails transfer verbal information, images transfer visual information and videos can transfer non-verbal, verbal, written and visual information depending on its conception. With the rise of the internet, digital communication has become next to face-to-face communication one of the greatest channels to transfer information. Oppegaard (2015) claims that human communication evolved from an entirely oral, interpersonal culture to a culture blending orality and digital mass media communication in digital and analogue forms. Digital communication is an essential need of modernized societies. Furthermore, the impact of the corona pandemic lockdown on communication channel usage is big (Obringer R., et al., 2021), given the abrupt transition from in-office to remote work and coffee meetings to remote phone calls to catch up with friends. Through communication platforms information messaging through written, verbal, non-verbal and visual channels including texting, phone calls, video conferences and media sharing can be facilitated. This leads to an ease of communication but also a massive increase of digital data being produced and transferred through the internet. The most popular and leading platforms in Europe are WhatsApp and Facebook Messenger, whereas Sweden's most popular platforms are SMS/iMessage, Facebook Messenger and Instagram according to statistics from May 2021 (Mehner, 2023). Established and developing communication platforms have an ever-expanding and evolving role within communication nowadays. Tools and features within the platforms are continuously developed, adapted, and improved over time due to continuous new learnings from hardware and software technology, user behaviour and needs.

### **2.1.2 Environmental Footprint of Data Transfers**

An environmental footprint is made up of several factors of which one is the carbon footprint. According to Berners-Lee (2020), all things done, bought, or created cost an emission, consumption or pollution, whether they are part of the real or the digital world things that are done, both non-digital and digital, have a carbon footprint. Ferreboeuf et al. (2019) unveil that the internet alone generates about 3.7% of global carbon dioxide emissions. To get a perspective, Berners-Lee (2020) calculates: daily messages and calls using mobile data on the smartphone generate about 70kg CO<sub>2</sub>, with 0.3g CO<sub>2</sub>e (carbon dioxide equivalent) accounting for every spam mail and 50g per mail with attachment. Also, according to him, the dark number of other impacting factors is hard to identify, and rapidly changing technology is hard to track, which is the reason why even the best calculations on carbon footprints are expected to be inaccurate to a certain degree.

Cisco (2020) calculated that global data traffic would be at an exponential rate of 150 gigabytes per second in 2022 which equals about 32 gigabytes for each person on the planet per month. Taking into consideration that only 66% of the global population uses the internet (Cisco, 2020), the real data transfers of people in Western Europe or Northern America would be a lot higher. The data transfers are causing a rapid deployment of data centres to store, retrieve and transmit them. Data centres have a negative impact on the environment, as they consume large amounts of power for running their hardware and non-IT components such as ventilation, cooling systems and lighting according to Al-Ayyoub et al. (2015), making data transfer an emerging issue for the environmental impact of digital communication.

### **2.1.3 Data Transfers and Sizes**

The most common image file type is raster file images that are made up of a fixed number of colour pixels. A colour pixel is the smallest component of a digital image and displays a colour that in combination with many other pixels creates the full image. Burian (2004) explains that the number of pixels that an image contains impacts the data size of the image because more pixels equal more information and thus more data. Another factor that influences the data size, he explains is how many colours are contained in an image, for example, a black and white image has a smaller data size than the same image in colour because the black and white image contains fewer colours and thus less information. There is a big span of data sizes that images can have: An image taken with a mobile phone could for example have a data size of 1100 KB while an image made with a professional camera, such as an SLR camera, could for example have a data size of 10900 KB. Media that is shared from one device to another through a communication platform is first uploaded to a data centre which stores the information, the data, of the media. To receive the media on the other device the data is downloaded from the data centre. Uploading and downloading media through

communication platforms consumes energy which varies in size depending on several factors, of which one is the size of the data that is up and downloaded according to Berners-Lee (2020). He explains, the larger the data size that is transferred, the more energy is needed to upload, download, and store the data in the data centre, and the bigger its carbon and thus environmental footprint. As users of communication platforms have no impact on many technical factors that influence the environmental footprint of the data centres themselves, it is relevant to focus on what users have an influence on, namely the sizes of the media files that users upload and download, and settings that are related to sending media files and influence the energy consumption of their data transfers (Berners-Lee, 2020).

The measurement of the data size of media transfers is taken in kilobytes of data that a photo or video contains. The units are displayed and declared in *Figure 1*. The bit is the smallest unit that can only store values from 0-1 and is not applicable to the media transfer that this study entails. Byte is the smallest unit for data size which can specify the amount of data sent in a very pixelated photo. Typically, data sizes of media that are sent through communication platforms, are a data size of a few hundred Byte up to a few Mega-Byte.

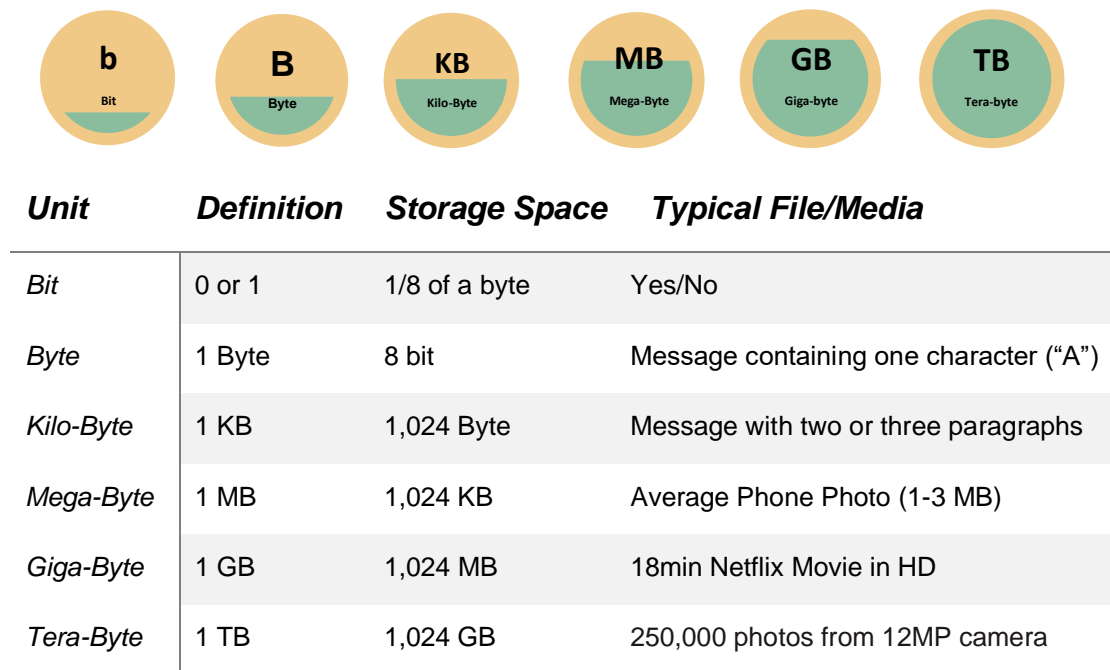


Figure 1: Data Units

#### 2.1.4 Environmental Footprint Measurement

There have been many efforts by authorities and researchers to calculate the environmental footprint of the Internet, digital communication channels and data transfers and storage. Up till now, there is no proven exact method to be found and the calculated footprint is often expected to be higher by up to 50% than accumulated, thus

all calculations come with a possible inaccuracy. There is a certain inaccuracy in most of the carbon footprint calculations, and just very little research and numbers available on the land and water impacts of the internet and data. That is one of the reasons why the study will not be based on exact numbers but rather on a more holistic explanation of sustainability approaches. Also if numbers would be stated, they might become invalid within a few years, as Aslan et al. (2017) disclose, given the technological and efficiency improvements in the internet sector and the changing energy supply portfolios around the world, there is a need to continuously update the previous calculation updates. Another ethical problem that might be occurring is that incorrect numbers are spread quickly through people and media when reporting them (Kooimey, 2014). The problem according to Kooimey (2014) is that incorrect data can have real-world consequences when widely believed and action is taken.

### **2.1.5 Sustainability Adaption of Communication Platforms**

All widely used communication platforms compress the media that is shared (Appendix B), giving the media a lower resolution, meaning a smaller file size and less data that needs to be transferred, than the original. By reducing the file size, more data can be stored in a data centre or phone storage as well as it requires less energy when being transmitted over the internet. This has the benefit of making media send faster and draining less internet data.

Another sustainable aspect is that most smartphones give the option to set the phone in dark mode, which enhances energy efficiency using dark colours. That is applied in communication platforms such as WhatsApp and Facebook Messenger, while some communication platforms, such as Snapchat, do not change their colours about the smartphone setting, only within the app settings itself. Most platforms allow the user to change the background for their chats, enabling the user to determine the colours that are used on the platform. Another sustainable aspect that WhatsApp settings allow is the option to never automatically download media or only when the phone is connected to Wi-Fi. Instead, the user must manually click the media to download. Furthermore, WhatsApp delivers statistics about the users' sent and received bytes within shared media and calls, and the number of messages that have been sent and received through the account. Another sustainable aspect of WhatsApp is that the user can change the default quality when sending media. The user can choose between 'save data', 'highest quality', and 'auto'. Facebook Messenger does not allow the user to change any setting regarding low- and high-quality media or data usage, while iMessage can be set to 'low-quality image mode' within the iPhone settings, and Snapchat can be set to 'save data mode', in which filters and 'snaps' must be downloaded manually and take longer to load.

As mentioned, some communication platforms give users the option to change the default quality of images. This enables the users to influence the data sizes that are

transferred when media is shared and thus links the decision of the users to the transferred data sizes. Furthermore, the users choose whether media is shared via Wi-Fi or mobile data, which influences the energy consumption of the transfer, as Wi-Fi consumes less energy than mobile data, according to Berners-Lee (2020). Lastly, users have the option to adjust their backgrounds within diverse communication platforms to images and many diverse colours, which influences the energy consumption of the device itself (Greenwood, 2021).

## **2.2 Human-Computer Interaction**

Human-Computer Interaction (HCI) is the interaction between man and machine that emerged automatically with the creation of the computer, as the computer or equivalently any machine is considered worthless unless it can be properly used by man (Karray, Alemzadeh, Saleh, & Arab, 2008). With the appearance of personal computers, the focus quickly shifted towards the user, which created a need for an interface with a user-centred design (UCD). UCD was first mentioned and defined by Donald Norman as the design process in which end-users influence how the design of a system or product is to be through involvement at every stage of the design process (Norman & Draper, 1986). In 1988 Norman continued his research on UCD and formulated seven principles of design (Norman, 2013) on which Nielsen (1990) later based the ten heuristic principles (*Figure 2*). The International Organization for Standardization (ISO) (2019) defined human-centred design as “an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques”. Furthermore, according to ISO (2019), human-centred design is directly related to the usability and user experience of a system.

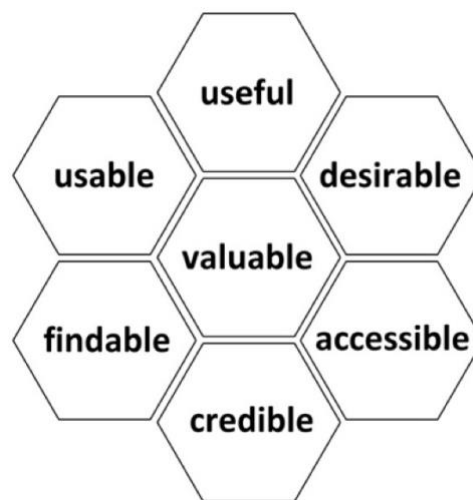
To understand how well an interface design and features compile with their end users, it is recommended to first construct a prototype before launching a final product. ISO (2019) defines a prototype as a representation of all or part of an interactive system, that, although limited in some way, can be used for analysis, design, and evaluation. Making this a required method for the following empirical study of this paper.

### **2.2.1 Usability and User Experience**

When defining usability, problems of clarity arise as Bevan et al. mention (1991) due to the diversity of views, such as a product-oriented view, user-oriented view, and user performance view, all concerning usability. They conclude that usability is to be viewed and measured in the interaction of the user and the product or system by assessing user performance, satisfaction, and acceptability. Furthermore, according to Bevan et al.

(1991), a product is not usable or unusable on its own but rather contains attributes that determine its usability to complete specific tasks by specific users in a specific environment. ISO (2019) similarly defines usability, as the extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. With the consumption increase of complex products and the World Wide Web, users started to take the ‘ease-of-use’ factor of websites for granted, thus shifting the focus more towards their reactions and emotional experiences of an interface (Bevan, Kirakowski, & Maissel, 1991).

According to Hellman & Rönkkö (2008), User Experience (UX) has no generalized definition but is considered to include more aspects than the commonly known usability definition. A widely accepted definition by ISO (2019), without generalization, is that UX is a “person’s perceptions and responses resulting from the use and/or anticipated use of a product, system, or service”. Morville & Sullenger (2010) formulated a ‘User Experience Honeycomb’ (*Figure 2*) that contains seven qualities that are to be considered within UX-Design. According to Morville & Sullenger (2010), the seven qualities are to be used as a starting point for information architects to create an infrastructure with good usability and user experience by successfully meeting their needs.



