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Feel Data:

Public Data Visualization As a Medium to Motivate Data Donation

TUDELFT MASTER THESIS

DESIGN FOR INTERACTION

Feed data:
Public data visualization as a medium to motivate data donation

Master thesis
Design for Interaction

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Preface

Thanks to Gerd and Natalia, my supervisors, for your suggestions and affirmations throughout the project which give me confidence and empower me to take control of this project.

Thanks to all the members who attended the project's sessions, especially to peiyue and doudou, who provided me with new perspectives when I was feeling hopeless and stuck.

Thanks to my parents, for supporting me unconditionally, and for leaving me enough time to focus on my work.

Thanks to my dear friend Susie and my partner Yuxin, your presence made my trip to the Netherlands meaningful.

Finally, I would like to thank my cat for letting me pet her when she was sleeping and accompanying me when I cried due to anxiety.

For all you do for me, thanks very much. Hope that I brought as much joy to you as you did to me.

Executive Summary

In our everyday activities, trackers and IoT devices are recording an increasing amount of data in the wild. It is believed that incorporating these data will contribute to more inclusive products and services as well as stimulate designers' creativity. As a result of the General Data Protection Regulation, users can now access their data and take the control of its usage. Under such circumstances, one can freely donate personal data for research purposes. Moreover, users have the opportunity to utilize their data more efficiently and to be aware of the importance of their privacy.

This project is about exploring how an effective public data visualization could be designed to encourage more people to donate personal data at the very beginning of the data collection process, with a limit on the amount of data that may be manipulated. Students who are not experts in data visualization are the target audience. And the brightspace platform is chosen since it is the simplest and most convenient way for students to receive faculty notifications. As data visualization outcomes and people's willingness to donate data vary depending on the type of data, according to the research insights, this project focuses exclusively on public photo visualizations. A series of two design iterations was conducted in order to leverage the intrinsic motivation of students to donate photos of their home working environment to be used for research purposes. This project explores motivation from the perspective of self-determination theory, and proposes criteria and design directions for designing photo visualizations for behavior change.

In this study, the author identified five fundamental needs, including autonomy, competence, connectedness, purpose, and stimulation in order to evaluate data visualization's effects on the intimate data donation experience. Autonomy: Donors should feel free to choose the type of photos they want to donate. Their photos can also be used to express themselves creatively. Competence: Users should feel their photos are needed for the visualization. Relatedness: Users could feel connected with the visualization platform as they explored or interacted with it. Additionally, they believe they could build relationships by donating photos. Purpose: Users believe that donating their photos is meaningful to themselves or to researchers who require them. Stimulation: The way to ask for their donation is novel. And the entire experience with this visualization platform is enjoyable and interesting.

Through the study of three types of photo visualization, it was discovered that whether the visualization is explanation dominant or exploration dominant has an impact on users' willingness and results in varying types of photo donations. Further, design directions for effective self-determined public photo visualization in terms of information, function, and visual form were synthesized as a staring point for more future data visualization projects to motivate autonomous data donation behaivor.

Reading Guide

This reading guide explains how the document's body is arranged and how it is to be read.
Every chapter opens with a figure that illustrates its scope together with a short introduction. Other than the main body of the essay that describes theory, user research, and design practice, two special elements are described.

> *Participants' quotes are shown in this way.*

Important insights are shown in this way.

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Chapter 1
Introduction

The purpose of this chapter is to introduce the project background regarding design data and provide a structured overview of the project assignment, including the problem definition, context, and research questions. It concludes by describing the design approach adopted during the entire process.

1.1 Data, user, and designer

In this section, the relationship between data, user, and designer is discussed as a background for this project.

Data collection

Quantitative and qualitative data are always used to support and evaluate design decisions made at every stage of the process. The methods used to collect design-relevant data can be divided into three major groups. The first is gathering data through surveys, interviews, and context mapping, which is called "generative design research". The data can be given as numbers on a scale, transcripts, and artefacts that people create [1]. In parallel to the development of the Internet of things, data generated in smart everyday objects and public space sensors give birth to the other two ways in which designers are equipped with prolific mediums to interpret the complex physical world, such as smart home devices, wearables, and wifi sensors [2]. Among all methods, representative users are first recruited with consent forms explaining the project purpose at the discovery phase of design. They then either make toolkits like workbooks or technology probes like network-connected prototypes to generate data in a period of time. This traditional data collection process is mapped out in figure1.

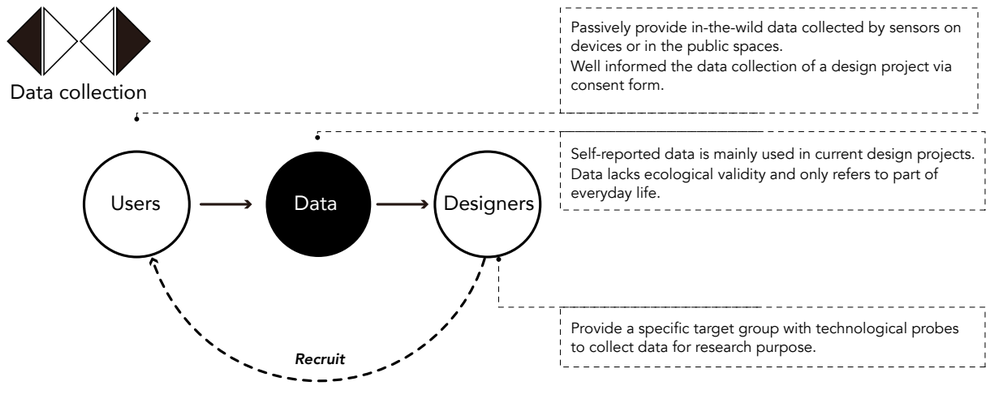


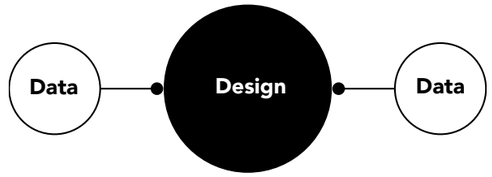
Figure1: Traditional data collection process

Data driven design

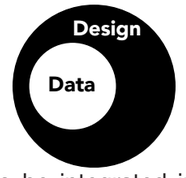
Bigelow et al. defined data in four characteristics, which are data semantics, data behavior, data structure and derived data [3]. The first two are about the objective attributes of data itself, like the real-world meanings of the data and the relationship among data values. These are the information that designers are expected to understand before manipulating data. The latter two also known as data abstraction refer to designers' activities centering around the data. Here, data is organized or filtered into either abstract representations or detailed tables or graphs to support design decisions.

When sufficient data is provided, how should a designer work with it? There are three main steps [4]. With a full understanding of the context of data and its owner, designers first need to decide the format to present and represent data, and critically evaluate it sometimes in collaboration with other stakeholders. While evaluating, they manage the data for a second use and explore the function of metadata. In the end, synthesized insights will be used to guide the following design activities.

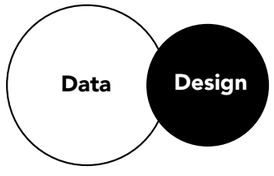
Data is addressed in the design process in three different ways [5].



Data used to inform or validate design is called design from data.



Data can also be integrated into a product or service as a material, this relationship is named design with data.



The third one, design by data, treats data itself supported by an algorithm as a designer. It is a future-oriented approach where data generated by humans, things, and environment is synthesized to support systems design new systems.

Human data interaction

Human data interaction emerges with the rise of personal data waiting to be managed and reflected on. It refers to decisions and actions triggered through people's understanding of these personal data [6]. Studies of HDI go beyond designing traditional data visualization and focus on the social and ethical aspects of personal data processing.

There are three stages from raw data to data that lay people can understand [1]. The origin is primary data which provides information deeply rooted in a work practice. Secondary data is then processed for professional oriented interpretation. Tertiary data transformed from secondary data is consumable and valuable to the public.

Mortier et al [7] proposed three aspects explained below that contribute to meaningful interaction with data. Legibility defines the transparency and comprehension of the data analysis process. Agency relates to the degree of control people take to express opinions towards the interpretations of their data and even further correct them. Negotiability concerns the dynamic relationships between data and the individual perception change over time.

Design value

People are living in a data-driven world in a passive position, only implementing privacy protection measures is not enough for an ethical data environment. Even with strict regulation, many data collection activities still happen with a lack of specific individuals' knowledge or consent [6].

Designers should take the responsibility for improving the participation of the end user in the process of designing data consumption environments. Thus, when users have the capability to better understand data and engage in the design process, they can not only provide insightful feedback but also play an active role in maintaining or extracting value from personal data in daily life. In addition, by interpreting and applying data, both designers and the public can think critically about social and political issues. Ideally, proper and meaningful strategies can be proposed.

1.2 Context

Relationship among designers, users, and data places a high value on data donation. This project is about exploring how an effective public data visualization could be designed to encourage more people to donate personal data. The data donation campaign has many stages, conducted by different organizations and launched through a variety of mediums; therefore, the focus of this project will be introduced here along with the current user experience.

Data donation is needed

Increasing amount of in-the-wild data is being recorded by trackers and Internet of things devices in our everyday activities. Personal data as a research material providing collective information has considerable potential to inform new designs and strategies in the health field [8]. For example, the number of steps indicates the degree of physical activity, sleep time duration can be an index to measure mental wellbeing, the number of takeaway orders reveals eating habits. Input from those data could contribute to more effective designs that support a transition to a healthier lifestyle. In addition, researchers have proven that data work incorporated in the early phase of design can foster designers' creativity. And relevant design framework was created to help designers work with data in a logical way [9]. With the support of General data protection regulation, users also have the right to access their data and take control of its usage. Donating personal data for research purpose of one's free will happen under this circumstance. From donors' perspective, reflecting on personal data they share intentionally or unintentionally, there is a chance for people to take value from their data and to be more aware of what they are protecting [10]. And from the researchers' and designers' perspective, making sense of big and open data on a large scale is essential for understanding society and building inclusive services [4]. While the flow among user, data, and designer is observed a great emphasis in the design field, data donation which can effectively bridge the gap is still a new and unfamiliar subject. Lack of research is conducted and intervention is devised to facilitate long term data donation behavior.

IDE collects students' data for services improvement

As both data visualization and data donation rely on contexts, students' home environment photos are selected as the target data. As well, an imaginary research project is carried as the background for the data donation. Now, our time spent at home is increasing. The experience of working from home attracts the attention of researchers and designers. In the IDE faculty, projects are also being developed to improve the home environment of students to increase work productivity and quality of life. However, due to a lack of data from real life situations, the interventions are less practical. More photos of the home environment are needed to better understand the students' living conditions and to inspire creative work.

At least three types of stakeholders should be considered in a data donation activity, namely, data donors, data recipients, and data users (Figure 2). Donors and users may overlap depending on the research outcomes generated by the collected data. In the design field, designers from the data recipients' side sending requests for specific data types start this activity. This post aims to move data owners or generators to contribute data for design purposes. This type of participation is called data donation, and it is these participants' behaviors that support its existence.

There are many ways to post data collection information on real-world or virtual platforms, including offline speech, interactive devices, text messages, videos, and so on. Due to the online education situation, donating data via virtual medium is chosen. Similar to most student activities held by the IDE faculty, students get access to data donation

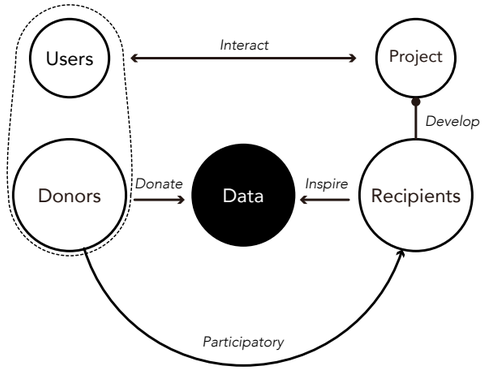


Figure 2: Relationship between data donation stakeholders.

announcements mainly from the brightspace platform under the "Master programme Industrial Design Engineering" course. This is a platform for students to find the information they need for their studies in Tu Delft which is expected to be checked at least once a day during the workdays. Current data donation scenario on the brightspace is illustrated in Figure 3.

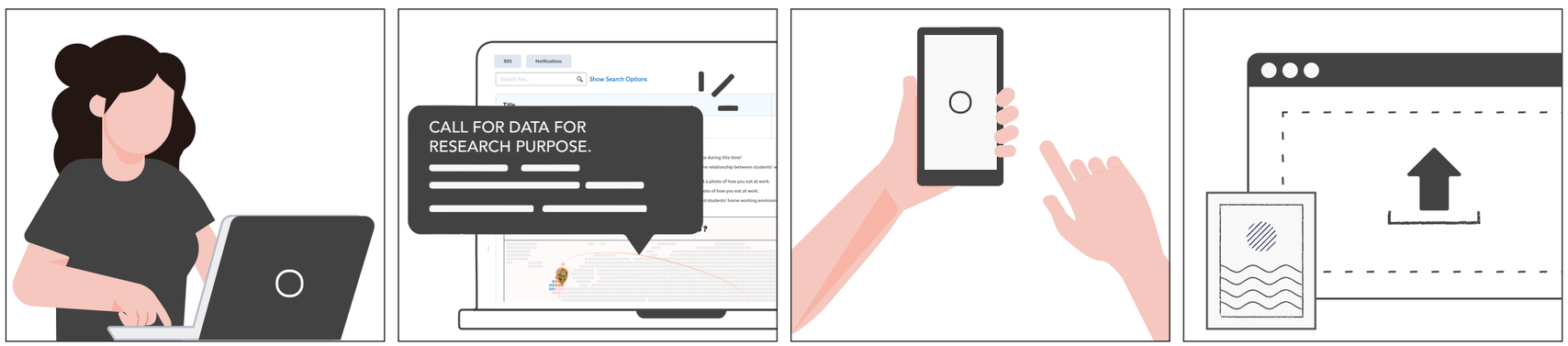


Figure 3: Project focused data donation scenario. (Image sources: freepik.com)

1. Check the brightspace as usual.
2. Notice the data donation notification
3. Take a photo according to the notification.
4. Donate the photo.

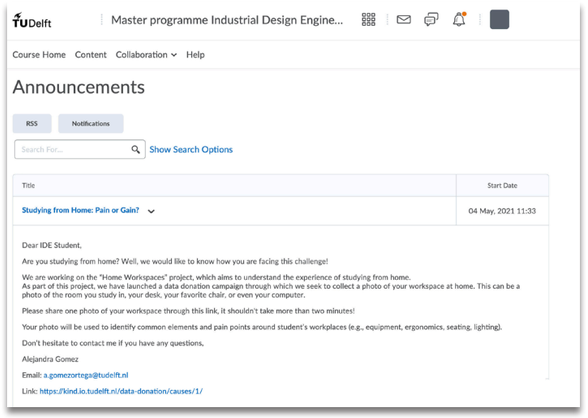


Figure 4: Request for students' desk photos posted on the brightspace

Problem definition

Students are facing an increasing number of surveys requesting their quantitative or qualitative data to conduct research. Although most of them are intended for students' benefit, such as developing practical services or products to increase their sense of happiness, none of the participants (18 ppl) in this project showed much interest in these surveys. Both literature reviews and interviews with users revealed some key reasons. Anya Statova stated that viewers' ability to gain a concrete overview of the consequences of donating personal data influences their decision to donate [13],

> ***With only a glance at the title, more than half of participants indicated that they would probably skip this announcement.***

while very few research results effectively reach data providers. When using the activity of collecting students' desk photos as an example, the author observed more aspects underpinning current data donation decisions (Figure 4). The text messages alone cause participants to feel overwhelmed and uncertain about the type of image they should take. Furthermore, after participating in these one-way anonymous activities for a number of times, they feel meaningless and are tired of providing data for the public good.

Increase the intrinsic motivation of students to donate data when they interact with the data visualization.

Project focus

Research done by the author has revealed that more appealing and comprehensible information about current data donation requests has a significant impact on users' intentions to donate data. During the design process, public data visualization is always applied to depict how participants' data is used. By communicating evaluated and clear knowledge derived from the content of data, traditional visualizations inform and motivate audiences. In this early stage of design, there are few data points to explore, and so the visualization is crucial in engaging students' interest in donating data. Therefore, the focus of this project is to motivate students to donate data once they have been attracted to the visual content and have entered the interactive data visualization website. (Figure 5)

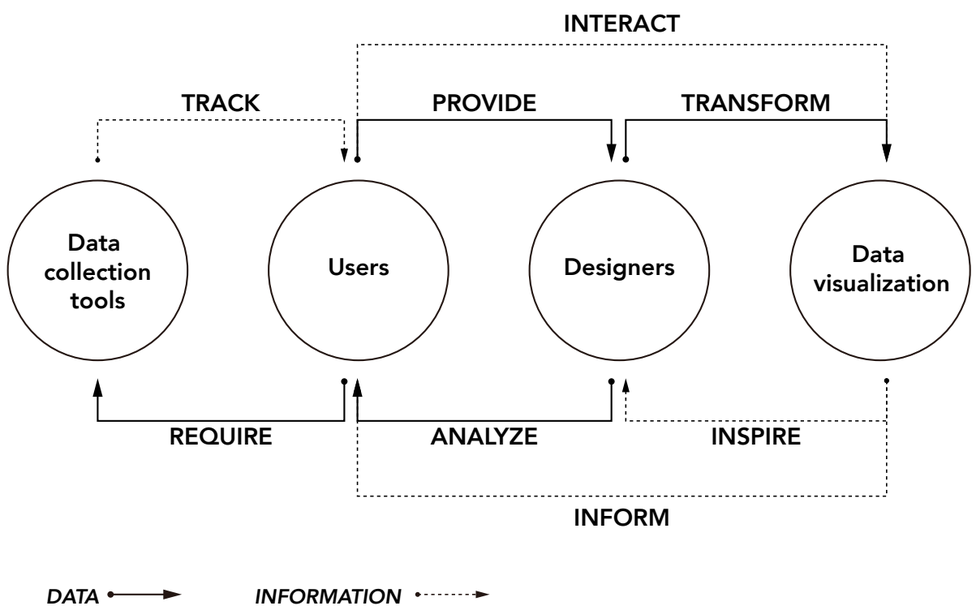


Figure 5: Data visualization as an incentive in the data donation process

1.3 Assignment & Approach

Assignment

It has been shown that visuals are effective in persuading target audiences to change attitudes or behaviors, not just in news and features, but also in advertising and campaigns. These include behaviors changed for one's own wellbeing, such as health and safety, and behaviors changed for the benefit of the community, such as charity and sustainability [14]. As with visuals overtaking text in social marketing, in addition to fully textual publications, some of the IDE activities posted to the brightspace are also complemented with video contents, like posters and short videos. In this project, a public data visualization as a visual means to explore and explain data is considered to contribute to data donation requests posted on brightspace by providing students with an incentive to donate data during the early stage of the design (Figure 6).

Data visualization is a widely used visual communication tool to help people understand, manipulate, analyze, and make sense of the rapidly increasing unprocessed data [11]. It can be seen from big screens or installations in public to self-tracking applications in smartphones. Both informative and actionable insights are delivered from it. In order to maximize

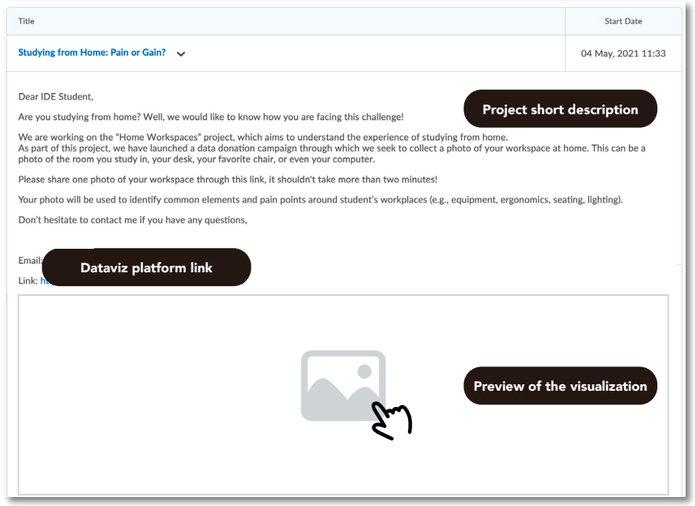


Figure 6: Project direction.

the benefits of public data visualization to data donation, psychological factors of data donation behavior and features of data visualization that can target these factors are two primary objectives discovered in this project. After transferring theories into the design of incentive motivators, an initial self-determined public data visualization framework is built, demonstrating the connection between users' intrinsic personal data donation motivation and composition of narrative data visualization. Collecting students' home environment photos on brightspace as a use case, the framework is further elaborated after two rounds of design iteration. In this way, this project provides strategies for the future design of data visualization for incentive purposes.

Research Questions

Research questions are raised as follows:

- What is the definition of autonomy, competence, relatedness, purpose, and stimulation in relation to personal data donation?
- How to translate donors' fundamental needs into the design of public data visualization features that motivate autonomous data donation behavior?

Approach

This project focuses on exploring data visualization's role in facilitating autonomous data donation behavior. Guided by empirical research through design methodology, the entire design process acted on a theoretical level as well as a concrete design level [12].

The author first formed a self-determined data visualization framework with the input from theme explorations of data donation and data visualization. Then, a concrete design brief was created working as the basis for exploring and generating new knowledge for this framework with quick prototyping. Finally, comments collected from the participants during the test together with reflections on the entire design process supplemented the existing knowledge of data visualization and data donation. Both the project approach and explorative activities are illustrated in the Figure 7 below.

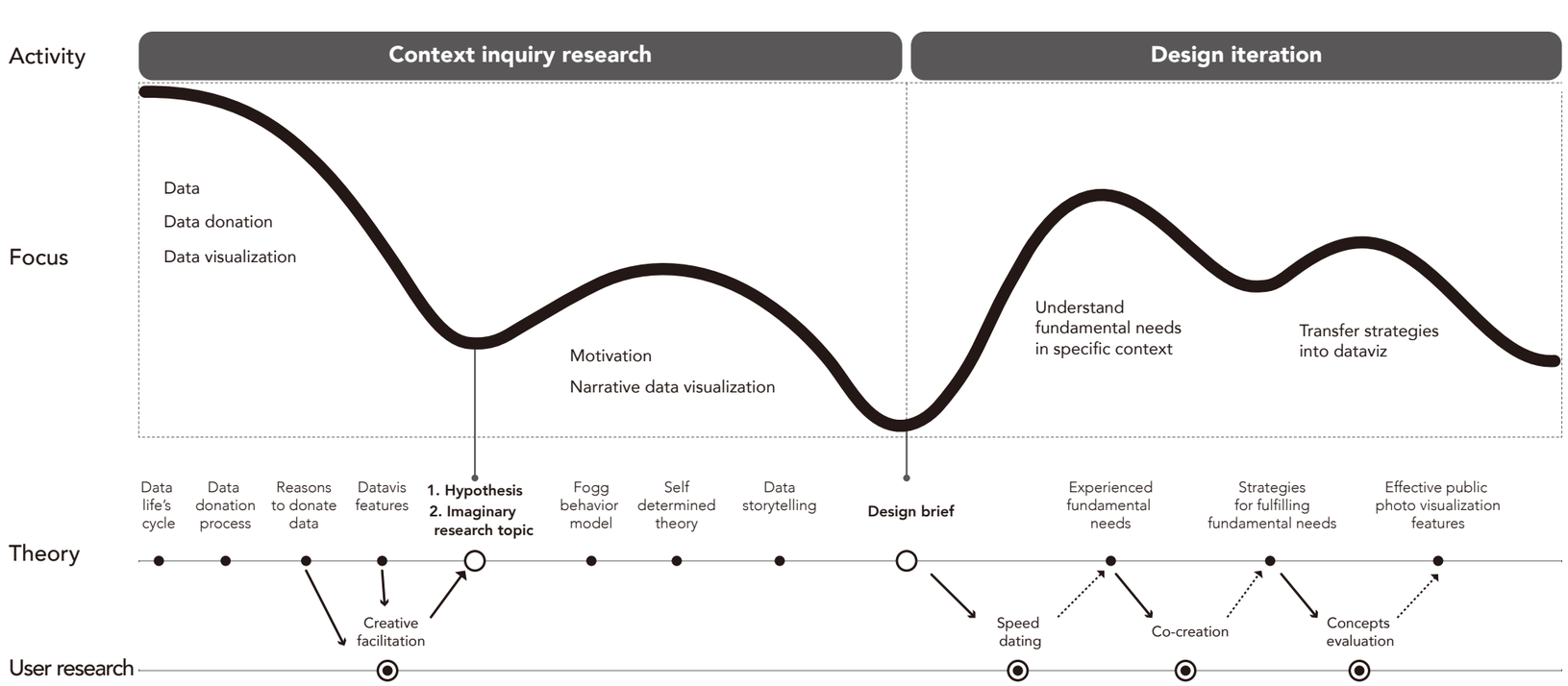
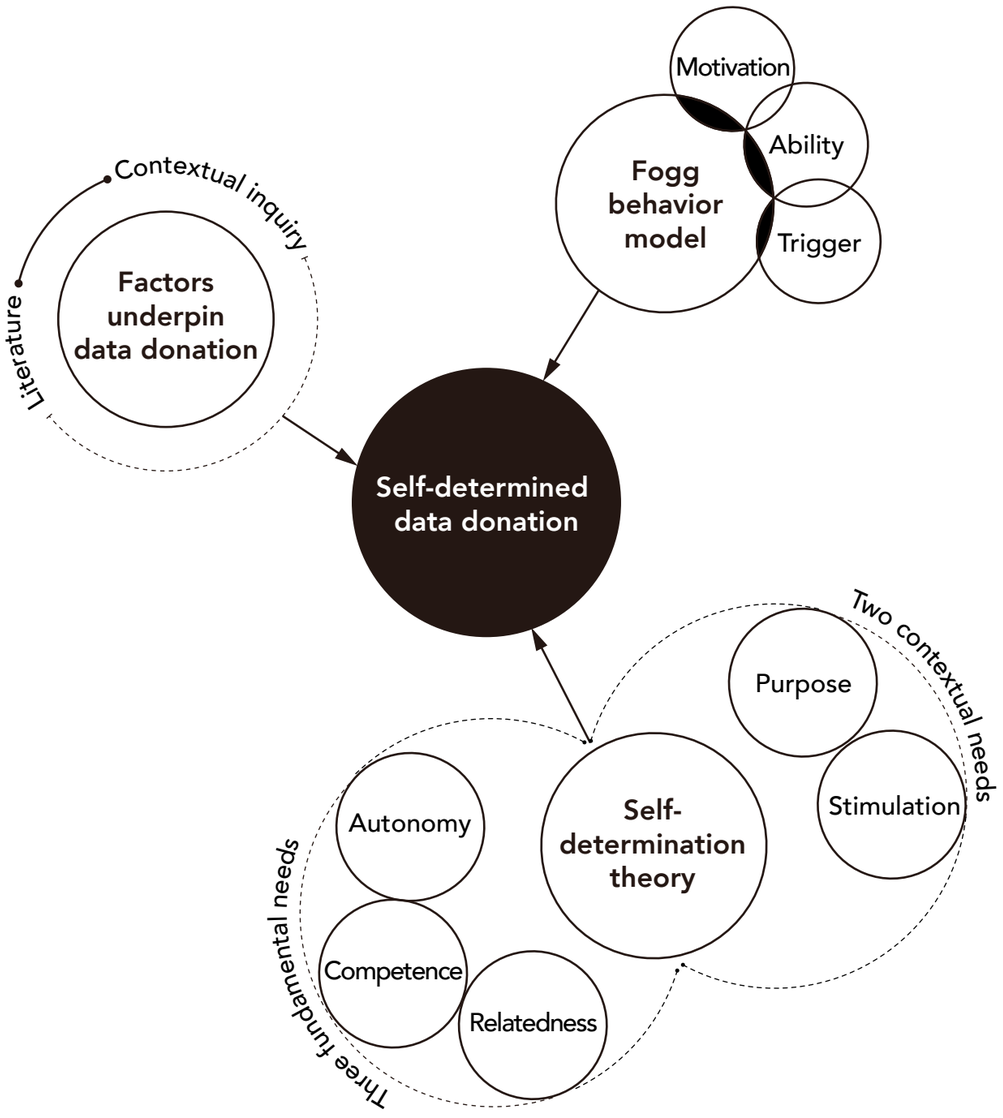


Figure 7: Project process visualizaed in a curve from left to right



Chapter 2
Theme exploration: data donation

As a first step toward incentivizing users to be actively engaged in data donation, psychological research and context inquiry research are used first to identify factors that increase and hinder their willingness to participate. In addition, theory on behavior changes and motivation is described in order to explore the role data visualization plays here. SDT (self-determination theory) is then chosen as a leading theory in human motivation because of its application to prosocial behavior. According to this theoretical guidance, factors that affect those who give data are divided into five fundamental needs. In this way, the goal of public data visualization is defined.

2.1 Data donation as a prosocial behavior

Over time, significant amounts of personal data generated in everyday activities were recorded and utilized by companies to increase their profits and optimize customers' experience. A turbulent time for data donation has begun with the introduction of Right to Data Portability which enables data owners to access their data collected by third-parties [15]. The public is now taking more control of the transference and consequence of personal data. Such data used in social beneficial research is both a useful tool in the digital economy and an invaluable asset to environment improvement and personal development, as long as people are willing to share it. This behavior actively performed for public good is called data donation.

2.1.1 Psychological factors underpin data donation

Similar to other prosocial activities like crowd-funding and volunteer work, there are also concerns and motivations for donating personal data that benefit others or society as a whole. Three distinct factors were proposed in preliminary research which was conducted to investigate psychological factors driving and hindering data donation behavior. They are the opportunity to receive direct benefits, the desire to contribute to the society, and the perception of the "recipient" organization [15,16]. People with a sense of social responsibility have a higher likelihood to donate. In most cases, data donation decisions are made based on the assumption that personal data is distributed broadly rather than solely collected by researchers who asked for it [17]. The influence of the receiver organization's information reveals donors' needs to understand the purpose of their actions, as criminal and unethical use of data might happen even with strict resolution mechanisms. And a large-scale survey has shown that the majority of participants are still willing to share with the full research community when they are offered the choice to decide whether or not to allow open access to their data [17]. On the contrary, concerns about direct self-benefit like external rewards or praises are negatively correlated with the decision to donate data [15,16]. Apart from the three reasons, Skatova et al [15] stated that privacy concerns, types of data, and the way to present relevant information to those who make the gift of personal data should also be taken into account in specific data donation domains.

2.1.2 Contextual research

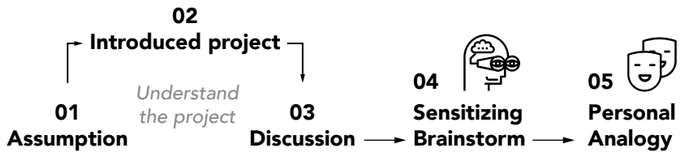
The contextual research hold in a creative facilitation format focused on examining students' motivations toward donating their personal data to the faculty for research purpose. 4 female and 1 male including the author participated, with the session being distributed via miro online generation platform and zoom meeting. This creative session contains two parts, problem definition and ideas brainstorming (Figure 8).

Setup

As shown in In the problem definition, the first step was to associate keywords with three categories: donate, everyday data, and data visualization. Then the author introduced the project background and current research findings. After the introduction, Participants were free to ask questions about this project. While reflecting on their previous assumptions, we reached a consensus on the design goal and assignments.

Data donation is an abstract and future-oriented topic. To collect reliable explanations of why participants are willing to or reluctant to donate data that can depict their everyday activities, a sensitizing brainstorm was designed to bring them into the scene. A miro board was created as a page of the diary to record their daily activities. Participants were encouraged to fill in the board with any data they wanted. Fifteen minutes later, each of them briefly went through their board and pointed out which data they would donate. Then, as a group, they sequenced all the post-its in terms of their willingness to donate and gave the reasons. The second round of brainstorming focuses on gaining a deeper understanding of their needs by encouraging participants to design an ideal public data visualization aiming for acquiring data. As describing the detailed information of public data visualization like what it would do and how it would look like, participants referred to the feelings they would experience while donating data.

Figure 8: Procedure of the contextual research



Results

People's motivations were summarized based on their explanation of data donation intentions and their expectations toward a dataviz that asks for photos. Among them, some closely matched those identified in psychological research aside from data recipient information. In this project, IDE faculty as the recipient is perceived as trustworthy and well-known. Therefore, students' data donation behavior will not be affected by it. Below are the other elements found in the research in addition to what is known.

Create bonds - As a result of visualizing donated data and presenting it to the public in a data visualization, the request of data donation is perceived as a new way to connect with others.

> *I would give the story behind specific data. People who donate data can receive a story from another randomly.*

Helpful - The participants start thinking about how and whether their donation can help other donors rather than only the researchers who need raw data.

> *As now people can gain the main points at the first glance, I will donate data that can make people happy, like my pets' photo or a short interesting story.*

Attractive - The visualization should take advantage of its creative and novel format.

> *It should not only look different from other data donation requests, but also look different from other visualizations.*

Control - Participants expressed a strong willingness to take control of the usage of their data due to concerns about their data being recognizable.

> *I need to take control of modifying my data or have the right to delete it if I feel uncomfortable about its usage.*

Interesting - Compared to a written request, data visualization enriches the donation experience by calling for photos in multiple ways.

> *You can set a contest for two opposite data. Or you can make the visualization looks hungry and the data donation is like feed a cute poor character.*

2.2 Motivating towards prosocial behavior

Davis et al. defined behavior as "anything a person does in response to internal or external events"[18]. Whilst possible reasons for data donation are uncovered, it remains unclear how a public data visualization can drive the audience towards data donation behavior in a methodical way. Therefore, theories on behavior change and motivation were explored. In the following pages, the author looks in detail at the Fogg behavior model (FBM) and the self-determination theory.

2.2.1 A behavioral model for persuasive design

The Fogg behavior model states that behavior is a result of three elements: motivation, ability, and trigger (Figure 9). In real life situations, a high motivation can come with a low ability, and vice versa. This compensatory relationship is illustrated by the curve line in Figure 5. It can be seen that the balance between motivation and ability is a determining factor of activation threshold. That is, triggers are perceived effective when the combination of these two elements exactly places a person above the curve line. Therefore, a greater likelihood for a person to behave in a certain way can happen only when he or she is sufficiently motivated, has the ability and is triggered to perform a target behavior at the right time [19]. In most persuasive design cases, either the level of motivation or ability is manipulated, but an appropriate trigger is often missing. Before identifying the role of data visualization in the data donation process, subcomponents of each element will be first introduced.

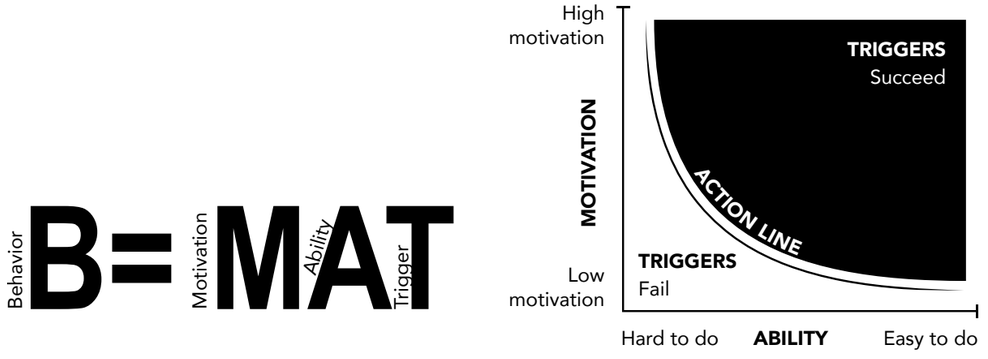


Figure 9: Relationship among motivation, ability, and trigger (image source: Fogg, adapted by author)

Motivation

Designing for motivation is to guide people with a high ability to cross the activation threshold. Fogg proposed three core double-edged motivators. They are sensational motivation about a sense of pleasure and pain, anticipatory motivation characterized by hope and fear, and social motivation controlled by social acceptance and rejection.

Sensational motivators as a product of the primitive tendency for seeking pleasure and avoiding pain is immediate, or nearly so. People are driven to engage in activities with little thinking or anticipating. Motivating through hope/pain which talks to people's anticipation of an outcome either good or bad is ethical and empowering. With a proper framing, both future gain and loss are of equal value in motivating people to act. A number of persuasive digital technologies like Fitness and social media apps influence people from the third dimension as we strive to be socially accepted and avoid being rejected [20].

Ability

Increasing ability is to ease the effort to perform a target behavior. It is about simplicity itself rather than training people for professionals. An activity can be considered as a simple one from six aspects: time, money, physical effort, brain cycles, social deviance, and non-routine. It is not necessary to leverage all of them in a design as they rely on the individual and the context. Instead, Fogg pointed out that the scarcest resource should be evaluated when triggering a behavior. For example, taking a photo of street scenes and uploading it on social media platforms may no longer be simple for people who forgot their phones at home. In general, when a desirable behavior requires a lot of effort, the improvement of its simplicity always precedes the boost of motivation.

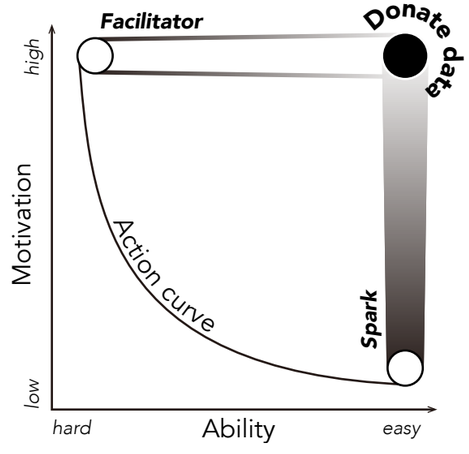
Trigger

As the combination of motivation and ability vary by the individual, triggers functioning in three different situations are identified. They are spark, facilitator, and signal. Spark is embedded in a motivational intervention in the lack of motivation situation, highlighting the three motivators explained above. An effective facilitator triggers behavior by making it easier to do without requiring extra resources. Unlike the previous two aiming to intervene in motivation and ability, signal simply serves as a reminder. For example, the traffic light as a signal trigger just indicates the appropriate behavior. The role of triggers in persuasive design is growing in importance, as advances in digital mediums enable people to perform a behavior immediately after encountering a trigger. People are now easily triggered to act on impulse.

Remarks

- Due to the increasing use of self-tracking technologies, a large amount of data about ourselves is produced and processed. Individuals can easily get access to personal data and are given full control over their data usage.
- To ease the data donation process and make it available to everyone, designers are now putting efforts into inventing a user-friendly data donation platform like the open humans platform where researchers are able to post data collection requests for patient-led projects [50].
- Lack of motivation to donate data is the primary objective that needs to be tackled by data visualization. Data visualization in this project mainly serves as spark trigger (Figure 10).