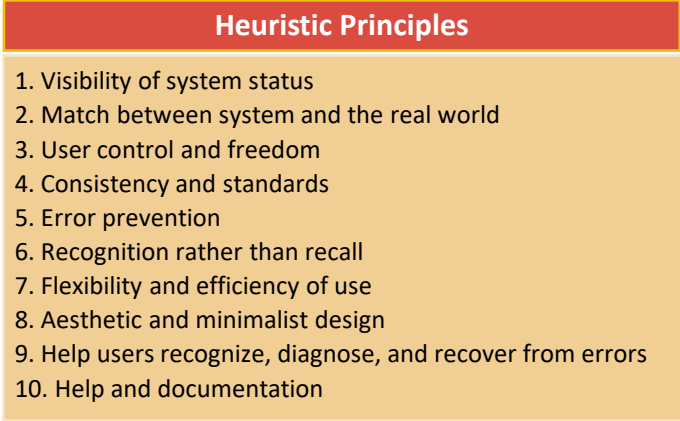
*Figure 2: User Experience Honeycomb (Morville & Sullenger, 2010)*

Nielsen (1990) suggests qualitative usability testing to evaluate the user experience of a product. Through conducting usability testing the researcher can uncover problems, discover opportunities, and learn about users. Usability testing allows quick and inexpensive research to answer the research question. Unfortunately, the output of usability testing has a low generalization, and its process is artificial and restricted. Nevertheless, they deliver actionable information and are useful when testing new

ideas, as they give clear evidence on specific parts that work and do not work within the interface. Also, Nielsen (1990) advises using five participants for the usability testing as they are enough to identify flaws in the design of a product.

### 2.2.2 Principles of UX-Design

In the context of HCI with a focus on a user interface that has a user-centred design, and good usability and user experience, many principles have developed over time to give guidance in the design of such user interfaces. Widely acknowledged principles are Nielsen’s heuristic principles (Nielsen & Molich, 1990) which are listed in *Figure 3*. Norman, the first researcher to mention the term user-centred design, defines six principles of design in his book ‘The Design of Everyday Things’ (1988), which can all be found in the heuristic principles, namely visibility, feedback, affordance, mapping, constraints, and consistency.

- 
- Heuristic Principles**
1. Visibility of system status
  2. Match between system and the real world
  3. User control and freedom
  4. Consistency and standards
  5. Error prevention
  6. Recognition rather than recall
  7. Flexibility and efficiency of use
  8. Aesthetic and minimalist design
  9. Help users recognize, diagnose, and recover from errors
  10. Help and documentation

*Figure 3: The ten heuristic principles*

### 2.2.3 Information Architecture

The term ‘Information Architecture’ (IA) was first mentioned by Bradford and Wurman (1996). They highlighted the importance of the transformation of data into information that is usable for the user. According to Rosenfeld et al. (2015), IA is one of the major influences on the user-centeredness of a user interface as increasingly information is required to be delivered to the reader of a website or user of an application. With that growth, an information overload is one of the parts that good IA counterworks, as also mentioned by Morville (2010). Rosenfeld et al. (2015) argue that good IA is dependent on the concept of connecting context, content, and users. They also highlight that good IA is displayed by two main functionalities: findability and understandability of information. These two functionalities of findability and understandability are based on four components within an interface, namely organizing, search, navigation, and labelling. An environment, according to Rosenfeld et al. (2015), differentiates itself

through its usage of language, meaning “labels, menus, description, visual elements, content, and their relationships with one another”.

This is especially important for the basic design framework of a new platform, as it is also important for empirical prototyping in the further course of this work. In the context of communication platforms, this requires preliminary research of relevant similar platforms and the subsequent implementation of their design infrastructure into the newly designed communication platform to create a familiar environment for the participants.

The most popular communication platforms, such as WhatsApp and Facebook Messenger (Curry, 2023) belong to the same environment as they all use the common language of digital communication involving a common application infrastructure and content such as video calls, voice calls, texts, and sending media and audio messages between users within the same platform. Elements within communication platforms are recognizable and users are familiar with their common features and architecture.

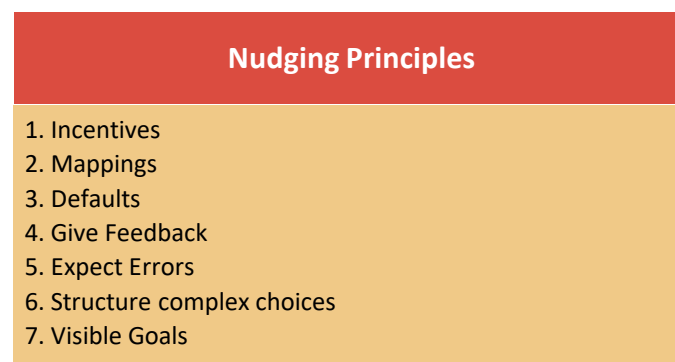
### **2.3 Nudging Theory**

Hansen (2016) describes nudging as the attempt of influencing people’s judgment, choice or behaviour in a predictable way that is motivated because of cognitive boundaries, biases, routines and habits in individual and social-decision making posing barriers for people to perform rationally in their self-declared interests, and which works by making use of those boundaries, biases, routines and habits as integral parts of such attempts. In recent years, digital nudging has become an important research focus in the information system community (Meske & Potthoff, 2017). An information system is a formal, sociotechnical, organizational system designed to collect, process, and distribute information. Within the field of informatics, a computer system is regarded as a system with installed software which, when facing the end-user, presents options to the user. Nowadays making decisions in a digital environment is mostly part of everyone’s daily life. In every application, every website, and every interface the user is faced with deciding which button to click, which link to follow, and more. Considering the number of choices that users are presented with, the way these choices are presented gains more and more importance, because the design of user interfaces, influences the behaviour of the user (Sunstein, 2015). In other words, designers of user interfaces automatically lead the user to a specific choice through the design of an interface. Therefore, designers need to understand the effects their design has on the choices of users (Weinmann, Schneider, & vom Brocke, 2016). They can either intentionally nudge the user to the most desirable choice or enhance the free will of the user by intentionally avoiding nudges that impact the users’ behaviour. The term ‘nudging’ originates in Thaler and Sunstein’s book about nudging (Thaler & Sunstein,

2008), where they define a nudge as a cheap and minimal intervention that alters people's behaviour in a predictive way without restricting options or significantly changing their economic incentives. They introduced the nudge theory, also known as choice architecture, based on research on psychology and behavioural economics.

### 2.3.1 Principles of Nudging

Thaler et al. (2010) define six design principles (*Figure 4*) within the nudging theory that helps to predict the behaviour of users. The first principle 'Incentive' is the custom to emphasize incentives to increase their effectiveness. The 'Mapping' principle delivers supportive data and information with a familiar measurement to the user. The principle called 'Defaults' preselects options by setting default options. This allows faster task completion for the user and creates an additional step for the user when he chooses a different option than the most desirable one. 'Feedback' entails providing feedback on the user's action either as a confirmation of correctness or a warning of error, for example through a pop-up window. The design principle of 'Expecting Errors' is used when the design of an interface is 'forgiving', that is when it is enabling the user to adjust or redo a task and delivering error messages that point out what must be changed in the task completion. 'Structure complex choices' describes the principle to encourage a user to filter and categorize their personal preferences and selections. Lidwell et al. (2010) add the principle 'Visible Goals' to the list, where the user is informed about their status of completing their primary task through a visual element.



*Figure 4: Nudging Principles*

### 2.3.2 Digital Nudging versus Persuasive Design

Persuasive technologies have existed for a long time in the areas of sales, diplomacy, politics, religion, arts and more. According to Fogg (2003), persuasive technologies are interactive information technologies that are designed for alternating users' attitudes and thereby their behaviour in comparison to the nudging theory, which is designed to subconsciously steer users to targeted behaviour and decisions (Thaler & Sunstein, 2008). Both persuasive design and digital nudging have goals that are change-oriented

but need to be differentiated as they contain principles that are relatable but do not cause the same effect on the user (Figure 5).

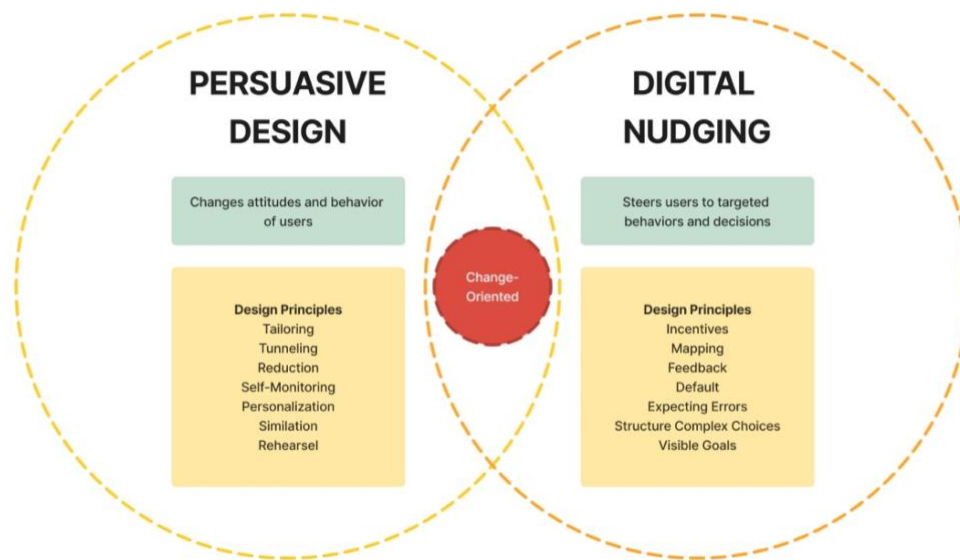


Figure 5: Persuasive Design and Digital Nudging

### 2.3.3 Evaluation of Nudging

Nudges are part of the design of a user interface. Therefore, the same methods that are used to evaluate the design of an interface can be utilized to test the effectiveness of nudges, so-called usability evaluation methods (UEM). The most frequently used UEM is user testing, the method that includes the participation of users (Fernandez, Insfran, & Abrahão, 2011).

### 2.3.4 Ethics of Nudging

Redström (2006) argues that design is inherently persuasive and suggests that designers should focus on how to consciously deal with issues of persuasion. This highlights the importance of considering the ethical aspect when designing. Similarly, Sunstein (2015) concludes that objections to nudges and choice architecture are pointless, as humans cannot live in a world without them. Concerning the general ethics of the chosen methods and this research, nudges can have paternalistic motives, where the nudge must be based on the interests of the nudgee (Hansen, 2016). This type of nudge simplifies ethical legalization as it only applies to the user's own interest. Nudges can also be viewed as the effort to influence a humans' judgment, choice, or behaviour in predictable ways in which the rational decision-making that is in line with the users' preferential choice set falls short of bounded rationality (Hansen, 2016). This type of nudge, also the more common and often unintentional one, needs to be critically evaluated on its ethics. Meske and Amojó (2020) argue that the ethics of nudges can be evaluated by a self-check on nudge choices within an interface in which the so-called

choice architect must be able to defend the used measures of their design. Additionally, they distinguish based on the aims between libertarian nudges, non-libertarian nudges, and manipulation. A nudge is a manipulation when the aim is to alter people's decision-making processes and consequent behaviour in a way, they would not have chosen by themselves (Meske & Amojo, 2020). To summarize, designers must, first, understand and be aware of the effect that the design choices have on users. Secondly, designers are obligated to have reasons for their design choices and their nudges. Thirdly, designers need to be honest about the aim and use of their nudges to ethically design user interfaces that support the autonomy and freedom of choice of their users.

## **2.4 Sustainable Web Design Guidelines**

Greenwood (2021) presents sustainability guidelines within web design. According to him, sustainable web design is based on minimalism, which is in accordance with general design principles (Lidwell, Holden, & Butler, 2010) and good information architecture (Rosenfeld, Morville, & Arango, 2015). In his book, he specifically mentions the data transfer of websites being improved through reduced data sizes of images and diverse file formats. The most energy-efficient image formats are WEBP and AVIF images which however are not accepted or editable file formats and therefore challenging to be used in communication platforms. PNG and GIF are most data efficient for images with few colours, such as icons or logos. Greenwood (2021) also mentions colour usage as part of sustainability, especially on smartphones, as most smartphones use OLED displays on which the pixels are switched off for displaying black colour. The green and red colour is 25 per cent more energy efficient than the blue colour. Other guidelines for a sustainable web that Greenwood (2021) mentions entail back-end aspects such as the choice of programming language, tracking scripts, and hosting service and data centres.

Greenwood (2021) suggests that web developers who consider sustainability should carry out sustainability benchmarking and set sustainability budgets. He explains the term sustainability budget in relation to the more common concept called performance budgeting where specified metrics get a specified budget which is not to be retained. Similarly, metrics can be chosen within sustainability such as page weight, website energy consumption (for example through the Energy Impact meter in Safari), carbon emissions and data transfer. The four steps for each chosen metric are as follows:

1. Benchmark and measure other web pages (current best practice)
2. Estimate the theoretically possible best-case scenario
3. Set the budget based on the current best practice and the best-case scenario
4. Stretch the set goal and set a more challenging sustainability budget

### 3 Methods and Implementation

The main data collection takes place through the construction of a prototype and its usability testing. Fernandez et al. (2011) discovered in their study about usability evaluation methods (UEM) that a combination of method types could provide better results than using solely one method type. Therefore, two method types were chosen in the evaluation of the constructed prototype, namely ‘user testing’ and ‘inquiry methods.