Figure 10: Public data visualization as a spark trigger



2.2.2 Self determined theory

Like FBM, motivation is mentioned the most as a determined unitary element in moving people to action in many widely used behavioral theories, including theory of planned behavior[21], social cognitive theory[22], controlled theory[21], and etc. Within these theories, there is no clear distinction between qualities and orientations of motivation. However, self-determined theory, grounded in health psychology research, not only differentiates motivations into many types and levels based on their sources but also emphasizes the internal and external aspects of behavior change[23]. It has been widely used as a theoretical lens in describing the mechanism of casual action in many life domains, such as health, education, and sustainability [24,25]. In addition, it establishes a direct link between self-determined behavior and improved wellbeing benefits [23].

These points bring the author to approach SDT and regard it as the theoretical foundation for the design of data visualization features. Definition of extrinsic and intrinsic motivation and the reason why this project focuses on increasing intrinsic motivation are explained as follows.

Types of motivation

Whether a motivation is extrinsic or intrinsic depends on the underlying attitudes and goals driving a behavior [26]. If a person behaves in a certain way expecting separate outcomes as opposed to finding an inherently enjoyable reason, he or she is externally regulated, and vice versa. Further, four sub-motivations rose from extrinsic motivation by the degree of internalization together with intrinsic motivation are placed on a control-autonomy continuum (Figure 11)[27]. Autonomous and controlled motivations are given:

- External regulation: Driven by receiving rewards or avoiding punishment.
- Introjected regulation: Driven by avoiding feelings of worthlessness, shame, or guilt.
- Internalized motivation: Behavior fits with personal goals and values.
- Intrinsic motivation: Behavior is interesting and enjoyable in itself.

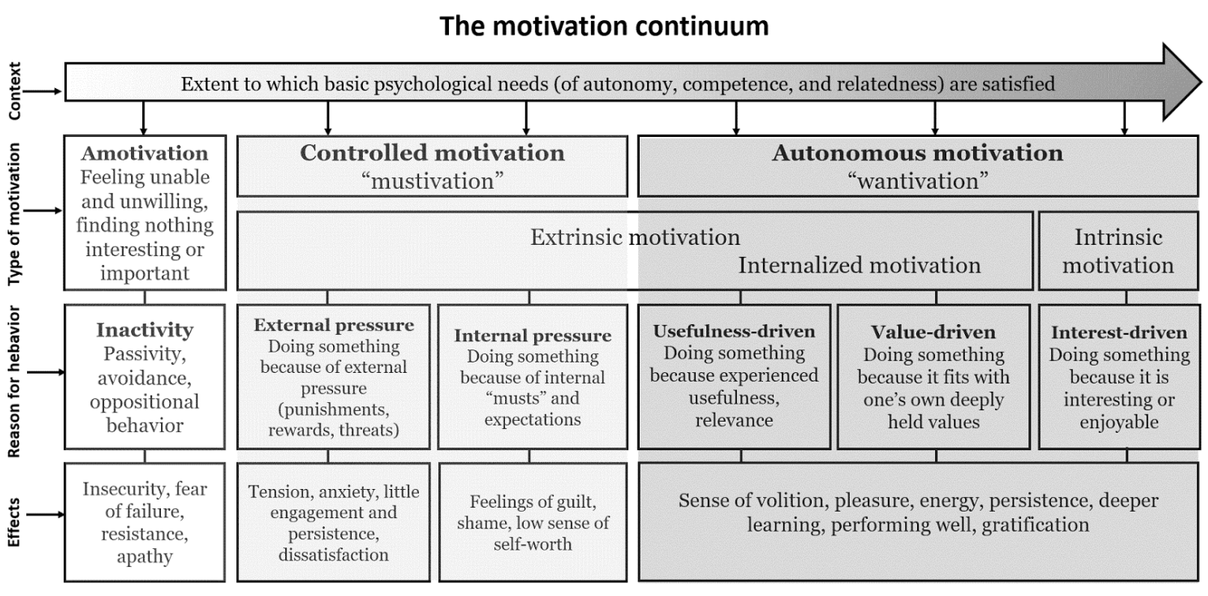


Figure 11: The self determination model. Extracted from Visser, C.F.

Why focus on intrinsic motivation

According to SDT, people who react to controlled motivators like a cash prize or a punishment are unlikely to maintain the target behavior over time [26]. It is common that modifications of their behavior only keep to the end of the intervention. Conversely, intrinsic motivation is allowed to be presented for a short period of time, as changes from within are more solid and can sustain through time. When it comes to facilitating prosocial behavior like donating data, it is always reliable to focus on inner-energy which can bring positive outcomes and committed behavior rather than the ever changing environment.

As well, researchers found that participants would give data if they thought the donation would be interesting and enjoyable than if external factors played a role.

2.3 Self-determined data donation

"Outer changes always begin with an inner change of attitude."

A. Einstein

An individual's action based on internal motivation and the pursuit of self-development and self-realization rather than external rewards is called self-determined behavior [28]. A self-determined activity is not defined by its outcome but by the meaning and pleasure people can grasp in the process [29]. Therefore, external incentives can equally contribute to the intrinsic motivation eliciting process. Like all the other self-determined behaviors, to enhance internal motivation for donating photos now and in the future, at least fundamental needs for autonomy, competence, and relatedness should be satisfied [23]. It is worth to note that motivation is not only prompted by the three universal needs, factors extracted in various contexts also account for reinforcing particular behaviors [30]. When Dupe et al. applied SDT in design for technology acceptance, with the self-adaptive characteristic of the declining older people in mind, increasing the awareness of oneself was counted as an extra design objective adhering to self-determination approach [28]. Thus, as a result of literature review and contextual research, the author outlined five primary needs as a guiding principle for autonomous data donation behavior (Figure 12).

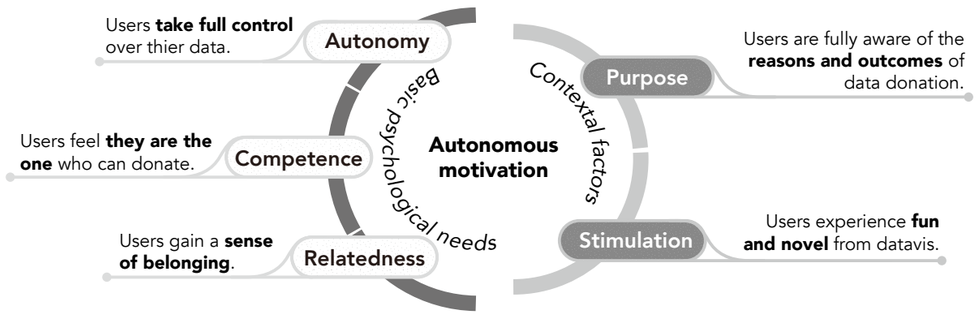
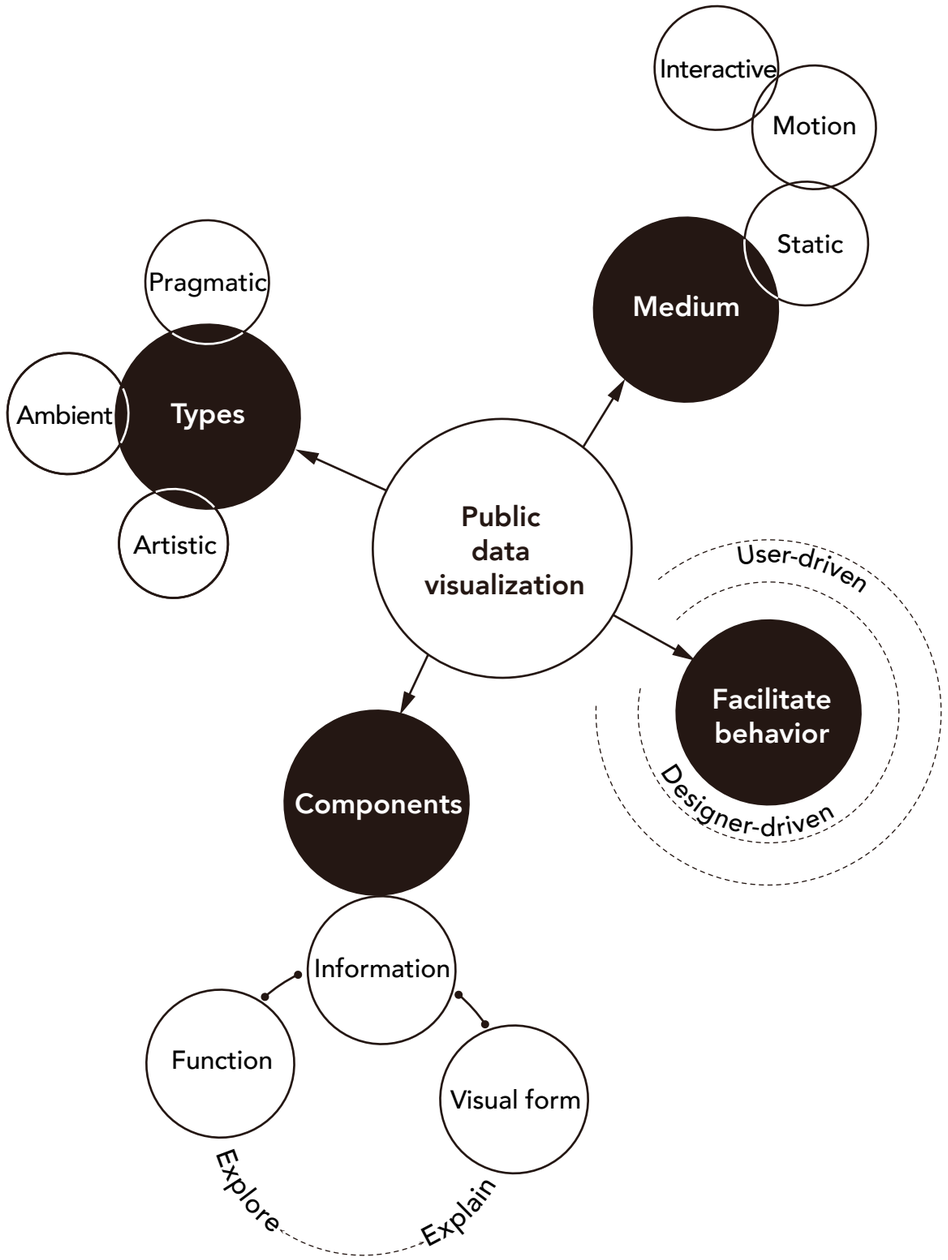


Figure 12: Three fundamental needs and two contextual needs for self-determined data donation

2.4 Summary

When it comes to data donation, public data visualization has a role to play in encouraging people's participation. Due to the number of behavioral theories, the solution space for motivating prosocial behavior is endless. The self-determination theory, among all the theories, is chosen because people's needs towards data donation requests that have been learned from psychological research and contextual research are highly related to the SDT's underlying foundation. In addition, behaviors driven by self-determination contribute to volunteer participation over the long run.

Measuring the individual's level of autonomy in prosocial behavior is a complex matter, especially when it comes to public platforms. According to SDT, five fundamental needs are analyzed as behavioral proxies that can be used to weigh donation intent.



Chapter 3
Theme eploration: public data visualization

An introduction to three types of data visualization is presented in this chapter, which also lays out some common media sources used to present davaviz. It allows the author to select photos as the target data to be donated. Afterwards, the author argued that dataviz can motivate people through its storytelling and interaction features. A web-based solution is eventually chosen in order to be able to provide the public with this data visualization and motivate them to donate their data.

3.1 Introduce data visualization

Due to human's preference for visual perception, compared to written and verbal information, visual information can be quickly transferred into understandable insights in a more permanent way. Data visualization is regarded as a sub-classification of visualization. Therefore, as an approach to present inferences using graphical representations, it is now widely applied to enhance people's perceptual capacities to learn from data produced in the science, humanities and our day-to-day lives [31,32]. An effective and efficient dataviz should assist viewers to identify interesting and useful and make reasonable decisions from either a large or a small scale data [33].

Data visualization can be categorized into three major sub-fields based on their properties, which are pragmatic, ambient, and artistic dataviz (Figure 13)[31].

The first refers to dataviz as an efficient communication tool for providing comprehensive information. As Kosara et al. argued, "To determine whether a visualization is pragmatic, we simply ask if it allows us to efficiently read the data (or at least the relationships between subsets) from the display." [34]. Here, detailed and thorough labeling are applied to defeat graphical distortion and ambiguity. Techniques for generating pragmatics can be applied to many data sets.

The second, placed in between reconciling the utilitarian and sublime, is committed to support information seeking and provides inspirations. Rather than combining the two properties into one function, ambient dataviz often chooses to keep them separate and let the audience explore and decide via interactions. The essential characteristics of these two information-driven dataviz's visual forms focus on readability, recognizability and meaning [35].

Dataviz, defined as artistic creation, made for inspiring awe, evoking deep emotional or intellectual responses, highlights its aesthetic quality [34]. To achieve this, the designer often starts from the selection of the data set. As it is not designed for fostering immediate understanding or providing ease of use, less user-friendly concerns will be raised compared to the first two. It preserves its own sublimeness and achieves its own purposes as a work of art [36]. In most user-centered design cases, a specific type of dataviz is always selected based on the project purpose.

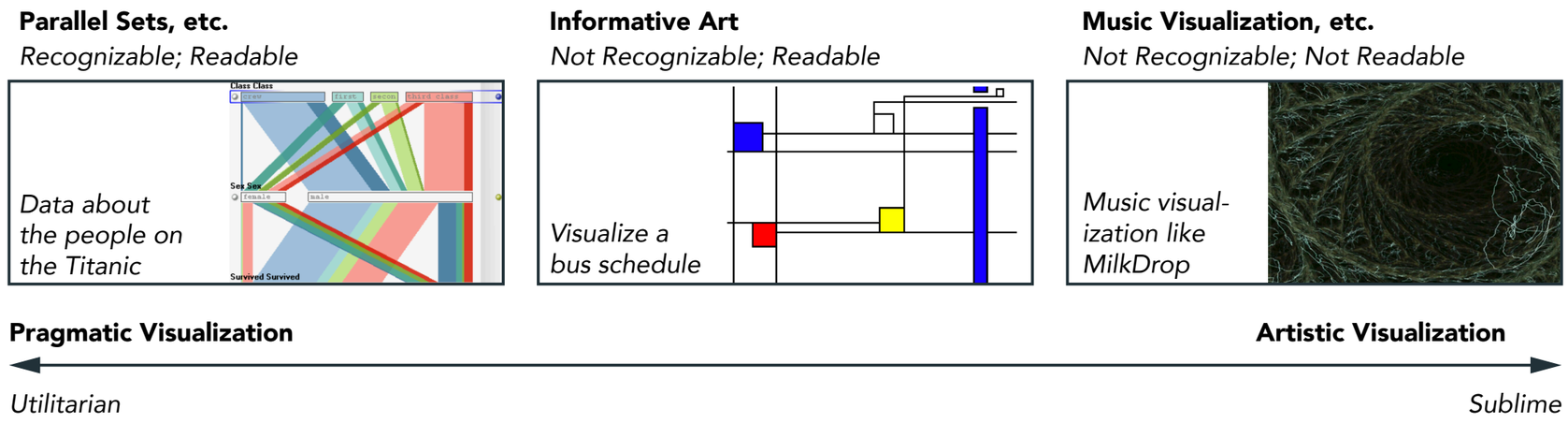


Figure 13: Pragmatic, ambient, and artistic dataviz, image source: Robert Kosara, adapted by author

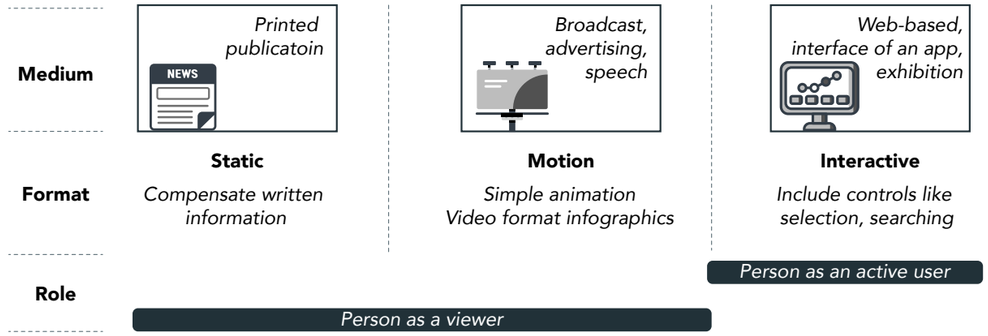


Figure 14: Features of static, motion, and interactive dataviz

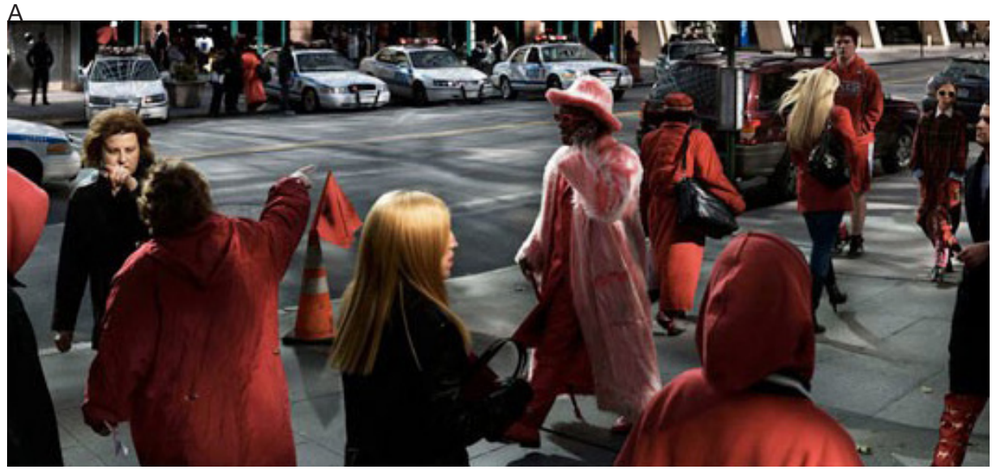
Ideas or stories extracted from data are communicated to the public via widespread media sources [37]. Meanwhile, new sources of media bring new formats of dataviz, which have corresponding features. Static, motion, and interactive are three representative formats. Some cases and default affordances are shown in Figure 14. The former two always lead to reactive thinking, while interactive dataviz encourages the audience to be proactive. In addition, research has shown that data displayed in interactive format is more accessible and engaging to the public [38]. And given its flexibility and convergence, interactive web-based data visualization is chosen for this project.

3.2 Photoviz

Data collected for dataviz exists in any form, varying from numbers to text to symbols [35]. Both qualitative data and quantitative data themselves have no meanings. They are abstract and open to interpretation. The value of dataviz is that it transfers those into understandable information for gaining insights. Dataviz has been a specific graphical tool for reasoning on quantitative data in the form of charts, numbers, infographics for a long time. Recently, designers emphasize generative research methods to empower participants to reflect on their tacit needs and values by making. During the session, data like words and photos are gathered which reveal a higher level information of the context and target users. To make sense of these data and communicate insights, a rise of methods for qualitative research are invented. This trend switches the author's attention from visualizing numerical data to non-numeric data like text, image, video etc [39,40].

Taking advantage of the invention of computer technology, people have never been exposed to such an abundance of photos and data before. Photography itself is a ripe communication tool that allows people to express thoughts and emotions. And new techniques like multiple exposure have pushed the creation of photos further. When describing a real situation, it can represent a richer and more comprehensive visual record than verbal or written methods [41]. Whereas efforts are required to make a traditional dataviz intuitively recognizable and appealing, visualizing photos takes advantage of people's initial visual preferences in the beginning. These features of photos bring photoviz, a kind of visualization done with photography or based on photography [42]. As an emerging field, it is considered an effective combination of photography and data visualization. In particular, aggregating photos can reveal the invisible and tell more descriptive stories than either traditional photography or dataviz. Some cases collected by Felton are shown in Figure 15.