Furthermore, two preliminary studies are executed: a survey that gives insight into how much data from media is transferred through users on communication platforms and their user experience when sharing these media. Secondly, an experiment reveals how much the most used communication platforms compress various media resolutions that would impact the transferred data sizes. The results, alongside the theoretical framework, are showcasing the amount of data transfers through communication platforms and the reason for the urgency of a design for communication platforms that would enhance more sustainability-friendly behaviour.

The prototype and its usability testing answer both research questions. The prototype design and implemented features answer RQ1 *“How can the design of communication platforms nudge users to select more sustainable application settings relating to data size reductions when sharing images and videos?”* and are confirmed through usability testing. The multi-layered usability testing answers the RQ2 *“How does a sustainability-focused approach in the design and features of a communication platform impact the user experience and its adoption?”*.



Figure 6: Methodology for Research

#### 3.1 Pre-Study 1: Survey about User Behaviour and Experiences on Communication Platforms

##### 3.1.1 Survey Planning

The survey aims to deliver quantitative data about data transfers and user behaviour and experiences on communication platforms, with a focus on sharing media. The data will be used together with the experimentation to argue the rising media transfers and their data impact validity and to reason the urgency for a platform design that enhances data size reductions by the user. Also, do they help to create an IA for the prototype.

### **3.1.2 Survey Implementation**

It was decided on a digital survey as it brings the benefits of having fast turnarounds fitting the time constraints of the thesis and the given sampling frame within personal and university contacts and the targeted group, following the survey advice of Sue (2016).

The survey contained 13 questions, which can be divided into three thematical areas:

1. Demographical data
2. Behaviour and attitudes
3. Experience with media quality on their preferred communication platform

The questions provided participants with a list of response options from which to choose, including dichotomous, and multiple-choice, oriented on the survey question advice mentioned by Sue (2016), with a few questions leaving space for open-end answers through input fields. A pretesting survey was sent out to three participants to control the correctness and understandability of the survey. Thus, a small interview with the three respondents and their survey answers was used for approval of it, as recommended by Sue (2016).

The survey was distributed using the communication platforms Facebook and WhatsApp and received anonymous responses from 295 participants. The complete survey and survey results can be found in *Appendix A*.

## **3.2 Pre-Study 2: Experimentation on Data Sizes of Media Transfers**

### **3.2.1 Experiment Planning**

A quantitative data experiment is conducted to collect data sizes of shared media on the four most popular communication platforms, explored in the survey. The aim is to find out, how much each platform compresses the original data resolution of media that is shared through them. Results will reveal which platforms compress media the most and on which range compression is applied and through that how much more or less data is transferred. This gives insight into how much data can be saved through media compression and explains the prototype design focus on the reduction of media data and their connection to enhanced sustainability-friendliness. Together with the answer to the following survey question number eight, it tells also how users are accustomed to media compression.

*Survey Question 8: On which communication platforms do you send the most images and or videos to others?*

The experiment will be divided into three parts:

1. Defining media, communication platforms and devices used
2. Preparing media, transferring media, collecting data of received data sizes
3. Comparing, analysing, and connecting data results with the survey results and the theoretical framework to explore their relevance for improving the environmental footprint of digital communication

### **3.2.2 Experiment Implementation**

The experiment was conducted with an iPhone XS on which six different media files were sent to an iPhone 11 Pro via four communication platforms: WhatsApp, Facebook Messenger, iMessage, and Snapchat. WhatsApp and iMessage were each tested in two different media settings (WhatsApp: ‘best quality’ and ‘data saver’, iMessage: toggle ‘low quality image mode’), equalling six tests for each media file.

The media files that were tested were as follows: iPhone photo (HEIC), internet photo (JPG), DSLR Camera photo (JPG), screenshot (PNG), DSLR Camera video (QT), and iPhone video (QT).

The complete experiment results can be found in *Appendix B*.

### **3.3 Prototype Building**

One of the two main methods for this study is the construction of a prototype, which delivers the applied visual answer to RQ1 “*How can the design of communication platforms nudge users to select more sustainable application settings relating to data size reductions when sharing images and videos?*”, as well as the objective to be used in the connected usability testing.

#### **3.3.1 Prototype Design Planning**

For this research, a prototype of a non-existing communication platform will be constructed. It will be created in high fidelity to enable as natural communication platform simulation as possible for participants in the related usability testing thus making data more reliable.

To construct a familiar digital environment for the user as advised by Rosenfeld et al. (2015) the result of the survey about user characteristics, their commonly used devices and communication platforms are applied to the basic framework of the prototype design.

A sustainability benchmarking that enables the definition of a sustainability budget will be conducted, as Greenwood (2021) suggests it. The chosen metrics to be budgeted for

the platform construction are colours, typography, options of reduced data sizes when sending media, and options of reduced data sizes when receiving media.

To enforce a sustainable but still familiar communication platform, the discovered sustainability budgets will be implemented in the familiar infrastructure.

Finally, the design of the prototype will be adapted to carefully chosen digital nudging principles mentioned by Weinmann et al. (2016) to nudge participants to the most desirable choice, in terms of digital sustainability, within the digital choice environment of the communication platform prototype.

### **3.4 Usability Testing**

The usability testing of the prototype validates the functionality of the implemented nudges which confirms the prototype as an answer to RQ1 “*How can the design of communication platforms nudge users to select more sustainable application settings relating to data size reductions when sharing images and videos?*”. The usability testing also assesses the user experience and usability of the prototype, thus answering RQ2 “*How does a sustainability-focused approach in the design and features of a communication platform impact the user experience and its adoption?*”

#### **3.4.1 Usability Testing Planning**

The prototype will be tested with multiple usability evaluation methods (UEM) seeing as a single UEM that addresses all problems within an interface is non-existent at this point (Fernandez, Insfran, & Abrahão, 2011). Fernandez et al. (2011) suggest using several UEMs, therefore the chosen evaluation infrastructure is as follows:

1. User testing: Usability Testing
2. Inquiry method 1: Questionnaire
3. Inquiry method 2: Interview

Five participants will be tested individually and each first be introduced to the structure of the usability testing. In the usability testing, they will receive six tasks and be asked to say their thoughts, questions, and opinions out loud while trying to finish each task. In the second part, they will answer nine questions in an online questionnaire, both qualitative and quantitative data will be collected through the questionnaire. All answers will be anonymous. Finally, the participants will be part of an open interview with questions that have arisen due to observations during the first part of the testing.

#### **3.4.2 Usability Testing Implementation**

The testing is carried out with five participants, three male and two female, with the ages of 19, 23, 26, 35, and 58 years. The usability testing was conducted in five different

locations connected to each participant to ensure they feel comfortable with their surroundings.

Firstly, the three parts of the usability testing were explained. Then the participant was given the phone that contained the prototype and introduced to it as follows:

*“You downloaded a new messenger application to your phone a few days ago. A lot of your friends joined the platform as well and you have had a couple of chats with them. Still, you have not had the time yet to properly look at all features and what else the app has to offer. As some friends still wait for your response, you take time now to answer them and take the opportunity to try out some of the new features at the same time. Talk out loud while using ‘youChat’, say which options you click, and which screens you enter.”*

Next, the participant received the following tasks, step by step:

1. *You received a push notification from Magda Ballmann. Check the message and download the photos she has sent you to your photo library.*
2. *Check your message from Magda Ballmann and answer with a photo from your photo library that answers her question. Choose between high or low photo quality.*
3. *Check your message from Maria Bermudez and answer with a photo from your photo library that answers her question. Choose between high or low photo quality.*
4. *Check your message from Heyn Anders and answer with a photo from your photo library that answers his question. Choose between high or low photo quality.*
5. *Search for the following setting and try to understand them. Ask us if any questions about the setting and its function occur.*
  - a) *Within the chat settings with Heyn, look for ‘Colour Mode’.*
  - b) *In the application settings, look for ‘Sustainability Mode’.*
  - c) *Within ‘Storage and Data’, look for ‘Media Upload’.*
  - d) *Within ‘Storage and Data’, look for ‘Manage Storage’.*
6. *Go to the app settings and adjust the app to your preferences.*

After complementation, the participant was asked to answer a questionnaire (Appendix D). The questionnaire contained eight questions regarding their user experience of the prototype and was structured as follows:

1. General experience with the prototype and new features (questions 1, 2, 3, 5)

2. Definition of ‘high resolution’ (question 4)
3. Attitude towards the resolution of shared images (questions 6, 7)
4. Real-life use of the communication platform (questions 8, 10)
5. Awareness of the environmental footprint of the internet (question 9)

The participant was then asked to join the third part: a short open interview that aimed to answer our questions that came up during the observation of the tasks. Some questions that occurred more than once were for example:

- *Why did you choose these specific settings when you adjusted the app to your preferences?*
- *When you sent the images (Tasks 2-4), why did you choose ‘send now’ / why did you not choose ‘send now’?*
- *Is there anything you would like to add or comment on?*

### **3.5 Reliability and Validity**

According to Middelton (2019), reliability is about ensuring the consistency of a measure while validity is about its accuracy.

To provide reliability, a relevant theoretical background is used containing an analysis of existing communication platforms, the definition of the environmental footprint and its relation to the internet as well as media transfers, user experience and its principles, as well as an explanation of the nudging theory and its principles. The researched background information created the base when choosing the methods for data collection, both qualitative and quantitative, in terms of relevant usability evaluation methods (UEM) that fit the research questions for this study.

To ensure consistency of measure and thus reliability, every usability test was conducted with the same prototype, phone, tasks, introduction, protocol, and questionnaire. We, the researchers, divided the roles for the usability testing into one being the observer and one being the moderator. These roles were kept throughout each usability test, establishing consistent and comparable notes of observations and consistent and similar moderation for each participant. Furthermore, all data collection for the usability testing was conducted within two days, assuring the same options of existing communication platforms and features for each participant, giving each participant the same conditions for background knowledge that was relevant to the research.

The validity, namely the accuracy of data collection, is in one way ensured by letting the participant complete the questionnaire immediately after testing the prototype. That

establishes more accurate data due to their ‘fresh’ user experience of the prototype. Furthermore, both researchers verified and validated the written observations while the participant completed the questionnaire. The open interview after the questionnaire was always, with permission, recorded, enabling a later validation of the quotes and data collection from individual statements. Additionally, the open interviews ensured that questions related to observations could be clarified and correctly interpreted.

Weinmann et al. (2017) explain that when evaluating nudges through UEM cautiousness is required, as participants in such methods consciously evaluate the user interface although nudges are based on the subconscious influences on behaviour. That is why the first four tasks of the usability testing had to be completed without any knowledge about the sustainability focus of the platform. Task number five called the users’ attention to the sustainability aspect to observe which settings the user would choose in task six after having gotten knowledge about the sustainability focus of the platform.

### **3.6 Considerations**

Several aspects within the execution of the chosen methods have been taken into consideration that aim to protect the rights of research participants, enhance research validity, and maintain academic integrity. The survey does not ask for the name of the participant, maintaining anonymity, while participants of the usability testing are not anonymous to the researchers but are kept strictly confidential within the report. Participants of the usability testing were informed about the expected timeframe of the testing, but intentionally not about the topic to maintain a reality-based reaction and existing background knowledge without preparation about digital sustainability. Also, the participants were relieved of any pressure on their performance by extensively mentioning that the usability testing was carried out to evaluate the prototype and not the participants. A potential social harm within the usability testing was avoided by reacting to the participants’ opinions openly and positively way, without judgement and rather an encouragement to express their opinion. We chose to intentionally not ask about the participant’s care for the environment as social pressure is high on sustainability nowadays and is therefore assumed to have influenced the participant’s responses and actions.

## 4 Results

### 4.1 Survey

#### 4.1.1 Survey Findings

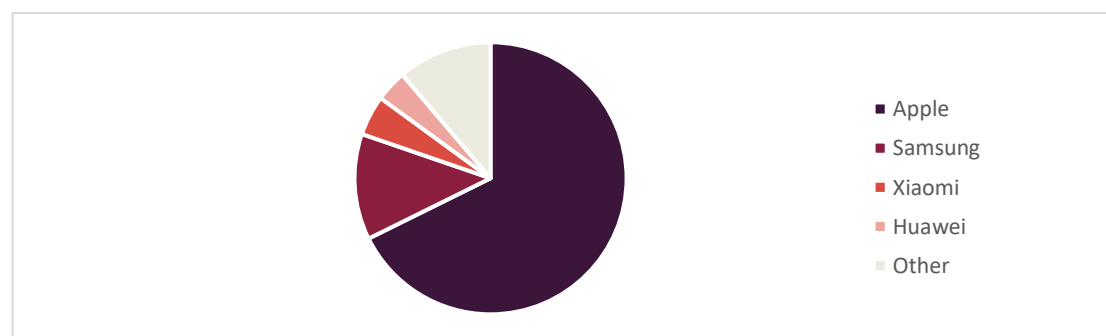
The survey was available for six days with an approximate 80% response rate that can be calculated, out of a total of 370 people contacted. As a result, 295 survey responses were collected, of which 294 were usable. The summary is based on three main areas: demographics, user behaviour, and user experience.

#### Demographics

Most of the survey participants (91.2%) were from the age group 18-24 and 25-39. The genders were not equally split: 62.9% of the participants identified as female, while 36.1% of participants identified as male. Most of the respondents (89.1%) resided in Sweden or other countries in Europe.

#### User Behaviour

All participants, but one, own a smartphone, with more than half owning phones of the brand Apple (67.6%) with a margin of 50% as the next most owned brand is Samsung with only 12.6% (*Figure 7*). Instagram Chat, WhatsApp, Facebook Messenger, and Mail platforms are equally used for communication. Followed by Snapchat and iMessage. WhatsApp is the most used platform by a margin of 32%. Most participants marked WhatsApp as one of the communication platforms where they send the most images and or videos to others, followed by Snapchat and Instagram Chat (*Figure 8*). 32% of the participants use more than one communication platform. 82.3% of the participants send an average of 0-20 images daily via communication platforms. Most people that send 40 or more images each day mark Snapchat as one of the communication platforms they send and receive the most images and or videos on. More than half of the participants manually save less than half or none of the received images on their camera roll. 18.7% save all by an automatic setting.



*Figure 7: Results of the survey question: Of which brand is your smartphone?*

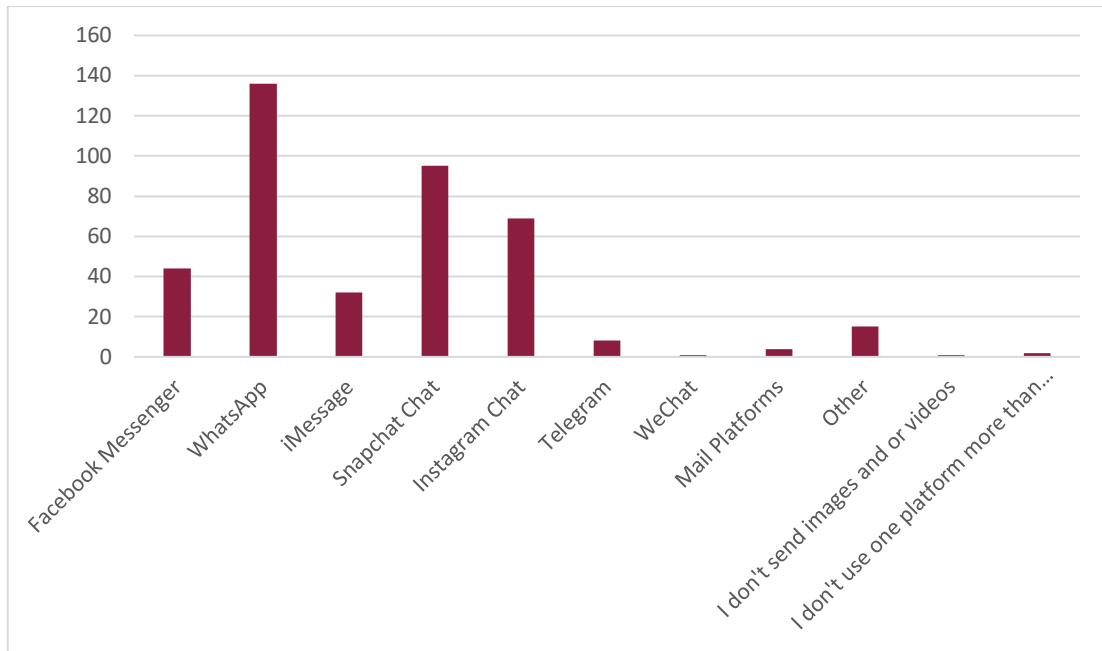


Figure 8: Results of the survey question: On which communication platforms do you send the most images and or videos to others?

### User Experience

A little over half of the participants (54.9%) were satisfied with the image quality of received and sent images (Figure 9). 11.6% of the participants did not know if they were satisfied with the quality of sent and received images, whereas 33.5% of the participants were not satisfied with the quality of sent and received images. 32% of the participants would use an email platform to send an image in good quality, while 20.8% would use iMessage, followed by 17% that would use WhatsApp (Figure 10). 14% would use a platform that was not listed, of which many participants mentioned cloud services such as WeTransfer and Google Drive, and several mentioned AirDrop.

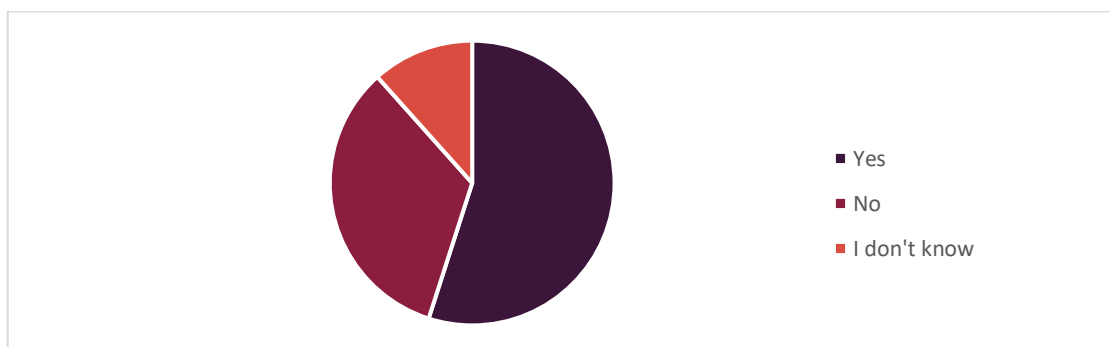


Figure 9: Results of the survey question: Considering the platform that you use most for sending images and or videos, are you satisfied with the quality?

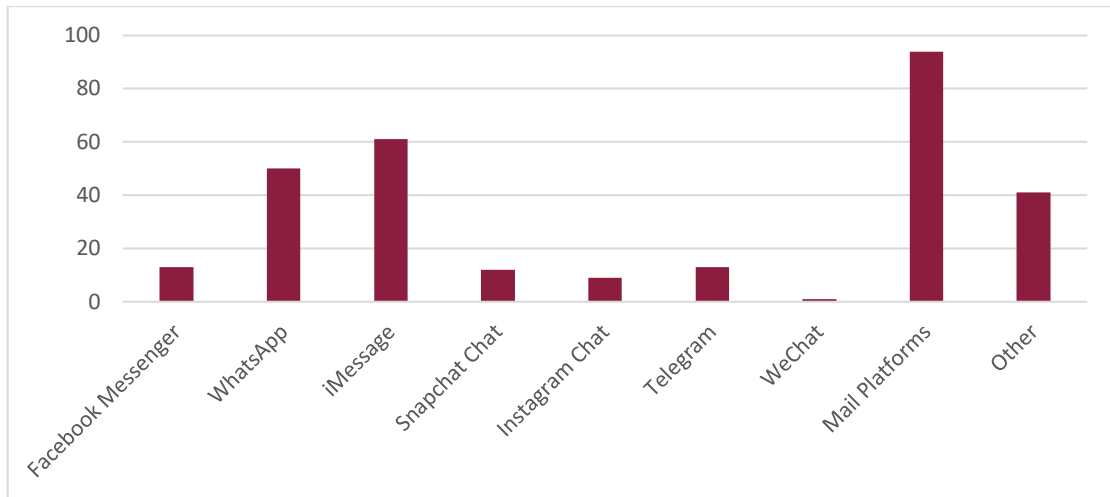


Figure 10: Results of the survey question: *Imagine you would want to send an image on a communication platform in a good quality to a friend. Which platform would you use?*

#### 4.1.2 Survey Findings Analysis

The survey yielded findings about a user group which all use one or several communication platforms, the majority are between 18-39 years old and have a residency in Europe.

Most participants used Apple phones, followed by Samsung and the rest were divided among other phone brands. This goes hand in hand with official sources about mobile vendor market shares in Europe (Statcounter, 2023). The results also showed that the most used communication platforms are WhatsApp, Facebook Messenger, Instagram Chat, iMessage and Snapchat, which are also among the most downloaded communication apps in the Appstore.

Media, as in images and videos, are for most users sent and received the most on WhatsApp, Snapchat, and Instagram Chat. More than three-quarters of the users save media manually and more than half of all the users save only half or less than half of the received media to their camera roll. Media that is received but not saved to the camera roll only stays in the chat and therefore has no specific or long-term purpose. A long-term purpose would be saving the media to the camera roll for a specific purpose such as keeping it as a memory, printing it, or adding it to a photobook. The question arises whether media without a long-term purpose, here called ‘short-term’ media, could be sent with a lower resolution than the media that is sent with a long-term purpose. Seeing as 57.1% of all users save half or less than half of the received media manually to their camera roll, a reduced resolution option for ‘short-term’ media could be investigated for the prototype.

Although email platforms are neither the most popular nor the most used communication platform for image transfers, around one-third of the participants would

use email platforms when the aim is to send an image in good quality. Considering that and the fact that only 1.4% of the participants marked email platforms as one of the communication platforms that they use to send the most media to others, it can be assumed that almost one-third of the participants send most media without the aim of sending it in good quality.

It is similar to iMessage: 10.9% of all participants marked iMessage as one of the communication platforms on which they send most media to others, but 20.8% of all participants would use iMessage for good quality, meaning around 10% of the participants send most media on a platform that they consider does not send images in good quality.

WhatsApp on the other hand is reversed: 46.3% of the participants marked WhatsApp as one of the communication platforms on which they send the most media to others, but only 17% of the participants would use WhatsApp to send images of good quality. That indicates that at least 29% of all participants use WhatsApp for sending images but do not consider the platform to send images in good quality.

These differences in platform usage when wanting to send a good-quality image demonstrate that most participants do not send most media on a communication platform that, in their opinion, sends images of good quality. This raises the question of the importance of image quality and, again, the question of the aim of most sent images. If most images are sent on a communication platform that in the participants' opinion does not send good quality, then most images must be considered as not needing good quality and thus being unimportant or in other words considered 'short-term' images by the participant.

Nevertheless, as discussed in the theoretical framework, a good user experience on communication platforms when transferring media is critical. Even if the goal is to reduce data sizes through a lower resolution, the resolution of the media should not influence the perceived experience of the communication platform, despite the assumption that most images could have a significantly reduced data size due to their presumed 'short-term' purpose. Nevertheless, the findings of the survey serve as a useful starting position and several above-named points will be brought up in the construction of the prototype.

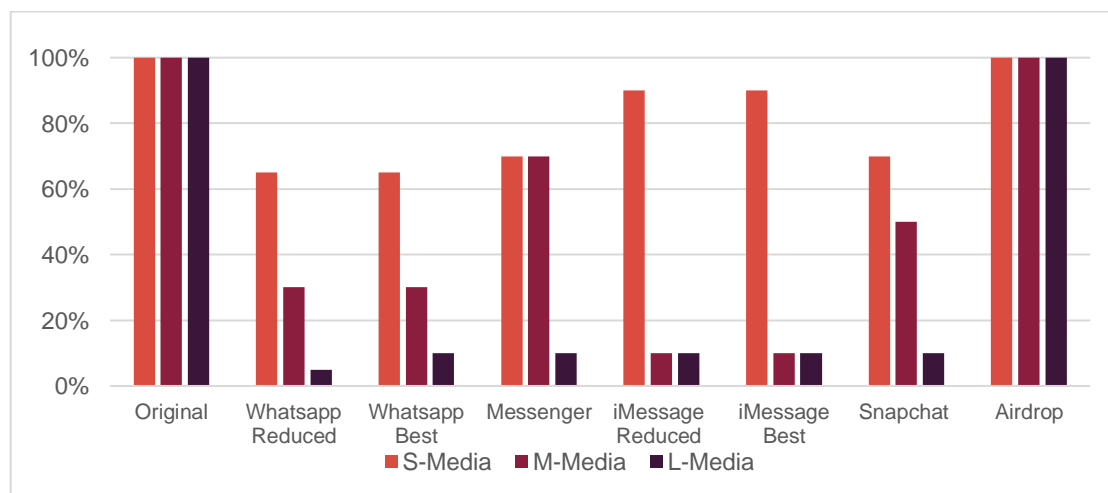
## 4.2 Experimentation

Most communication platforms use a compressing technique for media being transferred through them, resulting in lower image and video resolutions. Image compression is a process applied to minimize the byte size. For communication platforms, it is a relevant topic in which they try to keep the image resolution on a user experience acceptable threshold while compressing the images to enable media to send and load faster on the interface.

### 4.2.1 Experimentation Findings

The original media resolution could not be transferred through any of the tested platforms besides Airdrop, which does not count in this study as it transfers media via Bluetooth. Some platforms had different functions to send media of higher or lower quality. WhatsApp lets the user choose whether media should be sent with the setting of ‘best quality’ or ‘data saver’, and iMessage lets the user toggle between ‘Low-Quality Image Mode’ on or off. The functions, as it turns out in testing, did not always work reliably depending on the type of internet connection used and the original size of the image. The media used for the experiment was divided into three categories: large data size (L-media), medium data size (M-media), and small data size (S-media), based on a defined data size range.

All results are documented and compared in percentages of compression and can be viewed in Appendix B. To exemplify, the data sizes after transferring an iPhone photo with an original size of 1126,4KB are displayed in *Figure 11* as percentages in relation to the original data size. The results of the platform iMessage are counted invalid, as the data sizes and their reductions varied from transfer to transfer without any reliability or connection to whether the toggle ‘Low Quality Image Mode’ was on or off.