A



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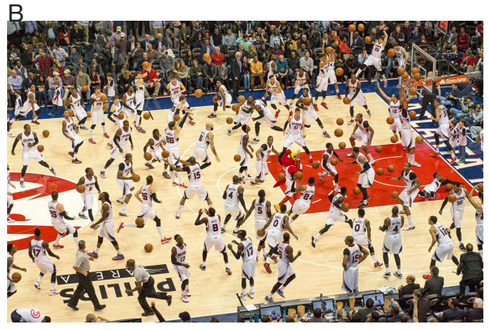


C

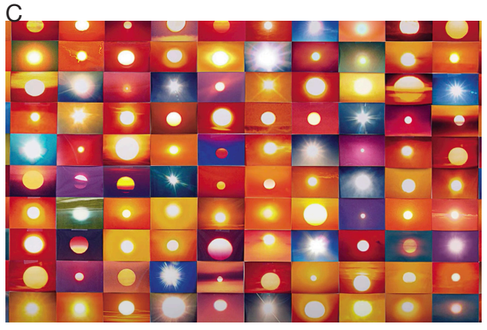


Figure15: Some examples of photoviz. A: One of the visualizations of Peter Funch's Babel Tales, which are constructed scenes that depict New York's streets during the same time of day during a given period. B: Feltron tracked the movement of the ball during a basketball game. C: Mosaic style is used for searching for differences in things or for putting things together. While the outcome is always repetitive, it can also be used to identify outliers.

3.3 Data visualization mobilize people

Dataviz involves an information exchange among the author, the receiver, and the content [34]. While dataviz together with other visualization methods in the design process works as boundary objects aiming to communicate insights or results to the stakeholders [32], research has argued that dataviz can allow users to exert influence over the content [43]. Among all media, user interfaces as a default communication channels take the main role to display visualization that focuses on behavior change. Further, approaching people's interaction with dataviz from the Norman's action cycle angle (Figure 16), it indicates that effective communication can turn insight into action. Thus, public data visualization in this project presented at the early stage of design (Figure 17) has the potential to mobilize data donation.

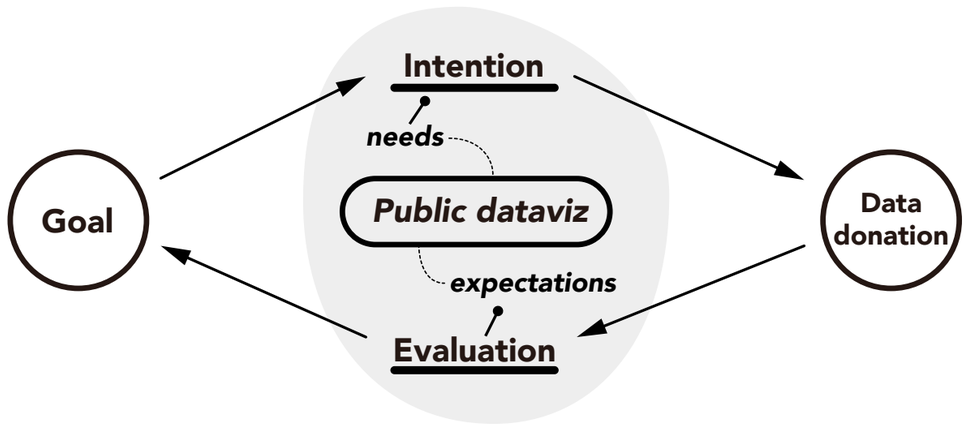


Figure16: Norman's action cycle applied in dataviz

Figure17: Public dataviz presented at the early and late stage of design

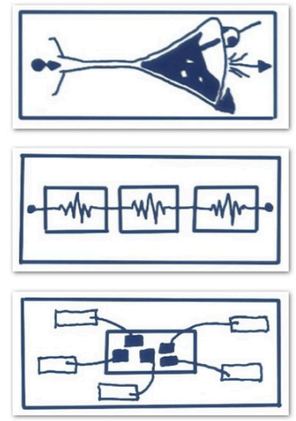


Figure 18: Illustrated narrative structures, from top to bottom: Martini glass structure; Interactive slidehow; Drill-down structure.

Narrative data visualization

Storytelling in dataviz is not only an appropriate approach to communicate science with non expert audiences [44], but is a powerful supplement to open up the audience to change.

Taking a broad view on storytelling with data, even simple tables with concise annotation can be called visual data stories. However, a narrative data visualization is formed by storytelling techniques and explorative interactions. By giving the viewer control over the insights emerging from interaction, it serves communication and persuasive purposes [45]. This combination raises a tension between author-driven and reader-driven scenarios proposed by Segel et al. [46]. A purely author-driven story provides no interaction, which progresses in a linear fashion defined by the author beforehand. In contrast, the person is free to interact and explore in an extreme reader-driven story which has no prescribed structure. Predictably, most real-life cases fall somewhere in-between the spectrum. And this brings the important property of narrative dataviz, which is a flexible balance of two sides. Similar to the three major sub-fields of dataviz mentioned above, three common narrative structures (Figure 18) with the two elements mixed in different proportions are given. Martini Glass structure prioritizes the author-driven approach. This visualization begins with tidy and detailed text, annotations, and other descriptions. This part is like the thin and single-path stem of martini glass. Only when the author's intended narrative is given, viewers can take a look at the attractive part of their own. The second more balanced structure is interactive slideshow which follows a single-frame interactivity slideshow format, like how it is named. Each slide often works as a martini story. The third, drill-down structure, displays a general theme and waits for the viewer to dig deeper to a particular instance of the theme. While it is risky to enable full reader exploration, the narrative can be easily disrupted and viewers may feel more confused when the visualization is constantly changing. All the three structures have their merits. These frameworks reflecting on the combination of explanation and exploration of a dataviz are the basis of public dataviz

design for data donation.

But how to make a narrative data visualization? How to transfer data into a visual story? As shown in Figure 19, the entire process contains four steps: data collection, data exploration, story creation, and story presentation [47]. Although it is presented in a linear way, the real storytelling process is always iterative in each stage. Built on the traditional dataviz, a narrative data visualization is made up of three components: data, narrative which includes interaction and story, and visual form [48,49]. Only by blending them together in a narrative dataviz can drive changes.

Data is the foundation of constituting central insights for each data visualization. A collection of data excerpts are always the result of data exploration. Before making the narrative, a story framing session as a key discovery is conducted to define the final central insights from these potential stories [49]. Here, viewers are recruited whose considerations to the data story help the author to make the decision. Narrative can be perceived as a series of causally related story pieces, which is supported by the central story insight generated in data analysis and corresponding interaction. Dataviz emphasizing visual aesthetics allows people to perceive a substantial amount of information in a more insightful and influential way. Besides, when the visualization is dominated by the author's opinions, story pieces are organized in order with annotations to avoid ambiguity.

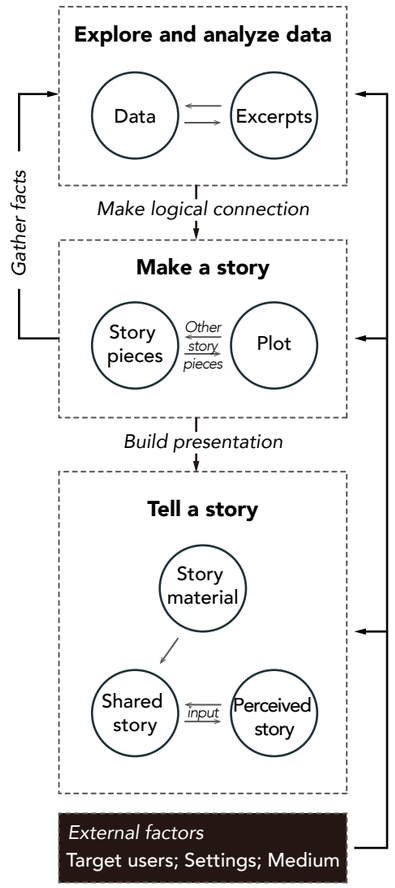


Figure 19: Narrative data visualization process (image source: Bongshi and Nathalie, adapted by author)

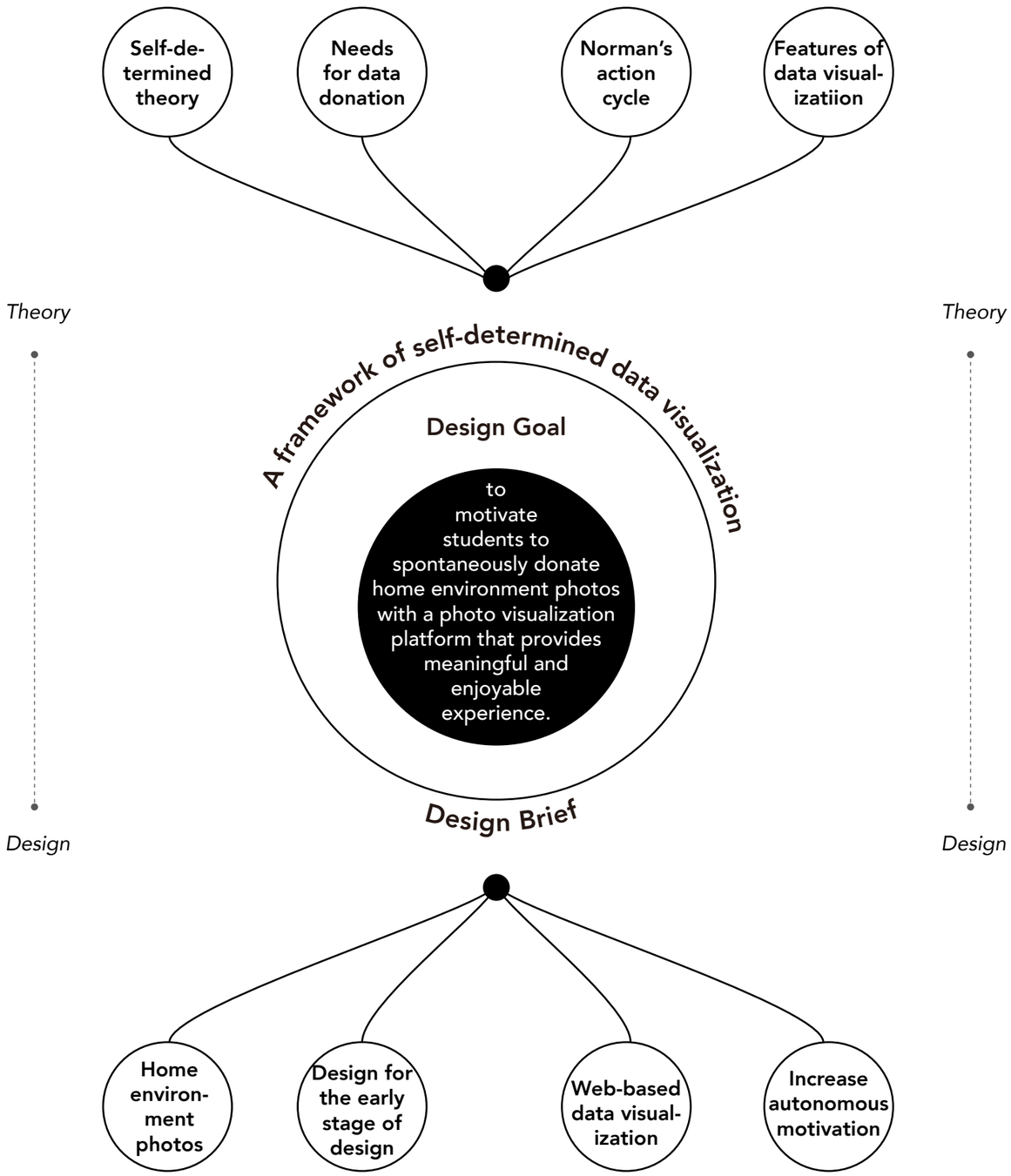
3.4 Summary

The visualization of data as an environmental feedback can encourage the audience to internalize their motivation to donate. While to make an ideal and actionable visualization, there cannot be a simple list of rules that should, in every case, be followed. Type of data, combination of explanation and exploration, function and visual form are all important factors that influence to what extent users' fundamental needs can be met.

Currently, narrative data visualization focuses primarily on author-driven cases that tell linear stories and present controlled exploration of data. Its design is more influenced by its characteristics than by the input of users.

According to norma's action cycle, reader-driven cases, which invite exploration or aim to evoke emotional responses, can also mobilize behavior change if they understand people's needs and expectations.

Photo is selected as the target data for two reasons. On the one hand, photo is an essential tool to gain deeper insights about users in the design process, yet its intimate nature makes collection difficult. Thus, it would be beneficial to encourage people to donate their photos for research purposes. On the other hand, the technology of image recognition and image processing makes it possible to visualise photos in even more ways. A proposed design guide for photo visualization serving as an incentive would prove useful at this time for those interested in this field.



Chapter 4
Research synthesis

The author took inspiration from the two theme explorations of data donation and data visualization, then built a framework as the basis for the concrete design experiments. After defining a feasible design scope and formulating a design goal, two cycles of concept iterations were conducted to understand how the framework can be applied in real context and gain knowledge towards the final proposal.

4.1 Self-determined data visualization framework

Besides the three extrinsic motivations, the context study of data donation also showed that people are internally motivated to donate data when it comes to self realization and self determination. Data visualization has emerged as a tool that can promote behavior change, which makes creating a public dataviz experience that meets people's fundamental needs an effective project for engaging them in data donation. To illustrate this experience, a self-determined data visualization framework was developed (Figure 20).

Typically, designers begin with a small sample of data either from online sources or from volunteers ***[DATA]***. It is worth noting that the value of the visualization here is not primarily derived from its inherent properties like readability or visual efficiency, but rather from the satisfaction of five fundamental needs that are directly related to the motivation of target behavior. After observing the photo itself and understanding the target users' needs, the designer determines which features of the data will form the basis for the visualization ***[CENTRAL INSIGHTS EXTRACTION]***. After that, the visualization will be designed to inform readers of the need for more data ***[INFORMATION]***, to allow them to interact with the data ***[FUNCTION]***, and to make it clear how the data is displayed ***[VISUALFORM]***. A combination of these features - visual form, information, and function - will produce either a highly effective communication ***[EXPLAIN]*** or a highly interactive ***[EXPLORE]*** experience or a balance between the two. Viewers will be exposed to the visualization after it has been presented to the public and will then have the opportunity to deduce donation intention by experiencing the visualization.

In spite of the framework of self-determined data visualization, it is still uncertain how information should be conveyed and what function visualization can offer in which form. Taking this theoretical framework into practice, this project will explore how fundamental needs can be transformed into data visualizations.

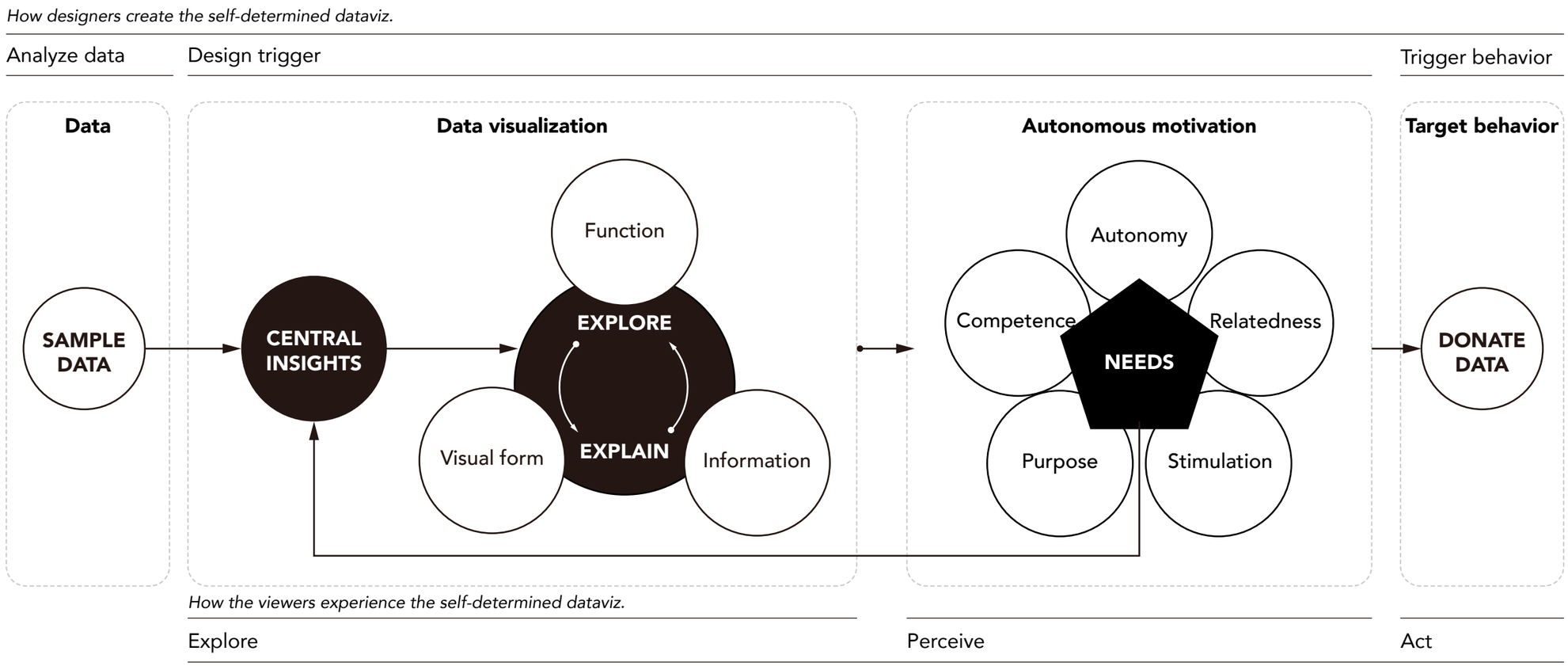


Figure 20: Self-determined data visualization framework

"A PICTURE TELLS A THOUSAND WORDS."

4.2 Design brief

Design for data is contextual. Both the outcome of data visualization and people's data donation will vary according to the type of data. As the author argued in the research, the photo as a medium for expression is used widely in participatory design to communicate data and evoke memories. Besides, visual methodologies like auto photography and photo elicitation can enhance the qualitative research. Also, in the context inquiry user research, students tend to believe that the photo is more sensitive compared to the number and written data. However, few photo visualization cases can be found, not to mention the lack of guidance on creating photo visualization for behavior change. Therefore, this project shifts from focus on data visualization in general to photo visualization only.

Scope

In the traditional design process, data visualization is used to convey research insights in the professional field or enable users to identify patterns and support sense-making activities. The visualization is always served by enough data. Whereas public data visualization here serves as requests for data collection at the very beginning of data donation, with a limit amount of data can be manipulated.

Too many numbers visualized in a graph can confuse the audience. A photo visualization also needs a theme or a purpose. To avoid the ambiguity resulted from massive unstructured photos and providing an immersive data donation context, an imaginary research is carried out. It is about collecting students' home environment photos for research purposes. Data in this project refers to students' home environment photos. As stay-at-home is becoming a new normal, it opens up many design opportunities for home environment improvement. This trend increases the value of home environment photos. With these photos, researchers are empowered to better understand the relationship between wellbeing and home environment, validate research results and propose proper solutions.

The project's target photos are not something people would like to take out of habit. Thus, people are requested to generate data to donate rather than given what they already have.

Digital solution is chosen for this project, because visualization displayed on a digital platform can get access to a wider audience and easily receive responses in an interactive way.

Goal

The purpose of this project is to describe each fundamental need to provide a definition of what it means in the intimate data donation context, and to examine the incentive role of public data visualization defined in the framework. Through a multitude of designs, the author will gain knowledge about which condition students will be motivated by dataviz falling in the framework to donate their home environment photos. And a new design space is expected to be proposed after systematically exploration.