*Figure 11: Comparison of data size reductions of an iPhone photo transferred via diverse communication platforms with different application settings*

## 4.2.2 Analysis of Experimentation Findings

All tested communication platforms use compression techniques for media being transferred through them. The range of compression varies largely depending on the original media size and the platform. WhatsApp compresses media the most by a large margin, while Snapchat and Facebook Messenger only compress by 10-50% which makes WhatsApp in terms of saving data on media transfers most sustainable. L-media is compressed the most and largely on every platform, and especially for printouts, using mail platforms or WeTransfer is highly recommended to avoid losing over 90% of the image resolution. Calculated in terms of the mass of images sent, the experiment provides information that communication platforms already save large amounts of data by compressing images. This means that a sustainably built application would have to compress to the greatest extent to be able to save as much data as possible which, as explained in the theoretical part, would have a positive effect on the environmental footprint of communication platforms. With 70% compression applied to M-media on WhatsApp, one of the largest and most popular platforms as the survey demonstrates, and over 90% applied to L-media on most platforms, these compressions should be considered as the current best practice and thus counting as the minimum compression setting for media that is sent through a sustainable communication platform.

## 4.3 Prototype

### 4.3.1 Prototype Implementation

The high-fidelity prototype was constructed with the help of the design software 'Figma'. It was built with a frame of an iPhone and with design implementations from Apple's 'Human Interface Guidelines', due to survey results that displayed that most participants own a smartphone by Apple. The basic infrastructure is based on the infrastructure of communication platforms within the same environment such as WhatsApp, Facebook Messenger, iMessage, and chat features on Instagram and Snapchat. It results in the commonly familiar information architecture with listed chats (*Appendix C.2*), the bottom navigation bar (*Appendix C.2*), and settings accessed by clicking on the user profile (*Appendix C.3*).

For the adaptation of sustainable web practices (Greenwood, 2021), the application was designed with a default dark mode by using a background colour of dark blue (with the hex code #344148) in combination with diverse green colours and white (with the hex code #ffffff) for most text. According to Greenwood (2021), darker colours use less energy than lighter colours and green uses around 25 per cent less energy than blue. Green was also chosen because it serves as proximity and a reminder of nature. To sustain a good user experience, a colour mode for individual chats was implemented that enables the user to choose between four different dark colours for each chat. 'SF

Pro Text' was chosen as the font because every Apple smartphone has that font downloaded by default and according to Greenwood it is more sustainable to use a font that already exists on the device to avoid downloading a new font.

Four new features, connected to sustainable aspects, were implemented in the application, of which all four are based on nudging principles and thus implemented as nudges in the application:

1. Sustainability Mode
2. Media Upload Quality
3. Send media via Wi-Fi
4. Statistics and Tips

**'Sustainability Mode'** (*Figures 12 and 13*) was implemented within the settings of the application and can be turned on and off by clicking a toggle button. The 'Sustainability Mode' enables the user to set the application to the most sustainable settings with just one click. It includes a background of black (with a hex code of #000000) and turns 'Auto Delete Chats After 1 year', 'Send all Media via Wi-Fi', and 'Data Saver (recommended)' within media upload quality on. Below the 'Sustainability Mode'-toggle is the effectiveness of the applications' sustainability displayed. This serves as the nudging principle of 'visible goals', as 100 per cent effectiveness is the goal, which is put into effect when sustainability mode is set to on.

**'Media Upload Quality'** (*Figures 14 and 17*) was implemented as an option to set the resolution of sent media. It presents three options: data saver (recommended), high resolution (10 min), and always highest resolution. The default, when the application is downloaded, is set to 'data saver (recommended)'. A default, according to Thaler et al. (2010), serves as a nudge that facilitates the user by recommending a pre-selected option. A new part of the media upload quality feature is a button that controls the resolution of the media that is sent. The button is located next to the normal features of editing media. This has the effect that it does not get too much attention but rather is an option for users that are invested in changing the resolution for certain images, while other users who might not care about the resolution of media can easily ignore that feature. Good user experience and task flows are identified by simplicity and as few clicks as possible to achieve a task, therefore the button that controls the resolution serves as a nudge, as it becomes another step in the task flow and thus nudges the user to not click the button when it is not necessary. If the application setting of the media upload quality is set to 'Always Highest Resolution' the 'High Resolution' button is automatically activated when media is sent, but the user is still able to unclick the 'High Resolution' button. The button contains a graphic of a little square and two stars that represent the higher resolution of the media, in which the stars are associated with a 'fancier' media setting. Furthermore, the button says 'HIGH RES' underneath the

graphic. When choosing this graphic as a button, three options were created and by testing each option on 10 friends and family members, it was evident that the square with the two stars was the one most people associated with a higher resolution. Also, the idea came to the surface to add a pop-up that appears when the 'HIGH RES' button is clicked but aiming for a user-friendly flow that contains as few steps as possible, it was decided to put this information concerning data sizes and usage of media into the settings of the application. Another issue that was discussed was the choice of words when an image was to be sent with a higher resolution. Some of the options that were mentioned were 'high quality', HD, and 'high resolution'. Due to the HD standard that requires a certain resolution for an image to be called HD, it was eliminated, and high quality was too unspecific, as it could be associated with the content of the image or the lighting and focus of the image content. Therefore, 'high resolution' was the most appropriate and specific term for representing the compression of media. The 'high resolution' button is tested by asking the participant to send three different images to three different people. It is expected that participants send 'short-term' images with low resolution and 'long-term' images with high resolution. The image of the dog is considered a 'long-term' image because it is sent with the purpose of being printed out, while the other two images are considered 'short-term' images because neither a screenshot of the current weather nor an image of a game is expected to have a deeper meaning to the participants that would justify sending them with a high resolution.

Another nudging principle besides 'default' was used, called 'expecting errors'. This was implemented by adding the option to download images in high or low resolution, even when the image was sent in high resolution. That enables the user to use less data if the user does not require a high resolution for the sent image. It also calls for attention and could clarify the difference between high resolution and lower resolution.

The third feature '**Send media via Wi-Fi**' (*Figures 15 and 16*) was the default setting for sending media when the smartphone is connected to Wi-Fi. That means, when for example an image is sent when the smartphone is connected to mobile data, the image is queued as a message and will be sent when the smartphone is connected to Wi-Fi. It implements the nudging principle of 'default' and 'feedback', as the media (that will be sent via Wi-Fi) displays how much data it would need to be sent when connected with mobile data.

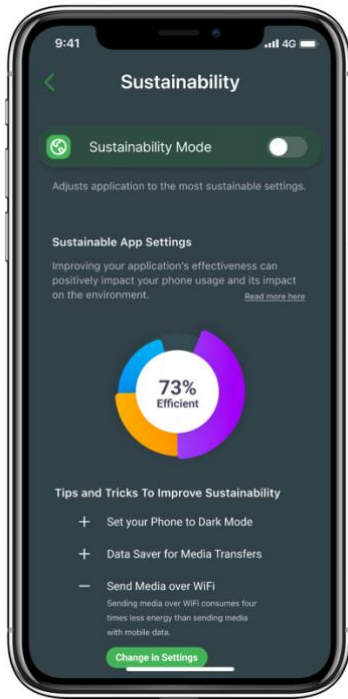


Figure 12: Sustainability Mode Off

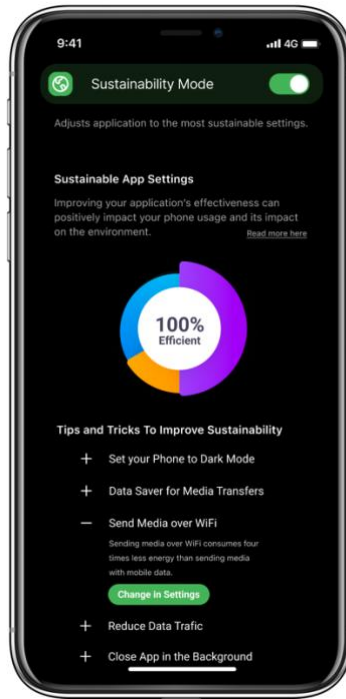


Figure 13: Sustainability Mode On



Figure 14: Media Upload



Figure 15: Send Media via Wi-Fi



Figure 16: Sends on Wi-Fi

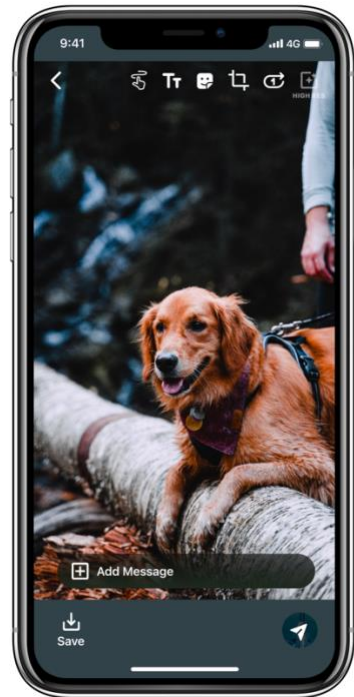


Figure 17: 'Long-term' Image

The fourth new feature that was implemented was **'Statistics and Tips'** (Figures 12 and 14). The statistics can be found within the settings of the application and display different data connected to sustainability. For example, in the storage and data setting it visualizes the difference between sending data via mobile data and Wi-Fi, and the usage of data for compressed media versus high-resolution media. This idea is based

on the nudging principle of ‘mapping’ information for the user in a way that makes information more understandable for them. It also acts as the nudging principle of ‘visible goals’ as the user is motivated when they see how much data can be saved by using certain settings.

The final prototype can be viewed and interacted with on the following link: <https://www.figma.com/file/Ai0IuU761PqtOwUT6GVM53/Communication-Platform?node-id=0%3A1&t=7zqJy bqJumpTIF3y-0>

## **4.4 Usability Testing**

### **4.4.1 Usability Testing Findings**

The invited participants managed to complete the tasks in the prototype testing with little occurring questions and overall high satisfaction. Especially new features and individually adjustable functions stirred the interest and pleasure of the participants. In total, the tasks within the application took between 6-10 minutes while subsequent discussions and the completion of the questionnaire took another 15 minutes. For all tasks, the participants managed to navigate fast and intuitively, as the interface environment reminded them of existing communication platforms. However, when applying the new features, there were some larger differences and reasons for the participants’ decisions. This ranges from technical aspects to emotional and sustainable considerations, and from work attitudes to private preferences and needs. The most relevant observations concerning the implemented features in youChat are listed below:

#### **Sustainability Mode – See Appendix C5**

*All settings that reduce power consumption and data sizes of media transfers are automatically activated.*

Participants perceived the sustainable effect as positive and saw few limitations for themselves that would justify switching it off. Explanations under the settings reinforced this positive feeling. All five participants chose to turn the sustainability mode on. Three participants adjusted the media upload quality to ‘Always Highest Resolution’, of which one participant also turned off ‘Send all Media via Wi-Fi’ and ‘Auto Delete Chats After 1 year’. A few participants mentioned that they would turn on some of the features manually, such as the dark mode colour setting, data saver and automatic deletion of messages after 1 year, if sustainability mode was not available.

## Media Upload Quality - See Appendix C.2

### *Sets default setting of media resolution for media transfers*

Three participants adjusted the media upload quality to ‘Always Highest Resolution’, all for different reasons such as Participant A wanted to avoid the step of setting media to the highest resolution, while Participant E, who works with photography, saw restrictions, and only wanted to send pictures in high resolution to both clients and friends. Participants C and D kept the recommended upload quality, reasoning with a ‘Why not’ answer, as no major limitations were identified with that setting. Participants C and D verbally connected sustainability with reduced media resolution, while the other three participants were more concerned with the mobile data that is connected to the data size of media and which in turn is a smaller problem due to the improving phone contracts and largely available mobile internet.

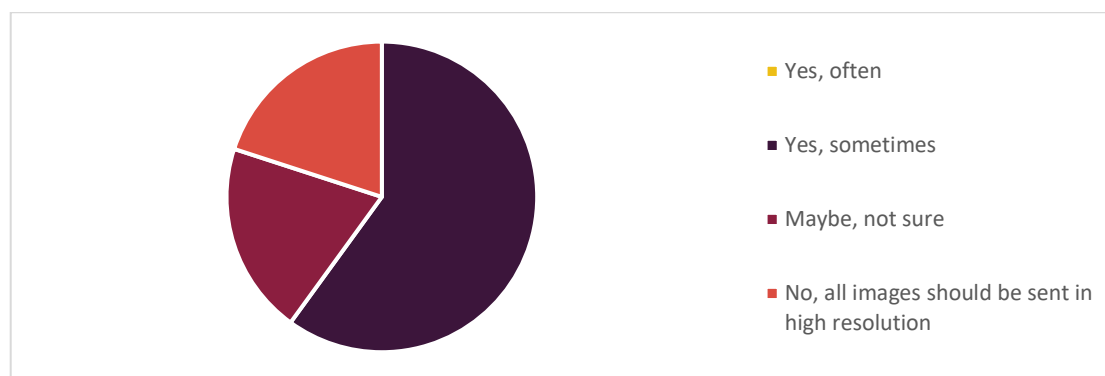


Figure 18: Results of the questionnaire question: *Is sending images and videos in reduced resolution something you would consider doing more often if you had the possibility?*

## Send Media via Wi-Fi – See Appendix C4, C10, C11

*Can be set as default in settings to send all media only when connected to Wi-Fi. Manual change to direct mobile data transfer is still possible.*

Four participants chose to directly send the media via mobile data, mostly because they thought it was part of the task to send the media directly, while one participant chose to send the media via Wi-Fi, because of a misunderstanding that the media was uploading and therefore blurry (not sent). Participant C expressed the opinion that people should receive pictures fast and therefore be sent on mobile data, but the participant would consider using the default setting anyways if there was a connection between sending media via Wi-Fi and improving sustainability. Participant D prefers to send images directly when she sends them, whether she is connected through mobile data or Wi-Fi, but she also recognizes the usefulness of the setting in some specific situations. Participant E turned the default setting off as he sends images often on the go and prefers them to be sent directly. Generally, there was a half-and-half opinion as some

users wanted the images to always send directly to achieve the actual goal and others considered that some situations would allow for a later transfer of images, especially after learning from the platform that this would improve the apps sustainability if Wi-Fi would be reached soon (ranging from one hour to later in the day).

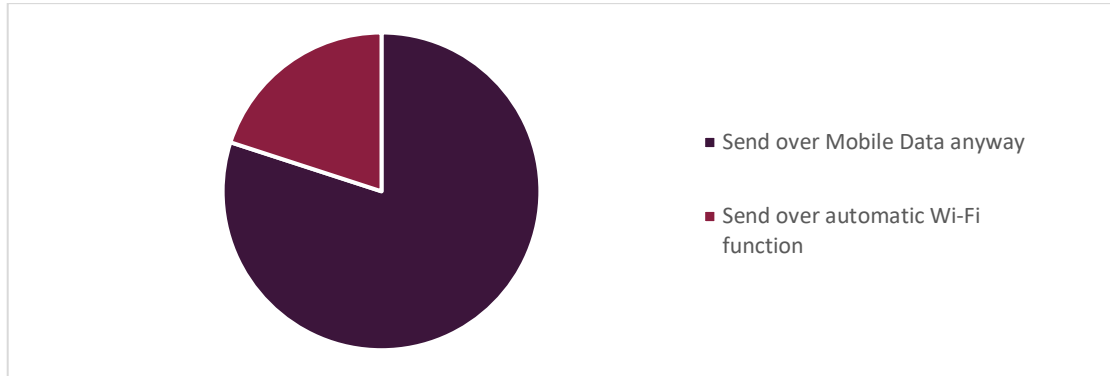


Figure 19: Results of the questionnaire question: *If you had youChat, would you send images always immediately when connected to mobile data or use the function of letting the image automatically send over Wi-Fi at a later point?*

### **Statistics and Tips – See Appendix C5, C8, C9**

*User statistics and comparisons between usage with sustainable and unsustainable settings. Explanations about sustainability on the internet and its application in youChat.*

All participants showed interest in the displayed statistics. Nevertheless, not all participants grasped or cared to the same degree about the connection between their app usage and the environmental footprint. Participants A and D requested that statistics should be made more tangible with more examples. Differences between data transfer with high or low resolution were part of the statistics, but users could not make emotional or logical connections from pure numbers and bars.

### **Colour Mode – See Appendix C.7**

*Allows the user to change the chat colour in dark mode.*

Every participant reacted positively when they were allowed to adapt the design themselves. We received no comments on the limited selection of dark colours. Instead, participants expressed individual colour preferences and selected them without comments on the restriction and without selecting a colour being part of the task.

#### 4.4.2 Analysis of Usability Testing Findings

The intuitive and fast navigation through the prototype and completion of tasks indicated that the prototype had a functioning user interface following the design of other communication platforms. The newly invented and implemented features like the ‘sustainability mode’, made it evident that users’ appeal to it could be strongly influenced by the platform’s information on digital sustainability in text and statistic form. Most participants understood the new features and design logic, function, and placement in the platform quickly and were not confused, even though they had never used them in other communication platforms. While some participants understood the connection to web sustainability and used it as an emotional basis for decision-making, other participants were hardly influenced by it and rather made sustainable decisions on the platform because they either liked trying new features or using the phones’ capacity most efficiently.

The questionnaire and open discussion revealed details about the participant’s work and private life which helped in understanding their decision-making when using the prototype. For example, Participant B had a genuine interest in sustainable living and Participant D worked with photography. They valued different aspects of the prototype as Participant D liked the option to send media in highest resolution, while Participant B liked being able to adjust her digital environmental footprint through any available feature. Positively drawn from all these different backgrounds in connection with observation, questionnaire and interview results is that all users could make use of either all or at least some of the new features. Also, all of them were ‘rather satisfied’ to ‘satisfied’ with the platform’s design, which was adjusted to Greenwoods’ recommendations about sustainable web design (2021). This, looking at the variety of most possible platform users, is positive, as the platform concept and its features can please a wide range of users to various degrees and in various forms.

Nevertheless, after testing the prototype, some gaps for improvement were also identified for the implementation of the new features. ‘Send media over Wi-Fi’ could have been explained more thoroughly in the settings. Also, for all statistics and the ‘data saver’ inside the settings, new ideas for improving visualisation were generated such as metaphors that make it easier for users to make everyday comparisons could be implemented in them.

Some expected behaviour of participants based on nudges was not met, such as sending the ‘short-term’ images in low resolution. Instead, when the participants were asked why a high resolution was chosen for sending the screenshot, several participants mentioned their concern that the small text on the screenshot would not be readable with a low resolution. The ‘long-term’ image of the dog, on the other hand, was, as expected, sent with a high resolution by most of the participants, except for one participant who did not notice the ‘high res’ button until later. The expectations based

on the nudges within the different sustainable settings were met to some extent, as two participants were successfully influenced and adapted their settings as expected, while the other three participants adjusted at least one of the settings based on their own interests, such as their profession or simple attitude towards high and low resolutions.

In summary, the usability testing proves that the chosen nudges influenced all of the participants in one or more areas where nudges were implemented. Additionally, the results demonstrate potential aspects for improvement within the implementation of the nudges, such as a simpler mapping of abstract data that clarifies the consequences of data transfers for the environment. Nevertheless, the nudges achieved the goal of guiding the participants towards more sustainable behaviour, within the possible framework offered by the application.

## 5 Discussion

The purpose of this research was to explore how the design and features of a communication platform can achieve greater digital sustainability-friendly behaviour from their users. Along with this study, users' behaviour and experiences with internet sustainability could be explored. This chapter discusses the findings of the study, by revisiting the study purpose and research questions.

### 5.1 Result discussion

#### 5.1.1 RQ 1: How can the design of communication platforms nudge users to select more sustainable application settings relating to data size reductions when sharing images and videos?

The answer to research question one is found with the prototype design result, which implemented guidelines for sustainable web design and features aimed at nudging users to the most sustainable choices of app settings within a prototype of a non-existing communication platform. In terms of general internet usage, the users would already achieve greater environmental sustainability by using youChat instead of alternatives as the applied sustainable web design decreases the applications' power and data consumption by default. Concerning variable sustainability settings within the application, an unexpectedly positive high use of the optional settings could be observed in the usability testing of the prototype. The design of our communication platform prototype nudged users to more sustainability-friendly behaviour by providing attractive statistics and graphs that inform about web sustainability. Optional settings that did not force but enhanced sustainability within the application would be applied as intended by users. Whereas some settings, like a default dark colour theme, do not even require user decisions and default settings were not considered as a restriction. The sustainability mode turned out to be one of the most interesting, novel features within the communication platforms and users easily understood and used it during our testing, which would in turn prove again their strongly enhanced sustainable-enhanced behaviour. There is a clear connection between the design of the communication platform prototype and the connected user behaviour. Nudges through defaults enable a more sustainable standard setting for data transfers and thus help users to act more sustainability-friendly without intentionally thinking about it. One example of that is how several of the participants in the usability testing did not change the resolution of the images and looked for an option to change the resolution until it was highlighted that the participants should intentionally choose between high and low quality. Another way that design influences user behaviour is through implementing the nudge of visible goals combined with mapping through the Sustainability Mode. Preliminary all participants acted more environmentally friendly in one way by turning the Sustainability Mode on. This decision was based on the clear connection to

sustainability and the satisfaction to fulfil 100% sustainability, supported by the simplicity of clicking one toggle. Despite the personal preferences of users in application settings that do not support sustainability, one can identify that the design in the form of nudges in which defaults are set, information is mapped, and visible goals are displayed enhance a sustainability-friendly user behaviour when applied generously and through diverse features.

The theoretical parts from Greenwoods (2021) guidelines for sustainable web design, as well as the intakes from Thaler et al. (2010) and Lidwell (2010) about the nudging theory were used and found to be functional both from a user and a technical perspective. They build a strong foundation for the executed prototype answer, that nudging design can turn users' behaviour more sustainability-friendly.

The theoretical background about the environmental footprint of digital communication shows strong grounds for causation that a change to more sustainable choices, initiated by the nudges, within a communication platform supported by the outcome of the usability testing could improve the environmental footprint. Nevertheless, it is important to remain critical and consider that exact environmental footprints cannot be measured with the existing possibilities and therefore an exact measurement of improved sustainability or the environmental footprint cannot and should not be made. Therefore, this study would benefit from further research continuing investigations of sustainable web design effects and nudging with clear footprint calculations, to fully assure the improved sustainability from the built prototype youChat.

### **5.1.2 RQ 2: How does a sustainability-focused approach in the design and features of a communication platform impact the user experience and its adoption?**

It was found that depending on the profession and private interests of users, the influence of different sustainability nudges as well as the attraction to sustainable web design could vary considerably. What is certain is that media transfer is a very important functional and emotional aspect of the use of communication platforms and the interest in the features associated with them is very high. At the same time, it was found that many users were not very knowledgeable about media resolutions and had some misconceptions about the resolution of transferred media on existing communication platforms. The same applied to knowledge about the environmental footprint of data transfers on the internet and energy consumption through mobile phone and application usage. These findings were obtained both from the quantitative survey at the beginning of the study and from the qualitative results from the usability testing of the prototype. A relevant thing that could be determined through the usability testing is that user opinions were very variable. Any kind of individually assessed advantage, such as greater sustainability or other technical improvements, could change the user's opinion on sustainable settings within features or the visual design of the tested application

prototype. Therefore, reduced data sizes of media do not equal worse user experience, just as little as default dark colour themes, little colour-choice options or longer waiting times when sending media through Wi-Fi instead of mobile data. Sustainable web design with the right motivation for the end user does not disadvantage but creates a better user experience with new opportunities for sustainability within the web, and at the same time opens the opportunity for a new comparison aspect within communication platforms. This research question links back to the user experience honeycomb of Morville and Sullinger (2010). The seven facets of the honeycomb, namely useful, usable, desirable, valuable, findable, accessible, and credible, can be evaluated based on the questionnaire and open interview. All participants of the usability testing would, if possible, download the communication platform, provided that their contacts are using youChat as well, which marks the platform as usable, as no participant would consider downloading an unusable platform. The questionnaire points out that two participants find the platform design ‘good’, and thus visually appealing, the other three are divided amongst rather good and a neutral opinion, proving that the platform also fulfils the facet of being desirable. Also, two of the participants would download the app because of the look of it, while three participants marked ‘improved digital sustainability’ and two marked that they are not satisfied with the current alternatives, meaning the platform was evaluated to be both useful, offering different aspects than current alternative communication platforms, and valuable, as all five participants would download it. All participants took very little time to complete the tasks of the usability testing, which points out that the platform was findable. The last two facets, accessible and credible, cannot be identified or evaluated as they were not considered within the data collection.

All in all, the platform fulfils five out of seven facets that ensure good user experience and meet the user need, demonstrating that the platform has good usability and UX foundation, being based on other platforms but also due to its own features and sustainable design.

## **5.2 Method discussion**

This chapter will discuss the methodology choices and their influence on the study.

The multi-layer method approach allowed us to find answers to both research questions. The preliminary studies brought knowledge that directly was implemented in the following main methodology step: the building of a prototype and its validation through usability testing, which aimed to answer the research questions. It also allowed us to learn about qualitative and quantitative research and how to conduct either of them. This had a great effect on not only the quality of the research but also our learnings from this thesis.

The online survey helped to understand user behaviour and motivated the right prerequisites to start the prototype with. Also, did it bring the first answers to the second research question. Sending the surveys out in a few hundred direct messages and applying a message that called for attention, had highly valuable outcomes as a response rate of over 80% was achieved and the total survey time could be reduced to 6 days.

The experiment brought insights into how different media resolutions were changed by the transfers on existing communication platforms and which individual settings for media resolution were provided by the platforms. This was highly valuable to prove which current possibilities for data size reductions of media are available. Nevertheless, in retrospect, we considered whether the time spent on this experiment should rather have been spent on an experiment with testers who could have objectively evaluated images in different resolutions, to see if lower resolutions are visible. This is also mentioned again as a suggestion for further research.

The prototype was designed with more sustainable web design guidelines and nudges than planned from the start. Own features, such as the "Sustainability Mode" were developed, and the result was a product that does not yet exist in the market of communication services.

The usability testing brought valuable and recurrent results and as anticipated, five testers were enough to get a good quantity and quality of testing results that could validate and assess the prototype. The results from the five usability tests created a big enough foundation for design improvements.

During the research, both the validity and reliability of data were ensured through the following: preliminary studies; a suitable size and selection of prototype test and survey participants; guidelines and books about chosen methods; ethical nudging guidelines.

## **6 Conclusions and further research**

### **6.1 Conclusions**

Research regarding sustainable web design has increased significantly in recent years, partly due to the growing awareness that our environmental problems require us to start questioning every action that is taken and the impact of everything that is consumed and used, including the internet.

Concluding the answered research questions, how to nudge users towards more sustainable decisions on the web and how that would influence their experience and adoption with the products, sustainable web development on communication platforms has high potential to be made mass applicable on communication platforms as well as other platforms. Sustainable web design can utilize advancements of nudging to expand a platform's sustainability towards enhanced user sustainability within those platforms, creating sustainable engagement across both the producer and consumer sides.