Design Goal

Thus, the concrete design goal of this prototype design is to motivate students to autonomously donate home environment photos with a photo visualization platform that provides a meaningful and enjoyable experience.

Research questions

As stated in the design goal already, research through design is the dominant methodology that guides this project. The author will transfer behavior change theory into the design of public data visualization with respect to its interaction, information, visual form and content. The research question below will be answered during the design exploration.

- What is the definition of autonomy, competence, relatedness, purpose, and stimulation in relation to personal data donation?

- How to translate donors' fundamental needs into the design of public data visualization features that motivate autonomous data donation behavior?

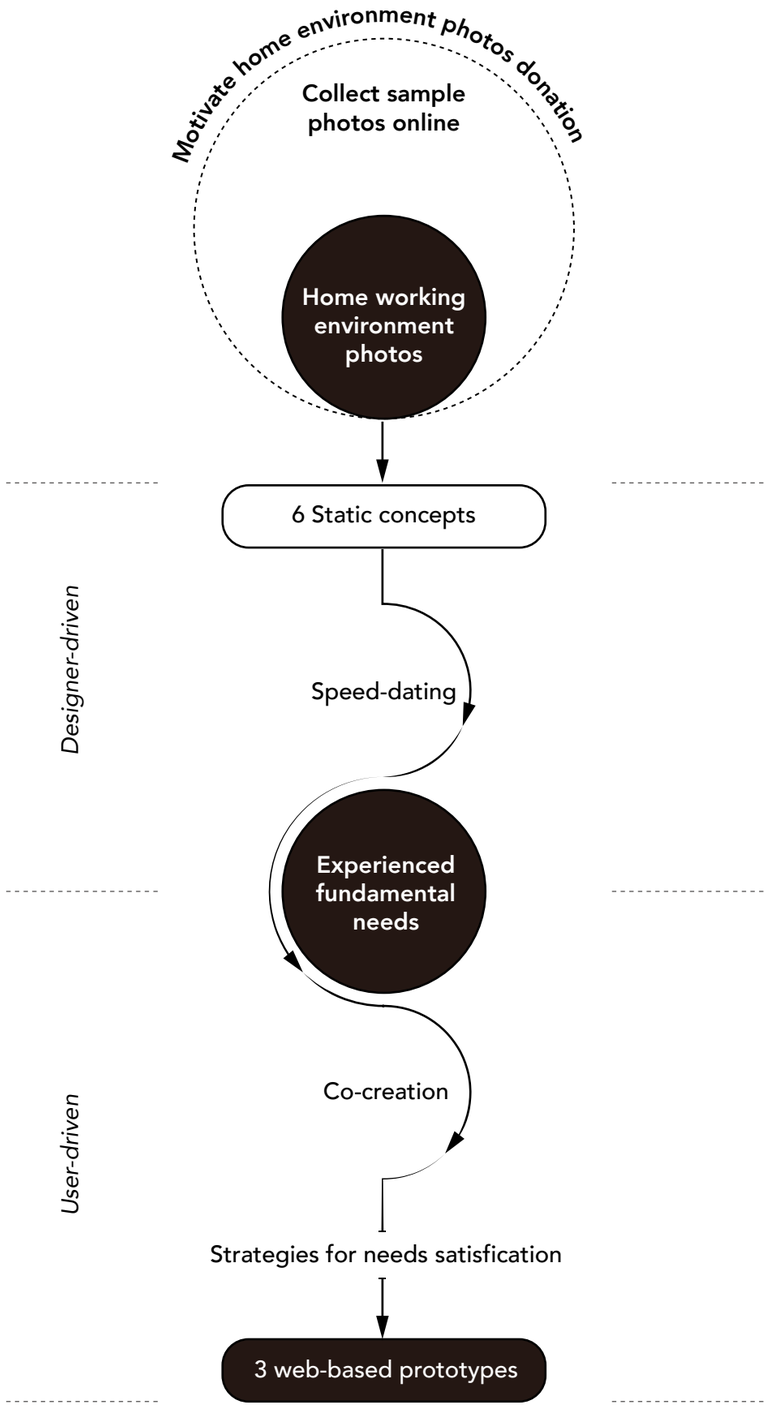
Target group

The initial target users of my project are non-expert readers of data visualization. Further characteristics of them are:

- College students and this is the first for them to approach data donation topics.

- They have high prosocial motivation which can be reflected in their experience with helping others and engaging in any kind of donation.

There are three reasons why this target group is chosen. First, IDE faculty is working on projects to improve students' home environment for better work productivity or wellbeing quality. There is an increasing demand for detailed everyday data actively provided by students. However, students are holding back to take current research activities for many reasons. Second, research has shown that people with higher prosocial concerns are likely to behave for the public good. As this project focuses on triggering motivation, designing for people who have this value can further ensures the simplicity of data donation behavior. Third, giving consideration to the pandemic situation, it is easier for the author to get access to them.



Chapter 5
Design iteration

In this chapter, two rounds of concept ideation and prototyping are conducted based on the concrete design brief. To begin, six static visualizations are tested as probes to comprehend contextually related fundamental needs. Following that, distinct insights related to autonomy, competence, relatedness, purpose, and stimulation are incorporated into the design of the photo visualization in terms of its visual form, information, and function. Ultimately, three concepts that touch on different combinations are designed to answer the research question.

5.1 Understand the framework

A fully understanding of people's five fundamental needs within this specific context is necessary before defining the building blocks of the photo data visualization, including insights, information, and visual form. Therefore, six photo visualization ideas were developed and tested as technology probes in this section.

5.1.1 Storytelling data visualization ideas generation

According to the self-determined dataviz framework introduced in the research session, the author first downloaded photos of home environments as visualization materials from social media websites by searching for tags. Since social media photos are always modified with personalized tags, there was a limited number of photos directly under the home environment category. Rather than creating a new tag and waiting for users to post photos to it, more relevant photos are found through tags associated with the existing ones, such as #mydesktoday and #wfhlife. Eventually, 72 photos were collected (Appendix **) that illustrate working from home activities. Figure 21 shows some examples of these photos. By immersing herself in these photos, the author was able to pinpoint the information of the visual data analysis based on the visualization thematic methodology (Figure 22) [12]. The descriptions alongside the photos were also used in generating insight.

As a result, 3 directions of visualization's central insights emerged from the photos, which were symbolic objects, hidden details, and vague meanings. Symbolic object refers to stories told about the main object forming the central theme of a photo. The term "hiding details" means visualizing photos by revealing detail that is easily overlooked by the audience. Vague meanings touch upon expressing the abstract information like a certain mood or emotion that people want to convey through photos.

The three directions were extended in the individual brainstorming into concepts with different balance of linear explanation and open exploration. Six concepts were identified, two for each direction. The next page lists all the visualization ideas developed for quick test setup.

Figure 21: Examples of collected sample photos

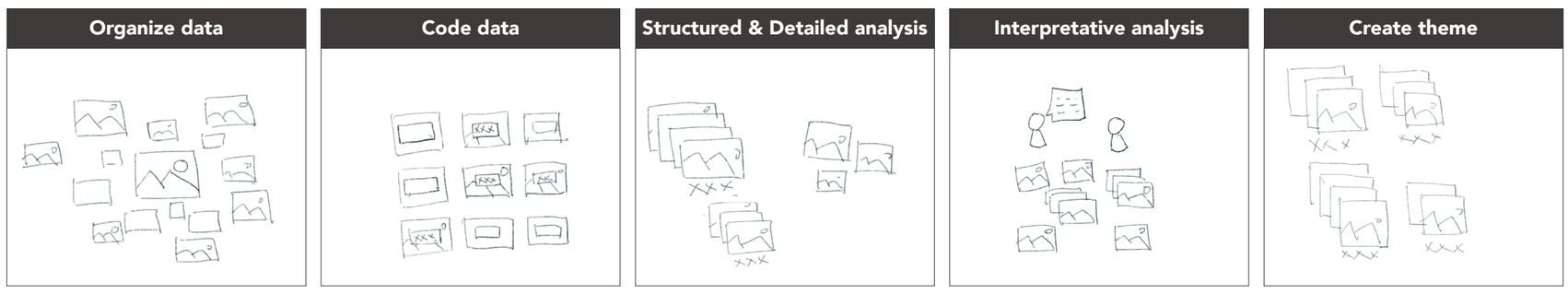
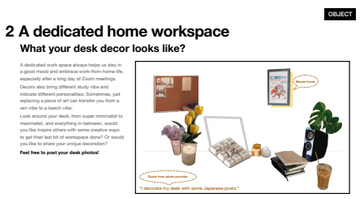


Figure 22: Visualization thematic methodology

6 photo visualization concepts

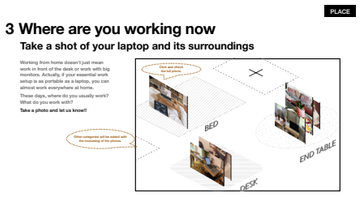
1.

This visualization is about essential equipment from laptop stand to ergonomic chairs needed for a satisfactory home working environment. Displayed photos are edited to highlight the equipment that they intend to depict. Photos about one object are grouped by their usage and appearance. Users can hover mouse over the layers to check other photos belong to one category and can swipe the page to explore other equipment.



2.

This concept presents items people used to decorate their work-from-home environment in a collage format. Decors in different photos are cropped and are automatically pasted on the blank desk background. For some decors, people can check their information provided by the owner.

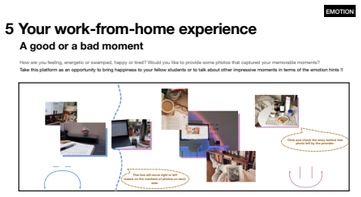


3.

Places that people would like to work at home are the basis of this visualization. Default places like table and bedroom identified from sample photos are drawn in isometric style to recreate the typical layout of a student's apartment. Photos tell existing places will be classified to the corresponding area. More places will be added as the number of people clicking the add button rise.

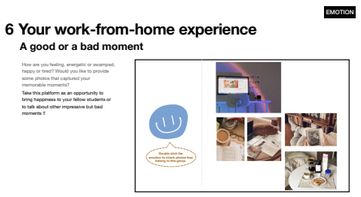
4.

In this visualization, photos taken at different times are listed on one timeline from 0:00 to 24:00. It indicates the number of people studying at different time slots and their home working environment. The visualization will update once a month.



5.

Photos about happy and sad moments are divided and put in a contest. People can click the photo to check why the donor feels happy or sad. The size of the photo depends on the number of people who have seen it.



6.

The initial interface of this visualization is varied emoji representing people's emotions. It allows people to customize and add their own emoji. People are free to interpret the meaning of each emoji and donate related photos. By clicking them, people can explore the relationship between donated photos and emotion icon.

5.1.2 Speed dating

In this activity, the speed dating method is applied to help participants elicit contextual ideas for 2 objectives in an explorative way. One is to gain insights into people's experienced fundamental needs for clarifying the evaluation criteria. The other is to discover how public photo visualization features effect data donation behavior.

6 participants living in varied home environments were recruited to represent the project target users. They are all students from IDE faculty and have engaged in some prosocial activities before. Their designers' background let them provide in-depth reflections on the user experience. The one-on-one online session was held via zoom, with animated slides shared by the author. It took about 2 hours and was recorded for data analysis. To provide participants with an immersive test environment, a fictional scenario and visualization concepts created above were first presented through narrative storytelling to depict the real data donation context.

Scenario description

"You are checking the brightspace as usual and you see an announcement about collecting students' home working environment photo for research purposes. The announcement is in a visualization form which is made by some sample photos. "

Participants were asked to complete two main stages for all 6 concepts, as shown in Figure 23. Concepts were provided one by one. They first took some time to go through each visualization while verbalizing their opinions and confusions. For each concept, an interview was followed to know the experiences they had over the five fundamental needs and investigate their experience with photo visualizations from central insights, visual form, information, and function aspects. Here are some examples of the interview questions:

- What do you think about the central insights of this visualization?
- What do you think about the visual form and information shown by this visualization?
- After seeing this, are you internally driven to donate your photo? Which features of photo visualization support this feeling?
- What's your concern about donating your photo? Do you think your photo donation behavior is in control? Why?
- Why do you believe that donating photos enables you to build relationships with others? Or feel a sense of connectedness?
- What's your purpose to donate your photo? Why do you think it is important to donate?

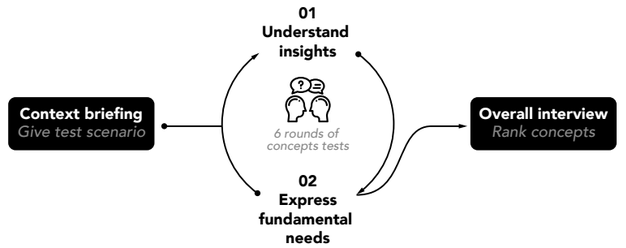


Figure 23: Speed dating procedure

5.1.3 Results

Participants' qualitative feedback provided the author with suggestions regarding the most influential visualization features from five aspects, as shown below. In addition, a summary of experienced fundamental needs are summarized for the second round design.

Central insights - more than category

The three central insights did not represent the different balances between utilitarian and sublime. All six concepts were visualized purely by grouping photos into different groups, with no additional information, exploration, or emotional resonance.

> ***It seems that you just classify photos. Like this one, photos are placed in a time order. Yeah, I can interpret that it is about people working at different times. But I don't think this point is strong enough to motivate me to donate mine.***

Concept 2 received the most positive feedback not because it is about home environment decoration, but because it is based on collage. Participants thought that it would be more compelling if the insights were expressed by the visual form or function of dataviz.

Information - experiencing rather than reading

> ***Are the remaining concepts the same with this one? I think what this visualization is about is clear enough, can I jump the paragraph?***

For the concepts using a long paragraph to describe and enrich the central story insights, 4 participants takes more than one minute to read and feels overwhelming while reading them. Two of them mentioned that the interaction itself told more than the text, they would prefer to understand the visualization by exploring rather than reading. But the last encouraging command-sentence was liked by all participants.

> ***Wait, can you give me a second to read it? I didn't read the text carefully at the begining.***

Data source -
amount and content are decisive

Donation behavior is likely to be hindered if there are too many similar photos in the visualization. More than half participants expressed that it is unnecessary to donate photos as their photos are not special enough. Especially for concept 1 and 3, existing photos' categories seemed to cover all the possibilities participants could imagine.

> *I probably won't donate photos if it already has similar items, like the flower.*

> *I don't know what I can do in this visualization, because I only work at desk. I rarely change my study place.*

Visual form -
show me something and hide something

Whether the entire photo or part of it is displayed makes a big difference. Partially visualized is preferred as this approach can clearly convey the information and ease donors' privacy concern.Participants also cared about how the entire visualization looks like. When it comes to concept 6 which replaces photos with abstract graphics, all participants are curious about photos hidden from them. 2 participants thought that it covers the purpose of this platform as no photo is shown.

> *Even if you decide which kind of photo you want to donate?*
>
> *No, I won't. I just feel the home environment is too intimate. And I am too lazy to tidy my room just for donating a photo. As long as there is a chance to leak my personal information, I will not provide my photo, especially when it will be shown to many strangers.*

Explorative function -
direct to donation

> *How would this visualization look like when the blank spaces are filled with decors? Will this visualization update regularly? Now it looks pretty because you select the photos, what if someone randomly uploads low quality photos and it will look chaotic and ugly at once.*

> *I really want to put my photo on it, but the biggest question is that I have no clue where and how to donate it.*

All participants mentioned that they expected more interactions with the visualization, as the only explorative function for current concepts is clicking the photos and knowing more about donors. For concept 1,2, and 3, 2 participants directly commented that it is hard for them to imagine what this visualization would look like when more photos are donated and displayed. Besides the function related to the visualization itself, a clear access to upload photo is incredibly critical for viewers to generate donation intention, like the add button and dotted square in concept 3.

Experienced autonomy:

They are free to choose the type of photos to donate. And they can creatively express themselves with their photos.

Experienced competence:

Their capability of donating photos depends on whether they feel that their photos are needed for the data visualization.

Experienced relatedness:

They would like to feel a sense of connectedness while exploring or interacting with the visualization platform. In addition, they believe that they can build relationships by donating photos.

Experienced purpose:

They believe that donating their photos is meaningful to themselves or to the researcher who needs their photos.

Experienced stimulation:

The way to ask for their donation is novel. And the entire experience with this visualization platform is enjoyable and interesting.

5.1.4 Insights

As a behavior change data visualization, the central insights should primarily be developed from the users' perspective, which is the fulfillment of fundamental needs. It is often biased by the researchers' perception to draw insights from the basic information of photos.

People's motivation may be affected by how the visualization will look when more and more photos are donated and presented.

The proportion of personal information in a single photo and how it is presented to the public may affect motivation.

As the final step in motivating people,It is important to provide a clear and intuitive access to data donation. By means of this, rather than building a separate website, a data visualization tool can be embedded within a data donation site.

5.2 Co-creation session for design ideation

The author's design goal is to motivate students to autonomously donate home environment photos with a photo visualization platform that provides meaningful and enjoyable experience. To seek inspirations in achieving this goal, a co-creation session was first conducted. In this session, users were involved as experts in providing creative insights into what photos the audience can take in the home environment setting and what they need to be intrinsically motivated. These insights were then developed into design features of a photo visualization platform with distinct focuses on autonomy, competence, relatedness, purpose and stimulation needs in the "self-determined data donation" framework.

5.2.1 Approach

4 participants between ages 23 and 26 were recruited in the co-creation session, one male and three females. Two of them graduated from the IDE faculty last summer and the other two are peer students studying remotely from their apartments. With a comprehensive understanding about this project context, their different home environment settings also contribute to challenging each other and generating a wider diversity of ideas.

Miro and zoom were used to create an engaging online collaboration experience in this session. The session took around two hours to complete three main sessions as shown in the Figure 24. It started with an introduction clarifying the project context and design goal. Visualization examples found online together with graphic prototypes made in the previous stage were selected as sensitizing materials in this section. Then, to help participants better reflect their thoughts on the photo visualization platform, they were asked to share their home environment photo with a short explanation of what it is about and why they took this photo.

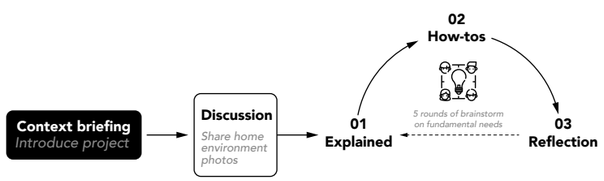


Figure 24: Procedure of the co-creation session

5.2.2 Results

The detailed co-creation board can be checked in Appendix **. Clusters of ideas that are meant to fulfill the five needs mentioned above were described below.

How-tos - Autonomy

Ideas to satisfy people's need to donate photos in their own creative way fall on the function and content of photo visualization. They are explained from 3 aspects.

1. Ensure privacy.

Definitions of autonomy, competence, relatedness, purpose, and stimulation needs given in the previous chapter were explained to ask how-tos questions for brainstorming, such as: How to enable students to donate all kinds of photos? How to make the donation behavior meaningful to students? How to enable students to build relationships with others via photo donation? For each question, participants first generated ideas in 5 minutes by themselves, then discussed with each other to extend and refine initial ideas. After the session, the author grouped ideas in each fundamental needs section into different design directions. These directions provided fresh perspectives on the information, central insights, function, and visual form of photo visualization. Therefore, the author was able to develop some of them into specific design strategies, shown in the results.

If donors are expected to donate whatever photos they want, it is important to ease their concerns about the personal information disclosure by recognizable elements in the photos. Functions like editing the photos with stickers or stylized filters and cutting photos into elements before donation could ensure the integrity of visualized information while achieving this goal.