#### **6.1.1 Practical Implications**

Through a multi-layer method study, it could be established that both nudging and sustainable web design can be used to improve on the environmental footprint of communication platforms. Not only could pre-existing knowledge be applied and tested, but also new application features developed which would have the potential to be applicable over a wide range of applications.

#### **6.1.2 Scientific Implications**

This paper opens possibilities for future research by contributing UX insights into pre-existing sustainability web design guidelines. There are several possibilities to continue researching sustainable web development in relation to its users' experience with it, some of which are discussed in the next chapter.

### **6.2 Further research**

We advocate for further research on two pillars of our study and one relating to the prototype that was developed during the methodical study. First, we recommend further study of the environmental footprint and calculation methods of data transfers and internet usage in line with the pros and cons of increased digital communication. Better estimates and calculations are needed to gain an even better awareness of the impact, but also to be able to build better solutions based on this to achieve a sustainable digital future. Especially for found solutions like sustainability nudging and sustainable web design, it would be relevant to have more precise figures on environmental savings to confirm their sustainability effect. The availability of such research knowledge would be a great base for communication platform providers to reduce their footprints by

adapting their platforms and for customers to adapt unknowingly and actively more environmental-friendly habits.

Second, we suggest further experimentation and research of the user experience about media resolution differences. The user experience concerning media quality satisfaction of our study was based on the survey, while the usability testing explored the user experience of sustainable features and design within communication platforms, thus statements about satisfaction with media resolution were made only based on given features, but not by practical testing of different resolutions. Personal usage and purpose, as well as users' profession played a big role in the user experience evaluation, while the abovementioned different study would be more focused on the true physics, how man would be able to recognize different media resolutions and based on, would be emotionally frustrated or exhilarated.

Moreover, the prototype design of this study and its features like the "Sustainability Mode" or "Sustainability Statistics" could be iterated in the design context of other mobile applications. This could reveal if developed features are mass applicable and bring more evidence to their overall sustainable effect.

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## **8 Appendixes**

Appendix A – Survey Results

Appendix B – Experimentation Results

Appendix C - Prototype Interfaces

Appendix D – Usability Testing

## 8.1 Appendix A – Survey Results

### Images and Videos on Communication Platforms

295

Antworten

07:04

Durchschnittliche Zeit für das Ausfüllen

Geschlossen

Status

1. How old are you?

Under 18	4
18-24	171
25-39	97
40-59	14
60+	8



2. What is your gender?

Woman	185
Man	106
Other	1
Prefer not to say	2



3. Where do you live?

Sweden	140
Other country in Europe	122
Other country outside of Europe	31



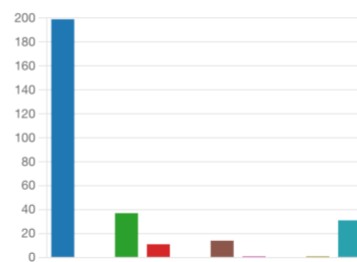
4. Do you own a smartphone?

Yes	293
No	1

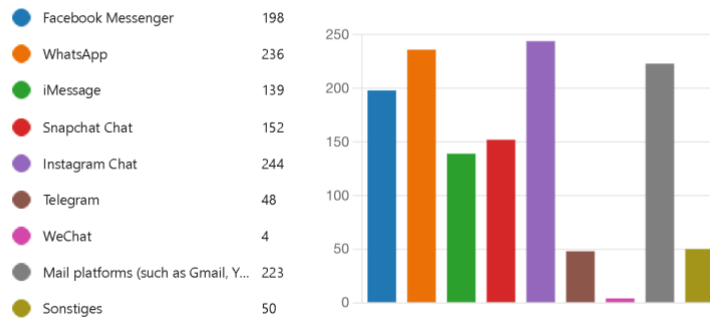


5. Of which brand is your smartphone?

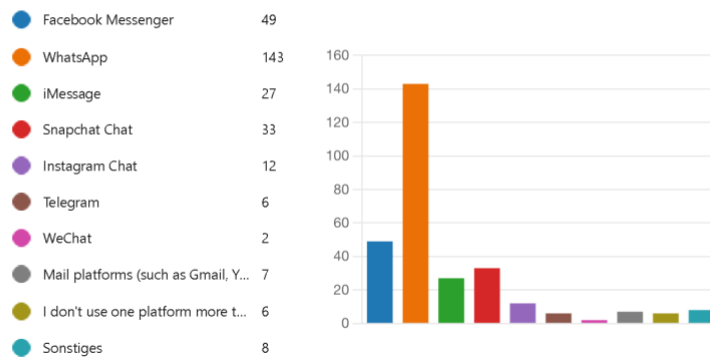
Apple	199
LG	0
Samsung	37
Huawei	11
Lenovo	0
Xiaomi	14
Oppo	1
Vivo	0
Nokia	1
Other	31



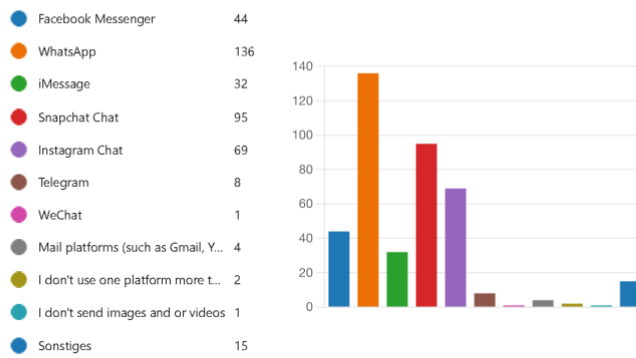
6. Which communication platforms do you use?



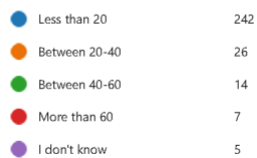
7. Which communication platform do you use most?



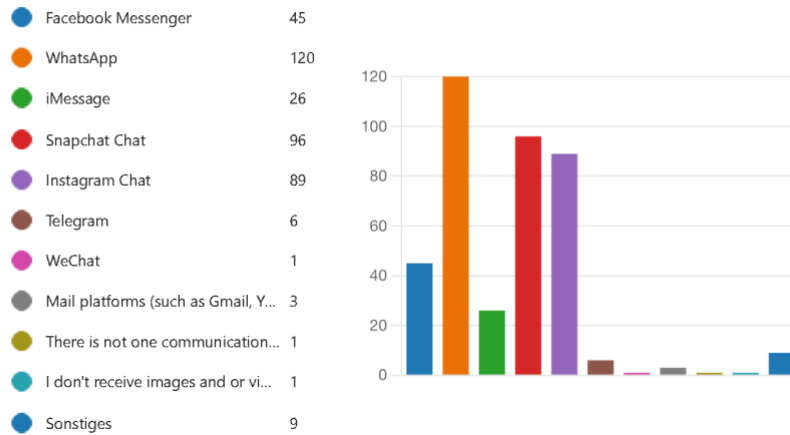
8. On which communication platforms do you send the most images and or videos to others?



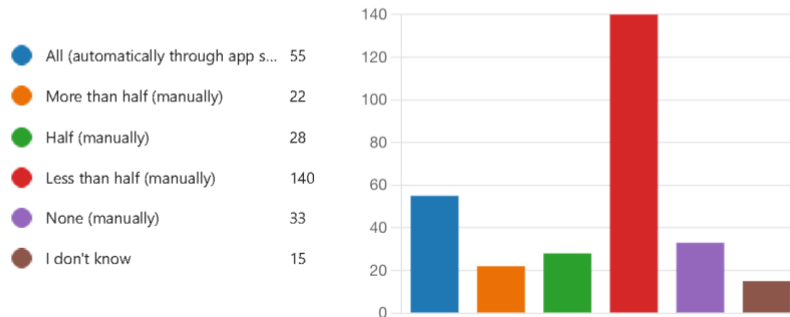
9. All in all, how many images and or videos do you estimate that you send daily?



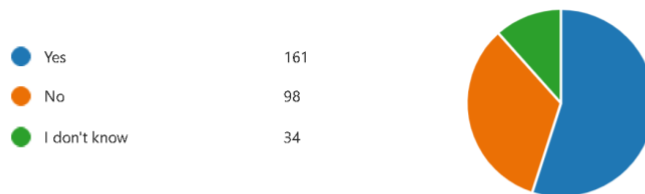
10. On which communication platforms are most images and or videos sent to you?



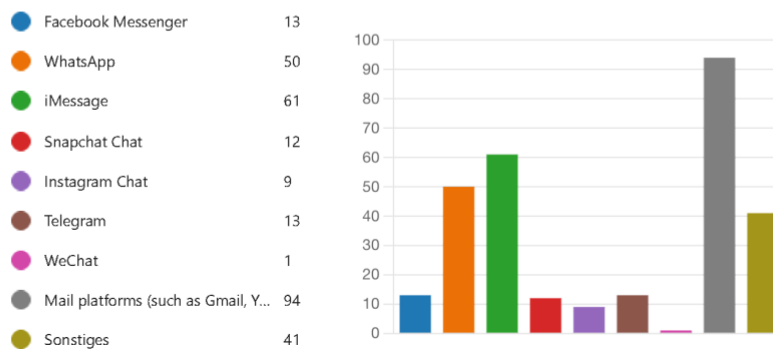
11. How many images do you estimate that you save on your camera roll of the ones that are sent to you in general?



12. Considering the platform that you use most for sending images, are you satisfied with the quality of the images that you send and that are sent to you?



13. Imagine you would want to send an image on a communication platform in a good quality to a friend. Which platform would you use?

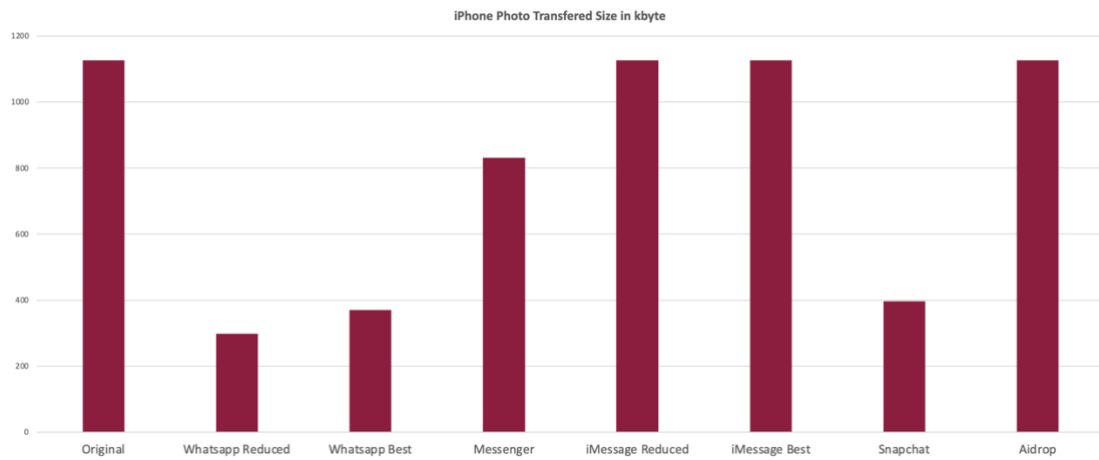


Note: The responses to question 12 and 13 are not considered as valid data, as the term ‘image quality’ is not pre-defined and we, as researchers, do not know each participants’ definition of ‘image quality’.