2. Take part in the consequence of photo donation.

Personalization functions like tagging photos with location, special objects, and time could give people more freedom to define the photo they are going to donate. Rather than fully relying on the algorithm or the designer to decide the insights of visualization, people could gain more control toward their photos and feel a stronger sense of autonomy.

3. Display indirect photo requirements.

Asking photo donation with a detailed description of a photo theme or a set of photos with the same style could directly limit donors imagination. People are encouraged to donate various types of photos if the requirement touches upon the abstract features of photos, like providing a photo with red objects.

How-tos - Competence

People's needs to feel competent and achievements about their donation behavior were taken into account by the participants. They came up with ideas targeted on donating similar photos. And the ideas belong to 2 categories.

1. Differentiate similar photos.

People are reluctant to donate similar photos if their behavior makes no difference to the visualization. However, it is clear that neither the photo itself nor the photographer are exactly the same. The purpose of this idea is to highlight those different but unnoticeable features in similar photos. It could be grouping photos into special categories or transferring photos into unique 3d models, virtual characters, and even numbers. In a more direct way, it could visualize the amount of "likes" toward elements in the photos.

2. Photo as a tool or material.

Treating photos as a communication tool or an essential material to form a game challenges the relationship between donating photos and sharing one's life. Photos could replace words or emoji to comment on others photos. Or it could be used to form a connect-the dots or find-the different games. It provides relief from selecting a special photo especially when there are already a lot of photos.

How-tos - Relatedness

In order to enhance people's sense of relatedness while interacting with photo visualization, ideas fell on the establishment of the photo community and were grouped into 3 directions.

1. Feedback from others.

Photo, providing more comprehensive information due to its visual format, could easily bring people with the same interests together. Thus, functions borrowed from popular social media applications to build a community among strangers like "comment'', "like", and "share" could be more effective in this platform.

2. Exchange stories.

Every photo has a story behind it, which could be used to create unique relationships between donors that never met before. By automatic matching different photos to unlock stories happened in the other's daily activities, it indicates a positive invitation to become familiar with each other, thus allowing for deeper connection. The story can be told not only in texts, but via a gif or a voice recording.

3. Collaborating online.

By placing photo donation in a context that can only be done through collaboration, it could turn this traditional individual behavior into a responsible teamwork. For example, colors extracted from every donors' photos are used to recreate a famous painting or to fill a black and white image.

How-tos - Purpose

Participants interpreted meaningful reasons behind data donation behavior in 3 different ways. And ideas were generated around the content, visual form, and function of photo visualization.

1. Gain knowledge for personal growth.

The donation behavior could be meaningful to donors themselves either by providing information that they are not aware of or by marked as a totemic moment. For example, they can get personalized adjustments to a specific home environment atmosphere, like a room for productivity or relax. Photos of the same subject donated by the same person will be processed into a gif or video recording one's changes over this period of time.

2. Help the researcher.

Providing information about the number of photos that are needed by a professor or a lab could evoke the audience's altruistic identity. Donating photos could become an intuitive and costless way to provide help.

3. Contribute to worthwhile programs.

Detailed information about the responsible research or the expected usage could give people the reason to donate their photos. Tagging elements in the photos based on their academic value or updating the number of papers, graduation projects, or policies inspired by the photos is a way to communicate this kind of message.

How-tos - Stimulation

2 categories of ideas were brainstormed to bring joy to the entire experience with a photo visualization platform.

1. Process or present the photos in a novel way

The way that photos are displayed in photo visualization should be distinguished from the way in common image based applications. Photos could be presented in a mosaic style or transformed into a 3D scene. Photos taken by students could also be connected with famous painting, films or cartoons.

2. A metaphorical visualization of data donation progress.

Compared with the traditional representations of calculation, combining the data donation progress with researchers' mood could make the experience more engaging. For example, a virtual character could be presented with different behaviors of facial expressions to indicate different stages of data donation. Or a "thank you note" from the research is slowly revealing with the increasing amount of photos.

5.3 Concepts synthesis

Under the guidance of the self-determined data visualization framework, the author synthesized findings gained from the speed dating and co-creation sessions into three most promising visualization enhanced photo collecting concepts. All of them are used to answer the research question more fully, therefore, design features developed for each concept focus on distinct combination of exploration and explanation to fulfill people's fundamental needs, as seen in Figure 25. Note that the concept theme is derived from three styles of visualization mentioned in the research phase, which is pragmatic, ambient and artistic. They are about communicating clear research insights, opening to inspiration, or expressing creativity. Each concept's unique features with respect to information, function, and visual form that were designed to meet five fundamental needs will be fully explained later (Figure 26, 27, 28). In order to keep the design consistent with the first round, students are motivated to donate home working environment photos for fake research with the visualization as an incentive in each case.

Figure 25: From clustering ideas to unique concepts

Pragmatic concept:
Show your food

A research team is working on the relationship between IDE students' diet and wellbeing conditions in the working from home period. This food photo visualization concept is given birth to motivate students to provide photos about what they eat at desk. It is a combination of the second and third type of individual brainstorming ideas, but targets the location classification added by donors. Inspired by the co-creation results, emotion is kept as an extra filter to define similar photos, thus to connect donors from different places.

As shown in the the scenario Figure 20, this visualization platform only presents the food elements extracted automatically by the algorithm. And donors will be told that the complete photo is collected and analyzed by researchers. Edited photos taken by different people are pinned on the world map based on their position. Before donors upload photos, they are also expected to attach their mood which is indicated by the color outline. Lines are drawn to link food with similar mood words. The dominant food and mood are informed on the platform. Stories and information about each food is waiting for people to explore by clicking the image and to leave a comment. In addition, both the background map and displayed photos will change according to the real-life time.

What could be positive about this concept?

- The food itself is an intriguing and rich theme. All the participants in the co-creation session mentioned it when brainstorming possible home environment photos.

- These photos are meant to be used by food or emotion related projects. The research purpose and consequence of data donation are visualized directly to the donors.

- By visualizing donors' photos in terms of their added location and time property, this visualization is open to more creative interpretations.

What could be negative about this concept?

- There are already many social media applications for people to share their food photos. It seems not necessary for students to share them again on this platform.

- People might feel unnecessary to donate photos if there are already a lot of the same food photos pasted at the same position on the map.

- As a pragmatic visualization, the insights provided by this visualization platform is informative but not actionable.

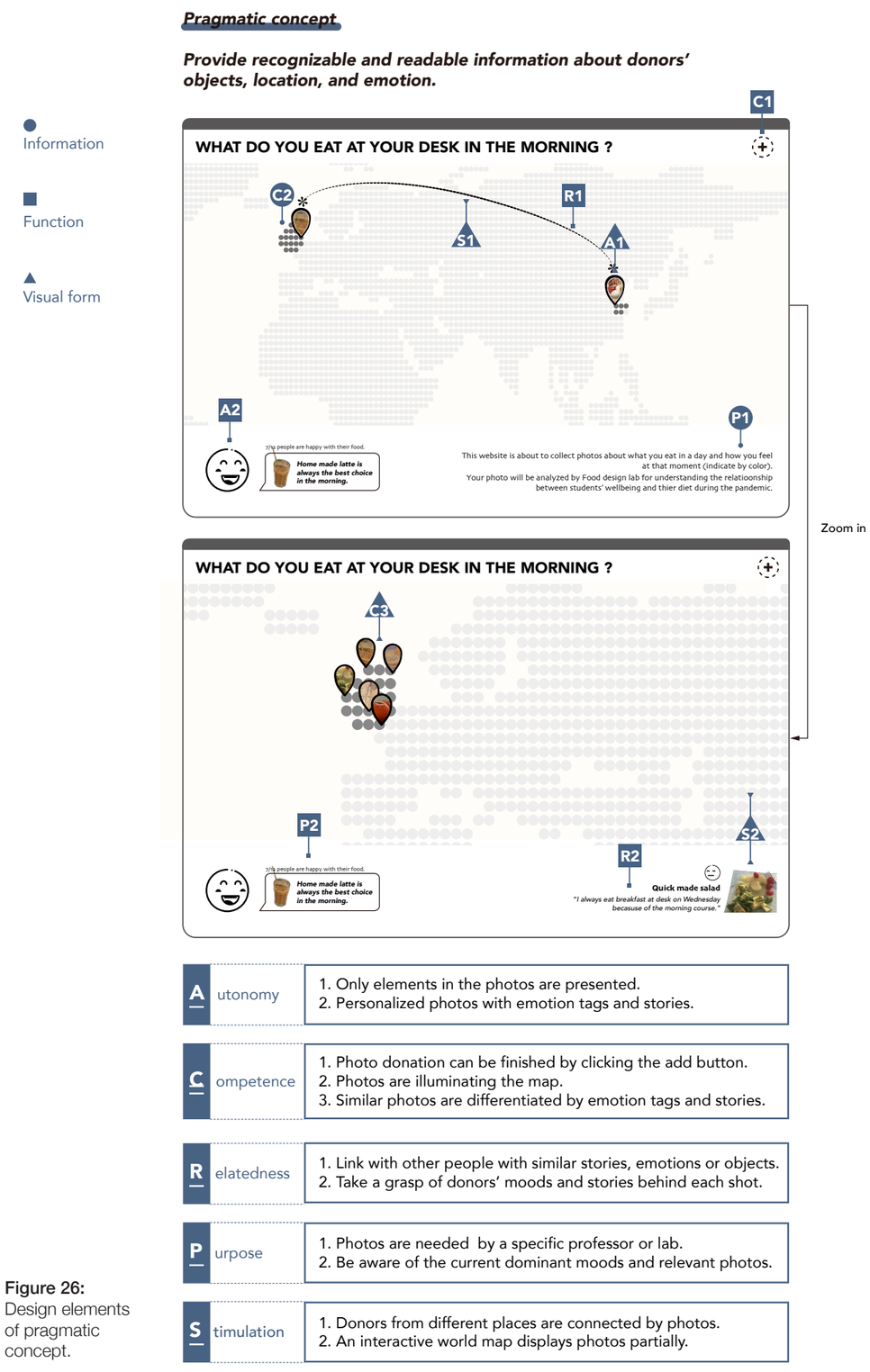


Figure 26:
Design elements of pragmatic concept.

Ambient concept:
Match your home environment photos with masterpieces

To develop practical strategies to improve students' work-from-home experience, their home working environment photos are essential materials for pain points identification. This concept aims to collect these photos from students. Collage, which is rated as the most favorite interaction in speed dating, is the basic mechanism of this visualization. Masterpieces created in the past including painting, film and cartoons are embedded as a reference for derivative work of students' photos before they are presenting in the platform.

The default interface is in an online exhibition format (Figure 21). The exhibition is constituted with processed donors' home working environment photos together with the introduction of masterpieces collaged in each photo. Likewise, the number of photos collected determines whether the exhibition can be successfully held. A museum icon and a bar are visualized to represent this progress.The collage is created by replacing real world objects in the photo with elements serving the same purpose in an artwork whose year and style are decided by the donor. People are free to visit different pavilions either by typing the artist's name or by selecting a specific year. After exploring for a while, they are able to donate photos in the blank area. Below each photo, a short message is left to tell the number of downloads. People can use the number given after donation to check detailed information about the usage of their photos.

What could be positive about this concept?

- Photos presented in the virtual exhibition are a combination of imaginary and real worlds. This approach not only eases donors' privacy concerns but also keeps the personality that they would like to express.

- The unique number built a deeper connection between donors and the researcher. Although the platform doesn't give a clear clue about the real purpose of donation, donors are given more control to the consequence by tracing back their numbers.

What could be negative about this concept?

- Online exhibition itself is a new design project. While evaluating this concept, the influence of participants' experience with the exhibition should take into account.

- It is unknown whether the look of the computer-generated photos will affect people's donate intention.

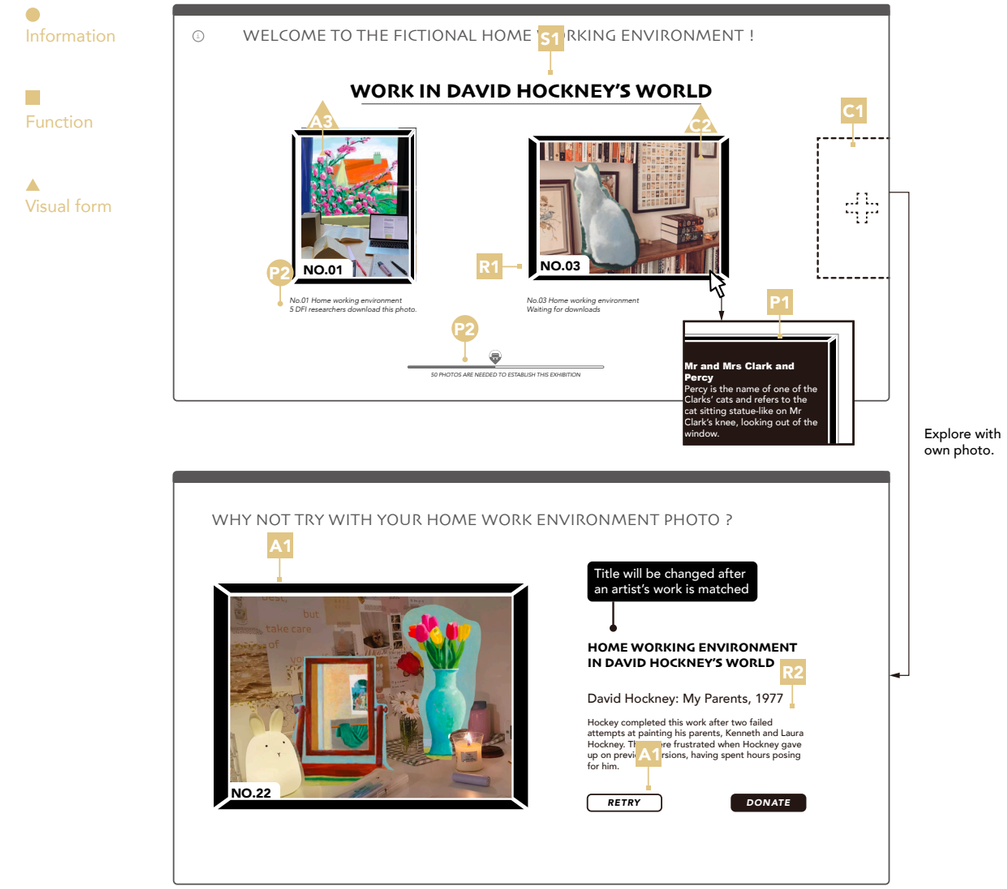
Ambient concept

Explore and get inspired a new home working environment in the art world.

Information

Function

Visual form



Explore with own photo.

Autonomy	1. The donor can retry if the outcome is not satisfactory. 2. Exhibits are created by donating photos. 3. Photos are modified by "art stickers" that is barely recognizable.
Competence	1. Photo donation can be finished by clicking the add button. 2. Almost no two photos are alike, since each is paired with a unique art work. Donors are able to donate a variety of photos.
Relatedness	1. While exploring the exhibition, viewers can imagine art tastes of people who provide varied home environment photos. 2. Become acquainted with the artists.
Purpose	1. Gain knowledge about the information of various artworks. 2. Photographs are collected for inspiration and to support future research. The progress bar indicates how many photos are needed.
Stimulation	1. Real life photos are associated with past art works and are presented in a virtual exhibition.

Figure 27: Design elements of ambient concept.

Artistic concept:
Photo jukebox

Photos in this concept are collected to trigger future projects. Both the data source and visualization features are new directions generated from the co-creation session. The main visualized graphic is created in an abstract way to be consistent in the vague photo requirement. Color, one of the basic components of photos, are highlighted and utilized to make this concept new and sentient. In order to ensure the authenticity of visualization, it keeps the elements which can represent activities in the original photo.

Figure 22 illustrates the initial state of this platform which is a black and white record cover and a play button. Visualizing photos into a new graphic and playing music are the core functions of this platform. Music in this concept is chosen to create a vibe in line with what the photo is meant to communicate. Donated photos are transferred into melodies of non-distracting music and components of the record cover. As the number of photos increases, the record cover will be filled with a variety of colors. The music style is influenced by the tone of donated photos which takes the responsibility for conveying moods like exciting, relaxing, lively and etc. While uploading the photos, donors are encouraged to pick the items that contribute to the hygge moment. It will be part of the cover. When a song is finished, it will be sent to the contributor and added to the platform.

What could be positive about this concept?

- This concept provides a gamified interaction, which might encourage people to donate more than one photo either to fill the black and white graphic or make a nice-sound melody.

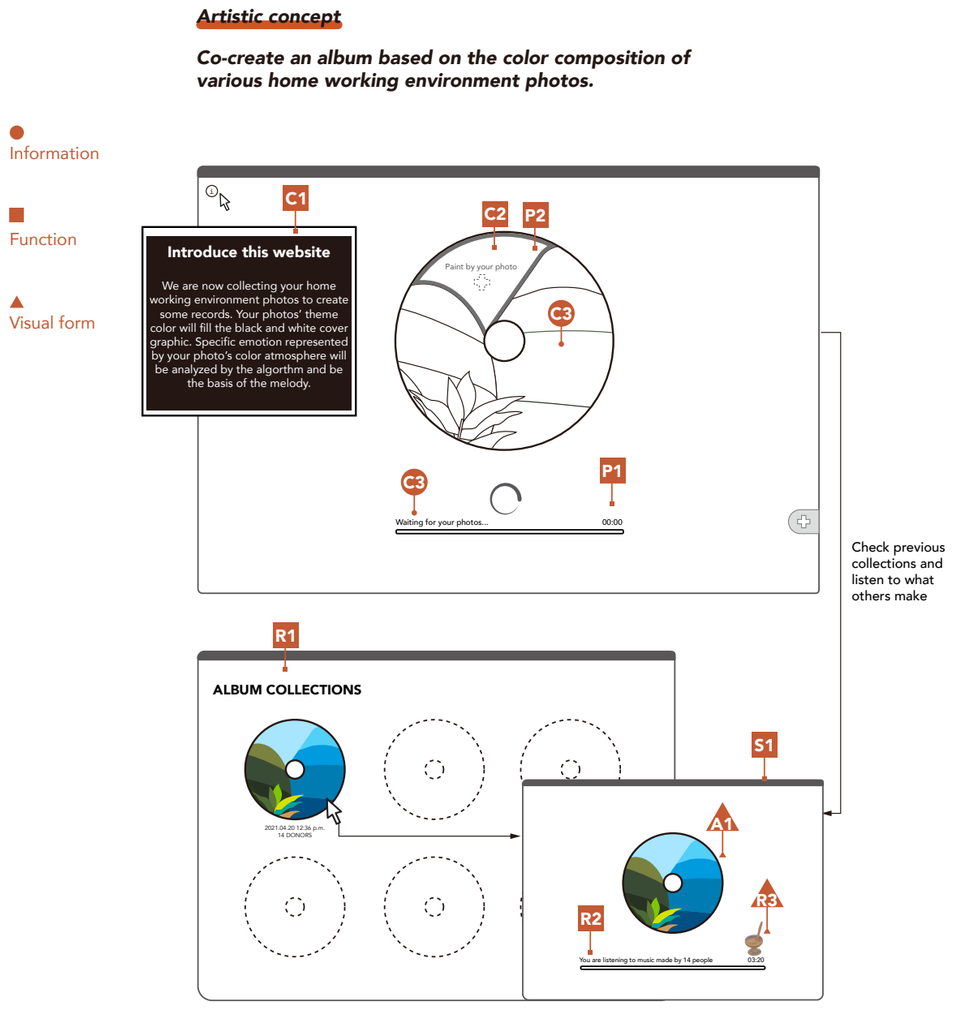
- The choice of photos is less likely to be manipulated by the existing photos.