## 8.2 Appendix B – Experiment Results

Platform	Original	Whatsapp Reduced	Whatsapp Best	Messenger	iMessage Reduced	iMessage Best	Snapchat	Aidrop
iPhone Photo HEIC / kbyte	1126,4	270	370	831	1126,4	1126,4	396	1126,4
Internet Photo JPG / kbyte	27	16	19	21	9	14	24	27
DSLR Camera Photo / JPG / kbyte	10900	35	310	1030	35	430	35	109000
Screenshot PNG / kbyte	3000	30	302	301	400	400	400	3000
DSLR CameraVideo / QT / kbyte	155200	1000	2000	3000	1000	3000	1000	155200
iPhone Video / QT / kbyte	14300	1700	3000	4300	9002	14300	1000	14300

*Media Transfer Sizes in kilobyte*



*Example Comparison: Transferred data size of iPhone photo on different Communication Platforms*

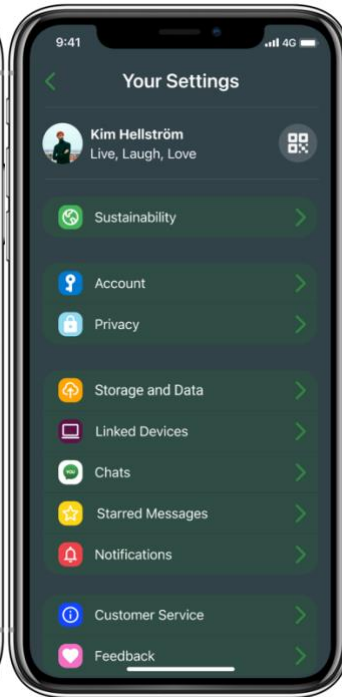
### 8.3 Appendix C – Prototype Interfaces



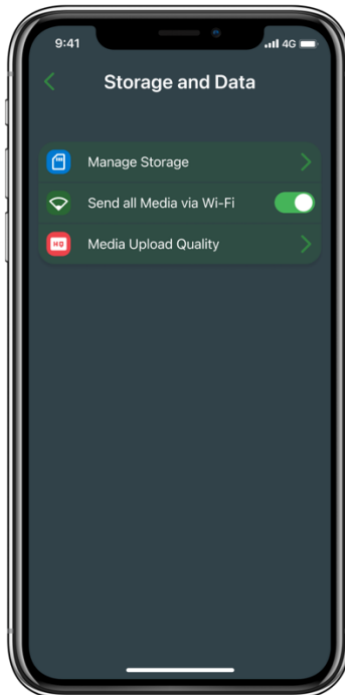
C.1 youChat Notification



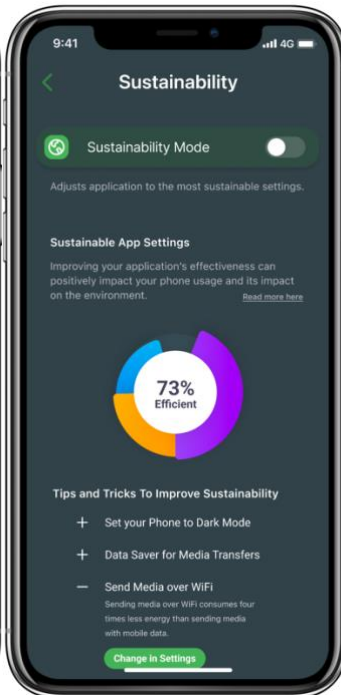
C.2 Home Screen



C.3 Settings



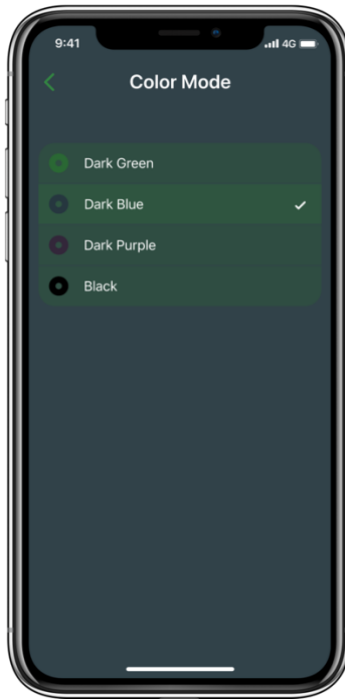
C.4 Storage and Data



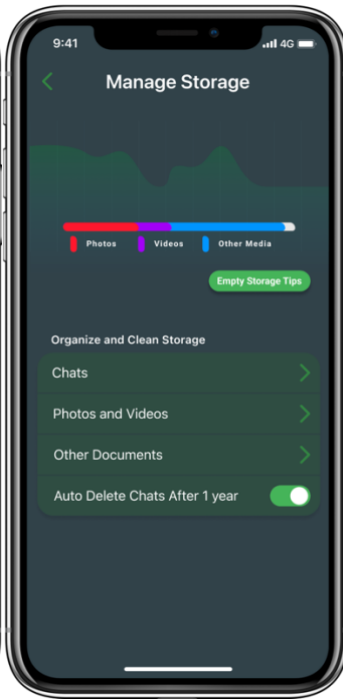
C.5. Sustainability



C.6 Sustainability Mode On



C.7 Chat Setting Color Mode



C.8 Manage Storage



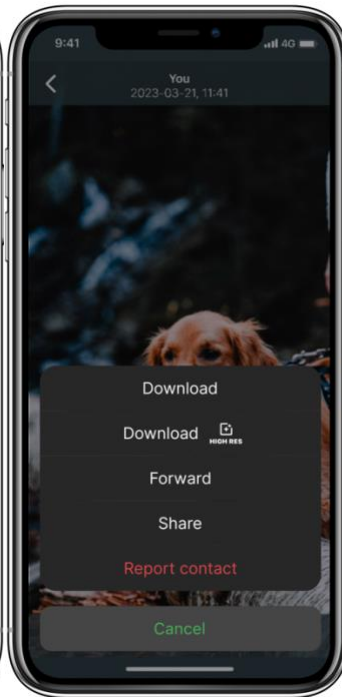
C.9 Media Upload Quality



C.10 Download Media on Wi-Fi



C.11 Send Media on Wi-Fi



C.12 Download High-Res /Normal



*C.13 High-Res Button*

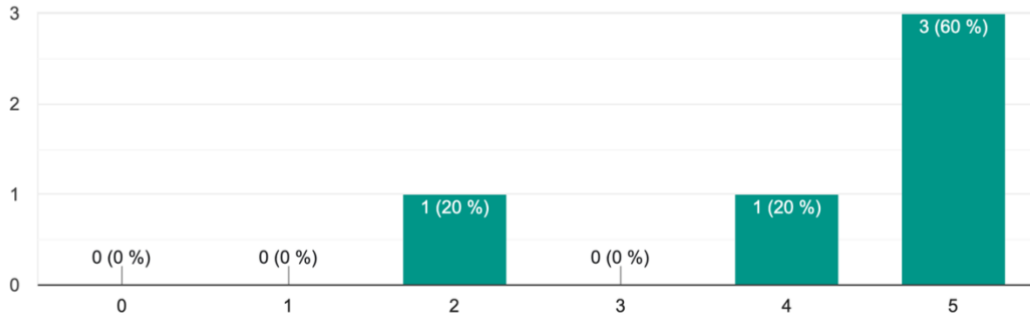
*C.14 High-Res Button Toggled*

## 8.4 Appendix D – Usability Testing

### 8.4.1 Questionnaire on Prototype Testing

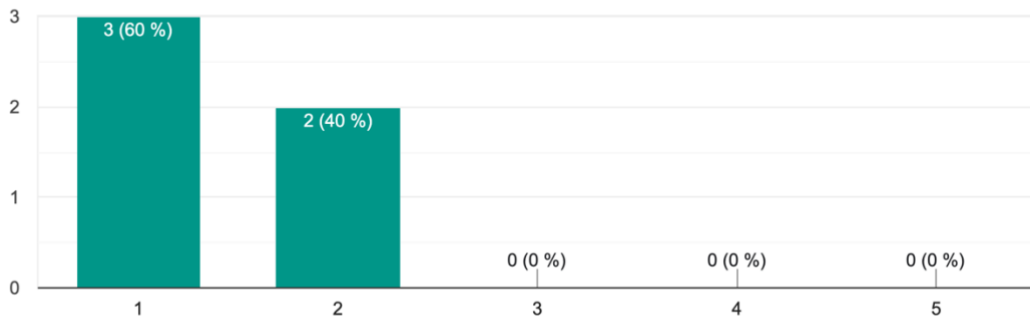
On a scale of 0-5, how did you like the app?

5 Antworten

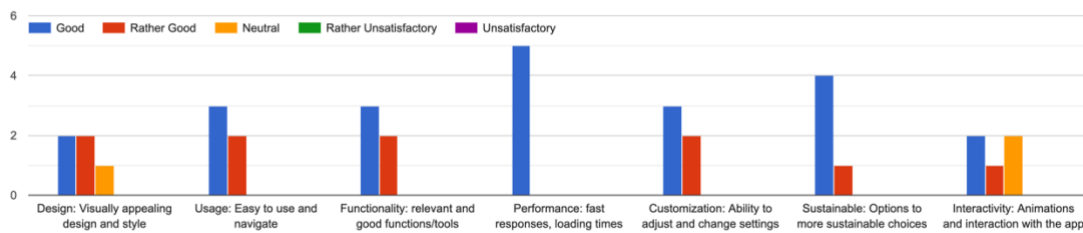


Were new features that you encountered in the app easy to understand and use?

5 Antworten



Rate your experience with youChat



## How do you define 'high resolution' in the context of image transfers through messengers?

5 Antworten

I can tell apart the faces in the photo

Clear pictures in color and quality, far from pixelated and grey hahah

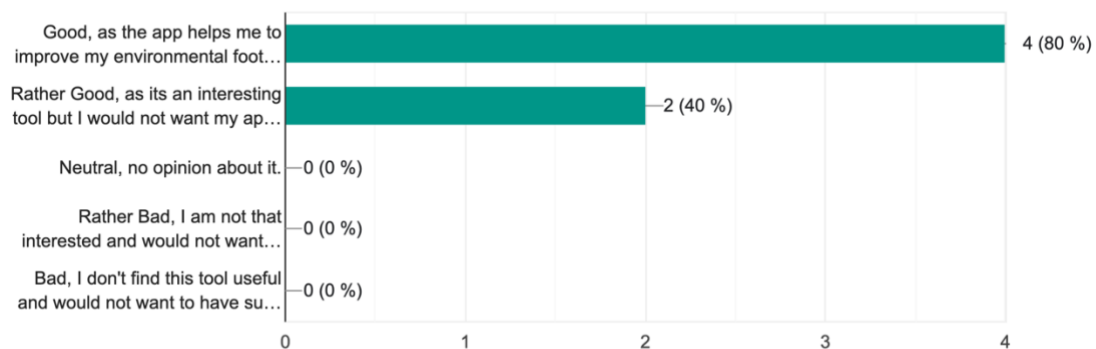
High resolution means full resolution, aka the complete file on the camera roll

Att bilden behöver större mängd data f;r att skicka bilden

I define high resolution as something that does not compresses the files when sending it. But I'm a content creator and values high resolution media.

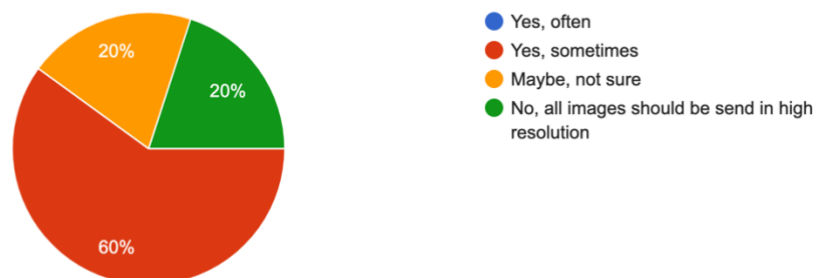
## How did you experience the sustainability mode (settings)?

5 Antworten



## Is sending images and videos in reduced resolution something you would consider doing more often if you had the possibility? \*sending images i...e and improves your environmental digital footprint

5 Antworten



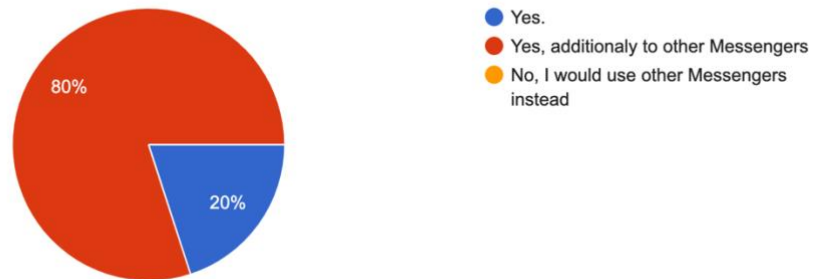
How do you like the idea of making high-resolution image transfers available but not standard for sending?

5 Antworten



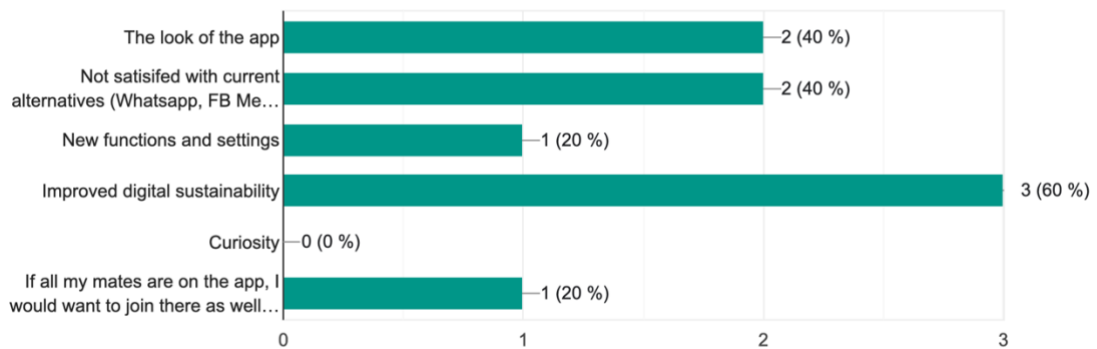
Would you download the app and use it? \*provided that all your contacts are using youChat

5 Antworten



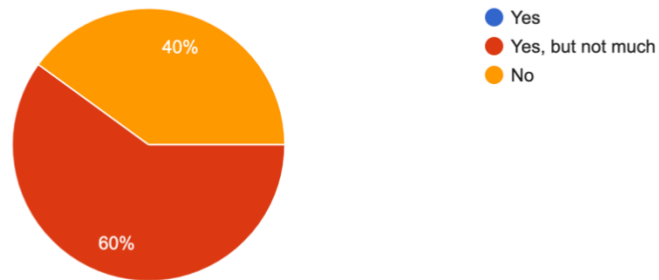
If you answered 'yes' in the last question, what are the main reasons that you would download the app and use it?

5 Antworten



Did you know about the environmental footprint of the internet and data transfers on messenger platforms before participating in this research?

5 Antworten



If you had youChat, would you send images always immediately when connected to mobile data or use the function of letting the image auto. send over wifi at a later point?

5 Antworten