- As this visualization platform also opens up opportunities to relax and look back, there are more chances to attract new donors and encourage revisits. Then, more photos could be collected.

What could be negative about this concept?

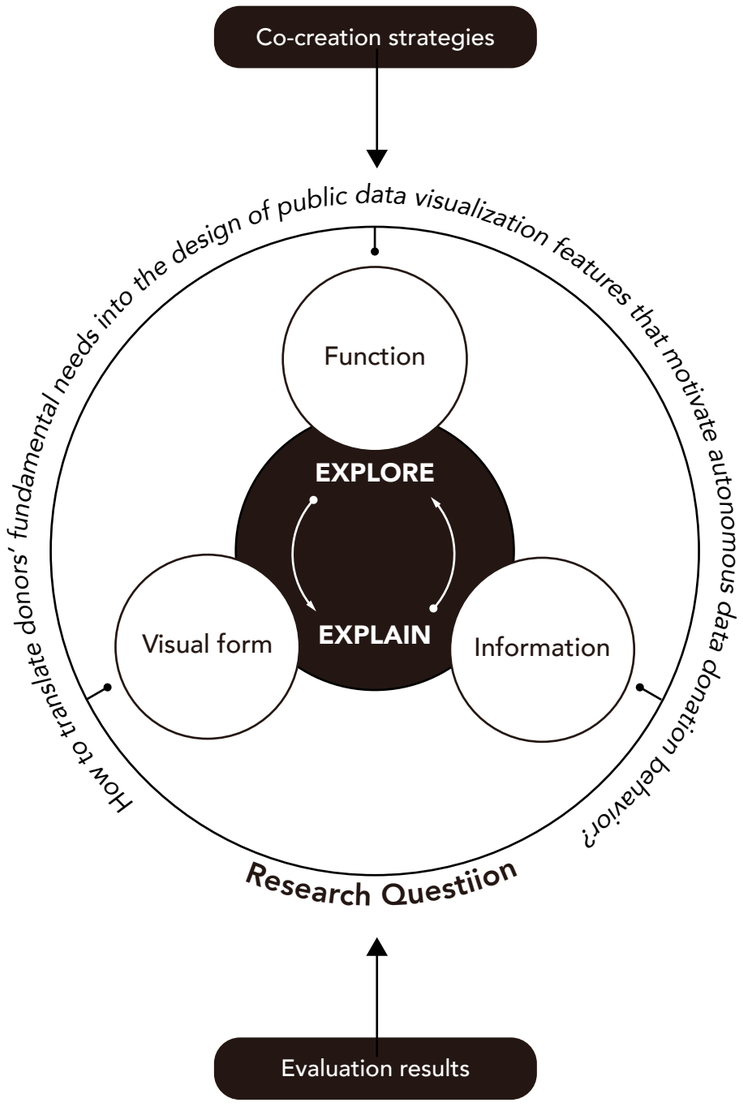
- With no photo can be observed in the initial interface, people might feel confused about what this visualization platform aims for at first glance.

- Donors might feel that the played music is irrelevant to the photos they uploaded, and the algorithm doesn't extract the color they expected. In addition, with more photos added to the platform, it is hard to guarantee the quality of the music.



Autonomy	1. Existing photos can only be viewed by long pressing the blocks.
Competence	1. A short information on how this visualization works is provided. 2. Photo is donated by dragging it to the white block. 3. Dominate color from each photo paints the cover and forms the melody.
Relatedness	1. Check previous works and listen to melodies made by others. 2. Painting the cover and make new melody with others. 3. Check the main objects captured in donated photos.
Purpose	1. Create own melody. 2. Fill the black and white cover.
Stimulation	1. Photos are transferred into music and color.

Figure 28: Design elements of artistic concept.



Chapter 6
Final Proposal

A detailed discussion of how the concepts are evaluated and the results of the evaluation is provided in this chapter. All concepts were developed using Figma and corresponding storyboards were drawn for feasible and understandable tests. As a conclusion to this chapter, the research question of demonstrating that theory could be translated into effective design features is answered by the co-creation strategies and the feedback gained from the concepts evaluation.

6.1 Measure impact on donation behavior

Three concepts as research materials will be used to test different combinations of visualization features in this section. Partially workable concepts were developed for three rounds of tasks. Participants' task performance gave answers to how the public data visualization can contribute to the satisfaction of fundamental needs and its influence to data donation outcome.

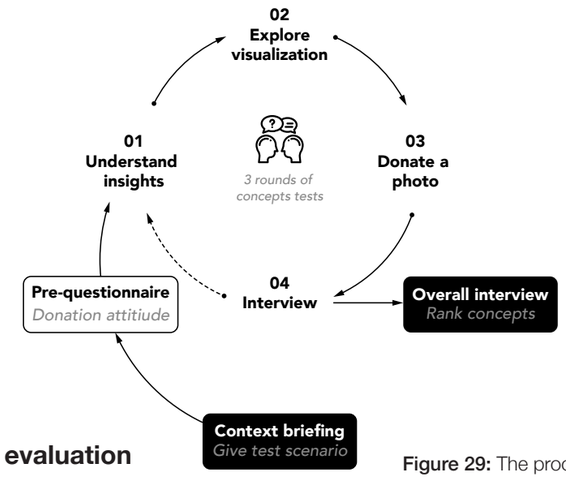


Figure 29: The process of concepts evaluation

6.1.1 Concepts evaluation

Participants

The author recruited six participants, one for the pilot test, for this evaluation session with half of them from the previous test. They all live in different home environments and are willing to help others or society as a whole. It is customary for them to check brightspace several times a day during the workday. And all of them have experience in taking photos and uploading them on social media.

Goal

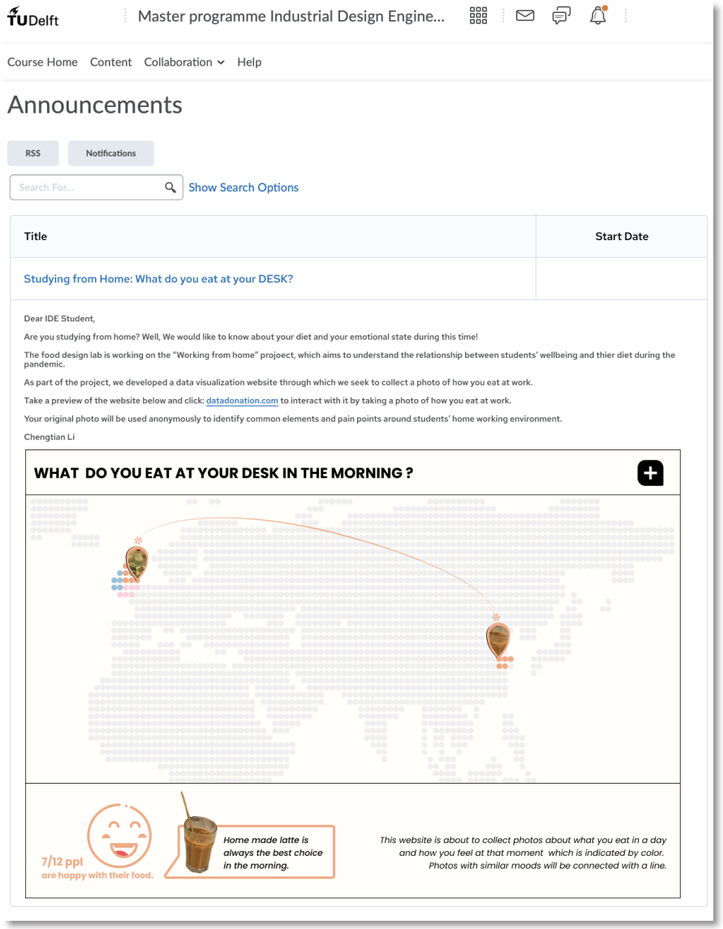
This evaluation session investigated how strategies from the co-creation process can be translated into motivational aspects of public data displays and how different types of visualizations affect the kind of photo people choose to take and upload.

Setup

All tests were conducted one-on-one online. Zoom invitation and figma link for all concepts were sent beforehand. Participants need to open the camera and share their screen when interacting with the figma prototype. During the test, they were free to interpret the author and ask questions.They were told to think aloud during the test. Their facial expression and how they interact with the prototype were observed. When needed, the author inquired about their confusions for deeper insights. Permissions were given before video and audio recordings.

The test takes about one and a half hours. Figure 29 depicts the user test flow. Same scenario as the first user test was narratively told and real-life looking prototypes were provided for an immersive test environment. Concept one set up as an example is shown in Figure 30 below. In order to conduct comparative study, the same data sources collected from the social media platform were used, an overview of these photos can be checked in Appendix**. Participants' basic information and attitudes toward data donation were collected before the test. Prototypes provided were built for specific tasks based on experience flow (Appendix**).

Figure 30: Pragmatic concept provided to the participants to understand the context.



Corresponding questions are raised in the follow-up interviews to learn how each visualization makes them feel their fundamental needs are satisfied, which features of the visualization contribute to this and how these needs motivate them to donate photos. In addition to these questions, some questions about the visualization itself are complemented if the participants do not mention them. User tests begin with understanding the participants' overall willingness to donate photos and end with asking them to take photos that they would like to donate. This last task set covers all concepts and is to obtain further insights on what factors individuals consider when donating photos in the public data visualization platform. When all tasks are finished, participants rank three concepts based on the extent of their willingness to donate photos.

Change after the pilot test

In order to determine how specific features mapped out in the previous chapter contribute to the satisfaction of people's fundamental needs, initially interview questions focus mainly on those features. During the pilot test, the author found that mentioning specific elements influences the direction of the user's answer, whereas his experience with the visualization is dictated by the combination of all features rather than a single one. So, questions asked in the other five tests chose to leave room for participants to describe their experiences. As an example, let's look at the question of competence. Originally, the question was: Do you believe the dots on the world map reinforce your belief that your photos are needed? It then changed into: Do you think that your photos are needed in this visualization?; How does this feeling arise?

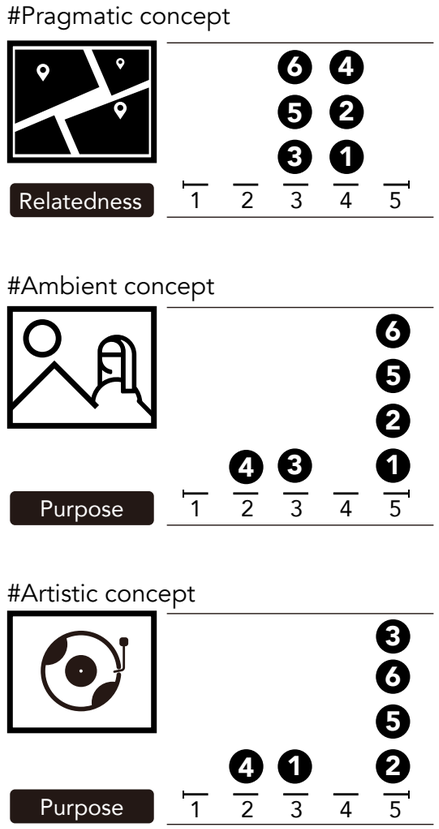


Figure 31: Motivation scores on each concept.

6.1.2 Results on the three concepts

Overall comparison:

Participants' willingness to respond to the original request for text data donation was first set as the base motivation degree. Figure 31 illustrates the degree of intrinsic motivation increased by all three concepts. While the first one is not the most influential factor in influencing the motivation of all participants, its effect got the most even distribution. In comparison to other two concepts that keep a more open photo requirement and associate initial photos with other pieces, the extraction of symbolic objects in photos and the expression of their meaning with donors and their locations (concept one) is easily understandable and less likely to be affected by personal taste. Participants interested in art and music are highly motivated to participate in the other two concepts. Especially for concept two, participant 4 mentioned that it is a great chance for her to donate a photo if her photo is combined with Disney scenes instead of David Hockney's paintings.

Sharing stories with others (relatedness) is the dominant incentive for concept one, while, as shown in the figure, it is not strong enough to motivate people to donate photos autonomously. In this case, they prefer exploring the visualization rather than being a part of the map. In contrast, participants who gave perfect grades for the other two concepts found that it is worthwhile and fun to take a look at the secondary creation of their ordinary living spaces by contributing relevant photos. They are primarily seeking to fulfill their curiosity by participating in this novel experience (purpose). As for the third concept, even two participants commented that they plan on uploading photos until one record is made.

Pragmatic concept

In general, rather than donating their own photos, users prefer to explore stories communicated by this platform.

The proportion of donated photos and empty spaces greatly affects users' intentions. They are more likely to upload photos when more than half of the dots are lightened, which means there is a greater chance for them to connect with others. In addition, this gives them more confidence that they can accomplish the "assignment" of filling the map.

Pros:

- Users' intention of donating photos will not only not be hindered by similar photos, but will be increased because it is a vital part of connecting with others.

> ***I think it's fun to see a lot of people doing the same thing like everyone's drinking coffee in the morning. I would love to join them.***

- Even without reading the short explanation, it is clear what the purpose of this visualization is and the type of photos required.

- A new lens for viewing photos is provided by stories and emotion tags, which also encourage people to stay on this platform for longer periods of time and increase the donation possibilities.

Cons:

- As opposed to connecting donors based on moods, which are already displayed through colors, connecting them based on similar foods would provide more of a magical feeling that is more likely to lead to data donation. There were four participants who expressed a desire to know if someone eating the same foods as them lived in a different area, especially if such foods were specific to the location and culture.

- Users tend to perceive the left corner more as an additional informational element of the entire visualization rather than as a motivator, since its content is determined by the objective dominant number of emotion tags rather than by the donors. Having a connection between donors and presented information would make this element more motivating. For example, the left-hand corner could display photos that other viewers liked, clicked or interacted with the most.

- Due to the specific nature of this visualization, whether people take a picture and donate depends on when they see this website and if they have food nearby at that time.

> ***Unless I have any food near me, I would probably just glance at it, turn it off, and take a photo later if available, but I would not necessarily donate it.***

Ambient concept

For this concept, experience how one's own photos will be processed is more motivating than seeing others displayed on the platform. While donors find it troublesome to select art styles and periods themselves, they anticipate more exhibition topics related to other artists or broader artistic expressions in the future. They wish to download the processed photos and share the link with others.

Pros:

- This visualization format eases users' privacy concerns and makes them more curious about how the algorithm will edit their photos, even though specific objects in the photos are randomly selected and replaced.
- With a clear idea of how many photos were needed and a visible progress bar, donors were more determined to make the photo contribution.
- Combining the real photos with visual contents not only take the role to provide a novel consequence of data donation, but also enable users to take a look at and inspire by how the artists or virtual characters could decorate their home working environment.

> *The combination of art makes my work environment more artistic, even if it doesn't really change the real-life set-up, but I see what my environment might look like. Spending too much time at home makes me easily tired. I can get some stimulation from such images.*

Cons:

- By contributing to one exhibition, users feel related to other donors, but the secondary creation of donated photos is the primary motivation behind this concept. The added photos button is perceived by users as an opportunity to play rather than as a request to donate. It is difficult, however, for them to immediately grasp this function just from looking at the visualization.
- While users are motivated to upload their photos as exhibits, the current horizontal design weakens the online exhibition experience.
- As opposed to donated photos automatically matching with artworks, donors can select a list of artworks from which they wish to donate. But this reduces their connection to masterpieces and makes the donation process more complex.
- Users tend to imagine the possible outcomes before taking photos. Yet, their aesthetic perception of art makes them uncomfortable donating photos that depict messy environments.
- It is intended to inform users of the potential research value of their photos by providing information about how many researchers have downloaded and used them. However, this does not influence their donation behavior due to the fact that there are no tangible results generated during the donation process. And they are unlikely to return to this website just for this information.

Artistic concept

The curiosity of users about the outcome of photo donation, which is a melody resulting from the color composition of the photos, intrinsically motivates them to donate pictures. Users who are first or last to upload photos are more willing to do so than the middle user.

Pros:

- There are no strict rules or obvious examples of donated photos, and just several photos can constitute a record. Donating photos on this platform is quite relaxed for users.
- The outcome of data donation is not a piece of music but rather a whole that is straightforward and more meaningful. Without waiting for other donors, users can check the creations made from their photos.
- The combination of repetition and regular patterns of sounds ensures that the melody is pleasing to the ears. Users have a higher tolerance to the melody, even though it lacks a pleasant melody, since the format is innovative and interesting.

> *I'm curious what kind of music we're going to make together and I don't mind how bad it could be. I'm really curious about what melody I can get when some extreme good mood photos mix with some extreme bad mood photos.*

- Having some photos already presented and turned into a song can increase users' sense of relatedness. If users were the first ones to upload photos, they would be more inclined to complete one record on their own. In this case, they are able to gain more control over the outcome and build connections with others by presenting their records as part of the collection.

Cons:

- It is important to consider how many people are responsible for creating one record, which is represented by the white block on the cover. Having too many blocks makes it difficult for the latter donors to change the melody clearly. Similarly, the co-creation feeling will be weakened if there are only a few blocks.

> *I am afraid that it is going to be too complicated to do with 14 people. It will be easier for me to donate photos if only four or five people are needed, since I can obviously change the melody and fill the rest blocks more easily.*

- Users pay little attention to the black and white cover because its pattern is unrelated to their photos. The pattern is expected to be as unique as the melody. It seems to be a simple interface for uploading photos and switching on "photo-to-melody" function right now.

Actual donated photos: From an object to a specific color

Participants were all aware that they were expected to upload a photo of their work environment at home, but the actual images they provided for each concept were quite different. Figure 32 shows some of the photos provided by participants. The first concept lets the viewer see the symbolic object of the photo and provides him/her with a way to explore the story and emotion behind it. In spite of the fact that the photos visualized on the platform are automatically edited, participants tend to focus on food with little regard to the environment. The second concept displays the original photograph with some stickers replacing random objects. With a potential outcome in mind, participants focus more on the angle of the photo and number of objects in the photo. Additionally, their understanding of what is expected of them is impacted by the existing photos. Here, since the desks appear as the main subject in the examples, people subconsciously take photos around their desks. In concept three, the central insight is color composition, one of the basic elements of a photo that can reflect the photographer's mood. In the process of taking the photos, participants are more interested in taking control of the main color of the photo either for the purpose of accurately expressing a mood or just to be curious about the corresponding melody, rather than more concerned with the fact that the photo is abstract or recognizable. A participant even only took a picture of her red notebook cover.

A commonality among all concepts is the fact that participants are concerned about donated photo's quality and aesthetics. They prefer to tidy the work area before taking a picture, or search for a clean corner when the entire working area has to be captured. One reason for this is that they believe photos shared in public have to be visually appealing first. On the other hand, they are affected by the existing photos. In terms of the second concept, the style of the piece also matters. There were four out of six participants (4/6) who stated that they would consider uploading photos featuring messy environments if they were combined with some complex modern art. However, they doubt their willingness to do so will be hindered initially by the overall lack of aesthetic appeal.

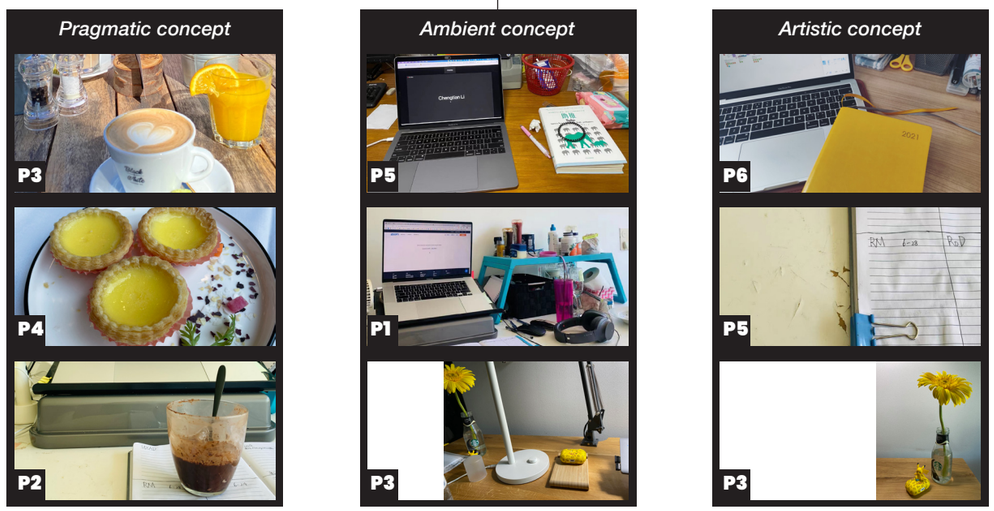


Figure 32: Real photos participants took for each concept.

6.2 Learn effective self-determined public photoviz features

Co-creation strategies for satisfying fundamental needs were examined through concept evaluations. From the photo visualizations presented to the public for asking for more home environment photos, evaluation results and design strategies are synthesized as a response to how self-determined theory can be translated into appropriate design components. The design directions for an effective public photo visualization introduced below can serve as a starting point for more future data visualization projects to motivate autonomous data donation behavior.

Explain-Explore

The explanation dominant public data visualization is easily treated as a new social media platform to allow users to share their everyday activities expressed through photos. When users perceive donation as a new form of sharing donations are perceived as sharing, they are unlikely to be motivated by the public visualization platform as there are already many mature social media platforms where individuals can keep in touch with friends. In addition, a lack of purpose and relatedness has been associated with sharing photos with strangers. Therefore, rather than contributing to existing information, they tend to read it. Through proper exploration, photos can transition from a way of sharing life to a way of featuring a special experience. As a result, users are also more engaged in selecting the photos they wish to donate and feel like they have more control over the donation process.

Information

The main goal of a self-determined photo visualization is to communicate that more photos are needed. To accomplish this goal, designers should understand what information users are expected to gain and how it can be communicated.

Information about the target photos

Information about the target photos can be conveyed from the intro text and existing visualized photos. Users' perceptions toward the target photos are mainly driven by the visual and interactive contents. Open requirements of photos can be represented by giving photos containing various objects or avoiding obvious symbols. When the target photos require people to take instead of selecting existing ones in the album. The central insights should correspond to the scenario that people encounter this visualization. For example, in concept one, as the visualization clearly group photos

into breakfast, snacks, and dinners, people who have breakfast photos but clicking into the website at night are hindered to donate photos.

Information about other donors

Here, the information about other donors is more than providing users a sense of relatedness by building a donation community, but strengthening their confidence in changing the visualization by giving photos. The initial donation progress is better to be decided at a middle value which makes the donation assignment easy to achieve, like the visualized bar in concept one. Users tend to feel unable to donate when there is a large amount of photos that are waiting to be donated like the great proportion of gray dots of the world map in concept one.

Information about the recipient

As this data donation request is published via TuDelft official website, students who are learning or have learned from this university perceive it as trustworthy and reliable. They have less concerns about the consequences of data donation. Although they expect to know the information about the recipient, the future usage of their data for them is more like a guarantee rather than a motivator. Moreover, for an incentive, it is needed to avoid overwhelming information. Users prefer to gain instant feedback from the visualization and check donation consequences later from the data donation platform.

Function

Considering the role of data visualization in the entire data donation experience, its motivated functions can be further divided into two parts, supporting the experience of forming donation intent and the moment of giving personal data. They are explained as follows.

Enable users to sense the value of their photos

Donating personal data is intrinsically motivated when users fully grasp the reason why it is necessary, which means data donation behavior is meaningful for them. Unlike data visualization presented at the late stages of design, which has communicated and extracted the value of the data, here people can only think of the future potential of their data, like the implications of research that might be undertaken with it. This kind of value lacks validity and is vague for donors.

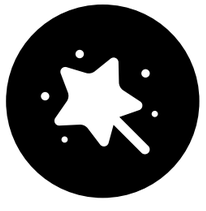
The value a user gets from donating their data isn't about providing external rewards that are hard to adhere to. Instead, donated data is expected to be used to achieve other things, like connecting with others, providing a new lens to perceive normal life, or simply serving as a source of entertainment. In this case, similar photos also will not hinder donors' ability to express themselves creatively. Taking into account that this is a temporary research context in which users will spend only a limited amount of time, its social connecting function should be distinct from some existing photo-based platforms that aim to create mature communities. Instead of integrating an open gamified experience into the last two functions, the value embodiment should be created to be aligned with the research context, which is best achieved by developing it by building it around the central insights of the target data.

Enable users to directly edit and donate photos

Providing people with the ability to preview the donation outcome is a motivated function of data visualization, which can satisfy their competence and autonomy needs. Since they are more aware of what will happen from their photos, they tend to edit their photos before using them, whether to highlight the focal point or to hide their identity. Despite the possibility of automated data editing, the user is still expected to be provided with easy-to-use stickers in order to customize their own data before they confirm their donation, just as in concept two, where the "try-out" function is highly promoted.

Moreover, the direct access to donating data also enhances the purpose of the visualization and intuitively guides viewers to the next step when they form the intention to donate data. As well, this data donation incentive is linked to a platform for managing donations, which helps in ensuring consistency across the entire experience.

Visual form



Visual form is about how the donated data is presented to the public. It takes an important role to build a clear and intriguing first expression of the data donation experience. Rather than providing techniques or formats on specific ways to process photos which vary in research background and photo themes, its general potentials in motivating personal photo donation behavior are introduced.

Visual form should fit the target photos

In comparison to the text explanation, sample photos have a greater effect on the type of photos users will take. Participants subconsciously take photos closely related to desks just because desk is the obvious object of both sample photos in concept two. Thus, designers should carefully choose and edit sample photos to match the target photos they need.

Visual form can ease privacy concerns

Users' perception of the data donation recipient and its subsequent use highly depends on the privacy issues protected by the visualization. Instead of providing text guarantee and follow-up services on donated data usage, the handling of identifiable elements in photos, which could potentially leak personal information, affects users' concerns about the donation recipient and its future use.

Visual form can distinguish similar photos

As mentioned before, people are reluctant to donate similar photos which weaken the value and necessity of their contribution. Thus, the visualization of each photo should retain its individual character, either by replacing common elements with personalized filters or by amplifying different, unnoticed features or stories behind each image.

Chapter 7
Project conclusion

As part of this chapter, the author first discussed her learnings on the project process. Then the contributions and limitations of the project are discussed. A conclusion is provided at the end regarding the project and its results.

7.1 Personal reflection

As described in my project brief, my initial motivation was to undertake a design-based research project to find out more about cutting edge technology's impact on everyday life. More than solving existing problems, I want to explore the possibilities of design. In reflecting back on everything that led me to this point, whether it directly contributed to the final report or was out of my control, it amazes me how much I have learned from both certain and confusing experiences.

When I began this project, I took quite a while to identify a convergent direction. As a basis for the project, I began with a broad topic of data donation and data visualization without focusing on specific data. After I realized that both domains are driven by specific contexts, informed by research experience and personal interest, I chose the photo of a home working environment as the target data. In recent years, data visualization has developed for many years and various examples have been created for various purposes. However, analyzing photos and communicating insights generated by them have just gained attention. In addition,lack of projects can be explored along with data donation, a field that is just emerging due to advances in quantified-self research. Luckily, by prototyping and testing based on existing knowledge and applying that to the exploration process, I have a deeper understanding of the research-through-design process, which was utilized in this project. The research questions, corresponding prototype development, and design outcomes were influenced by the place and time limitation. It is challenging yet interesting to adjust the test material and test flow for a better presentation to the participants in order to gain as much authentic feedback as possible.

The final lesson I learned from this whole experience is to confront bias when extracting insights from both literature and user research. Despite the fact that an emphasis on one direction is necessary to conduct actionable suggestions, it is easy to miss significant insights and make inaccurate conclusions without a clear understanding of bias. At this point, communicating with other designers is crucial. Comments from them can reduce the amount of cognitive overload caused by the imperative to find the answer for a research question, as well as pointing out the bias caused by that necessity. My first design iteration, for example, was based on the definition of fundamental needs. But after the pilot test, I realized I needed to identify the subtleties of contextually related fundamental needs if I was to facilitate target behavior.

I'm grateful for this opportunity to apply design theories and methodologies in a different way. Having this experience equips me as a designer to generate knowledge from academic fields and contribute to the creation of a preferable future.

7.2 Discussion

Contribution

The purpose of this study was to establish a connection between data visualization and data donation. As part of the design iteration, building on the three psychological factors behind general data donation, a deeper understanding of users' concerns regarding donating personal data is derived based on five fundamental needs. It is suggested that data donation should not be treated as purely a prosocial activity, but as an enjoyable experience.

Data is continuously being generated about people all the time. These data range from numerical numbers like loyalty card data that illustrates a specific activity to images shared on social media that provide a broad idea. Researchers in the fields of anthropology and machine learning have developed a variety of methods for interpreting photographs. They are widely used to enable users to express latent ideas and photo recognition applications. In choosing photo as a subject for processing and visualization, this project highlights the importance of gathering and analyzing photos during the design process. As well as providing a new perspective on the application of these technologies.

Despite the constraints of pandemic, several types of dataviz are developed through a user-centered design process to explore how data visualization can influence intrinsic behaviors of data donors. From the adaptation of self-determined theory, the author offers practical recommendations for exploring the major features of dataviz that researchers can refer to.

Reflecting on the theoretical framework of how photos would be intrinsically motivated to donate by the visual incentive, this paper offers insights into the creation of triggers that compensate for the development of data donation platforms. By building upon the three concepts to collect different types of photos, data donation request is not merely a detailed introduction and advocating slogan.

Limitation

Due to the fact that this project was conducted during the Covid-19, a number of traditional real-life activities were adapted to be conducted online remotely. In addition to affecting the preferred outcome, this situation negatively affected the productivity of sessions involving target users, such as co-creation sessions and concept evaluation sessions. Aside from the force majeure, there are other limitations to the project caused by its lack of a data donation program. First, this project's scenario focuses on users regularly checking brightspace through their laptops. It is expected they provide a photo just related to their environment. However, there are many other ways in which a person can come across the data donation request, like checking their phones while they wait for a bus or seeing the poster during a break. In these cases, the visualization design might be different from this project. Research is needed to determine if effective trigger strategies for data visualization still work. Secondly, as a data visualization that calls for data for design purposes, it is worth gaining insights from designers who will use these photos. By incorporating these concepts into a real-world platform developed for a real project, the three concepts can be further iterated. Finally, as the data donations grow, the visualization will continue to evolve. How the donor's attitude will change can be evaluated by developing prototypes for long-term testing when time allows.

7.3
Conclusion

The design of data donation and qualitative data visualization is gaining more attention as cutting-edge technology advances. The increase in personal data generation and ownership suggests that design can significantly contribute to enhancing and enabling individual autonomy, as well as building a sustainable relationship between researchers, data, and users.

Through the use of a research-through-design methodology, this thesis contributes to this field through the design of three types of public photo visualization aimed at motivating autonomously donating behavior. Definition of five fundamental needs and synthesis of effective features of public photo visualization, based on self-determined theory, can be taken as an example for the replication, extension, or improvement of future studies.

References

[1] Locoro, A. (2015, May). A Map is worth a Thousand Data: Requirements in Tertiary Human-Data Interaction to Foster Participation. In CoPDA@ IS-EUD (pp. 39-44).

[2] Wolff, A., Gerd, K., Gooch, D., Giaccardi, E., & Speed, C. (2016, June). Designing with Data: A Designerly Approach to Data and Data Analytics. In Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems (pp. 53-56)

[3] Bigelow, A., Drucker, S., Fisher, D., & Meyer, M. (2014, May). Reflections on how designers design with data. In Proceedings of the 2014 International Working Conference on Advanced Visual Interfaces (pp. 17-24).

[4] De Götzen, A., Kun, P., Simeone, L., & Morelli, N. (2018). Making sense of data in a service design education. In Service Design and Innovation Conference: Proof of Concept (pp. 177-188). Linköping University Electronic Press.

[5] Speed, C., & Oberlander, J. (2016). Designing from, with and by Data: Introducing the ablative framework. In Proceedings of the International Design Research Society Conference.

[6] Victorelli, E. Z., Dos Reis, J. C., Hornung, H., & Prado, A. B. (2020). Understanding human-data interaction: Literature review and recommendations for design. International Journal of Human-Computer Studies, 134, 13-32.

[7] Mortier, R., Haddadi, H., Henderson, T., McAuley, D., & Crowcroft, J. (2014). Human-data interaction: The human face of the data-driven society. Available at SSRN 2508051.

[8] Brennan, P. F., Downs, S., & Casper, G. (2010). Project HealthDesign: rethinking the power and potential of personal health records. Journal of biomedical informatics, 43(5), S3-S5.

[9] Kun, P., Mulder, I., De Götzen, A., & Kortuem, G. (2019). Creative data work in the design process. In Proceedings of the 2019 on Creativity and Cognition (pp. 346-358).

[10] Speed, C., & Oberlander, J. (2016). Designing from, with and by Data: Introducing the ablative framework. In Proceedings of the International Design Research Society Conference.

[11] Bigelow, A., Drucker, S., Fisher, D., & Meyer, M. (2014, May). Reflections on how designers design with data. In Proceedings of the 2014 International Working Conference on Advanced Visual Interfaces (pp. 17-24).

[12] Stappers, P. J., & Giaccardi, E. (2017). Research through design. In The encyclopedia of human-computer interaction (pp. 1-94). The Interaction Design Foundation.

[13] Skatova, A., & Goulding, J. (2019). Psychology of personal data donation. PloS one, 14(11), e0224240.

[14] Joffe, H. (2008). The power of visual material: Persuasion, emotion and identification. Diogenes, 55(1), 84-93.

[15] Skatova, A., & Goulding, J. (2019). Psychology of personal data donation. PloS one, 14(11), e0224240.

[16] Skatova, A., Ng, E., & Goulding, J. (2014). Data donation: sharing personal data for public good. Application of Digital Innovation. London, England: N-Lab.

[17] Wilbanks, J., & Friend, S. H. (2016). First, design for data sharing. Nature biotechnology, 34(4), 377-379.

[18] Davis, R., Campbell, R., Hildon, Z., Hobbs, L., Michie, S., 2015. Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. Health Psychology Review 9 (3), 323–344.

[19] Fogg, B. J. (2009, April). A behavior model for persuasive design. In Proceedings of the 4th international Conference on Persuasive Technology (pp. 1-7).

[20] Oyibo, K., Adaji, I., Orji, R., Olabenjo, B., Azizi, M., & Vassileva, J. (2018, July). Perceived persuasive effect of behavior model design in fitness apps. In Proceedings of the 26th Conference on User Modeling, Adaptation and Personalization (pp. 219-228).

[21] Simons, J. J. (2016). Psychological frameworks for persuasive information and communications technologies. IEEE Pervasive Computing, 15(3), 68-76.

[22] Locke, E. A. (1987). Social foundations of thought and action: A social-cognitive view.

[23] Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. Canadian psychology/Psychologie canadienne, 49(3), 182.

[24] Wehmeyer, M. L., Shogren, K. A., Little, T. D., & Lopez, S. J. (Eds.). (2017). Development of self-determination through the life-course. Springer.

[25] Ryan, R. (2009). Self determination theory and well being. Social Psychology, 84(822), 848.

[26] Villalobos-Zúñiga, G., & Cherubini, M. (2020). Apps That Motivate: a Taxonomy of App Features Based on Self-Determination Theory. International Journal of Human-Computer Studies, 140, 102449.

[27] Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary educational psychology, 25(1), 54-67.

[28] Dupuy, L., Consel, C., & Sauzéon, H. (2016). Self determination-based design to achieve acceptance of assisted living technologies for older adults. Computers in Human Behavior, 65, 508-521.

[29] Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55(1), 68.

[30] Teixeira, P. J., Marques, M. M., Silva, M. N., Brunet, J., Duda, J. L., Haerens, L., ... & Hagger, M. S. (2020). A classification of motivation and behavior change techniques used in self-determination theory-based interventions in health contexts. Motivation Science, 6(4), 438.

[31] Dove, G., & Jones, S. (2014, June). Using data to stimulate creative thinking in the design of new products and services. In Proceedings of the 2014 conference on Designing interactive systems (pp. 443-452).

[32] Kun, P., Mulder, I., De Götzen, A., & Kortuem, G. (2019). Creative data work in the design process. In Proceedings of the 2019 on Creativity and Cognition (pp. 346-358).

[33] Bikakis, N. (2018). Big data visualization tools.

[34] Kosara, R. (2007, July). Visualization criticism-the missing link between information visualization and art. In 2007 11th International Conference Information Visualization (IV'07) (pp. 631-636). IEEE.

[35] Li Q. (2020) Overview of Data Visualization. In: Embodying Data. Springer, Singapore. https://doi.org/10.1007/978-981-15-5069-0_2

[36] Van Wijk, J. J. (2006). Views on visualization.

[37] Bigelow, A., Drucker, S., Fisher, D., & Meyer, M. (2014, May). Reflections on how designers design with data. In Proceedings of the 2014 International Working Conference on Advanced Visual Interfaces (pp. 17-24).

[38] Wattenberg, M., & Kriss, J. (2006). Designing for social data analysis. IEEE transactions on visualization and computer graphics, 12(4), 549-557.

[39] Palys, T., & Atchison, A. J. (2013). Text, image, audio, and video: Making sense of non-numeric data. Research decisions: Quantitative, qualitative, and mixed method approaches, 303-332.

[40] Glaw, X., Inder, K., Kable, A., & Hazelton, M. (2017). Visual methodologies in qualitative research: Autophotography and photo elicitation applied to mental health research. International Journal of Qualitative Methods, 16(1), 1609406917748215.

[41] Snavely, N., Simon, I., Goesele, M., Szeliski, R., & Seitz, S. M. (2010). Scene reconstruction and visualization from community photo collections. Proceedings of the IEEE, 98(8), 1370-1390.

[42] Felton, N., Ehmann, S., & Klanten, R. (2016). Photoviz.

[43] Pandey, A. V., Manivannan, A., Nov, O., Satterthwaite, M., & Bertini, E. (2014). The persuasive power of data visualization. IEEE transactions on visualization and computer graphics, 20(12), 2211-2220.

[44] Dahlstrom, M. F. (2014). Using narratives and storytelling to communicate science with nonexpert audiences. Proceedings of the National Academy of Sciences, 111(Supplement 4), 13614-13620.

[45] Hullman, J., & Diakopoulos, N. (2011). Visualization rhetoric: Framing effects in narrative visualization. IEEE transactions on visualization and computer graphics, 17(12), 2231-2240.

[46] Segel, E., & Heer, J. (2010). Narrative visualization: Telling stories with data. IEEE transactions on visualization and computer graphics, 16(6), 1139-1148.

[47] Lee, B., Riche, N. H., Isenberg, P., & Carpendale, S. (2015). More than telling a story: Transforming data into visually shared stories. IEEE computer graphics and applications, 35(5), 84-90.

[48] McCandless, D. (2014). Knowledge is beautiful. London: William Collins.

[49] Dykes, B. (2019). Effective data storytelling: how to drive change with data, narrative and visuals. John Wiley & Sons.

[50] Greshake Tzovaras, B., Angrist, M., Arvai, K., Dulaney, M., Estrada-Galiñanes, V., Gunderson, B., ... & Price Ball, M. (2019). Open Humans: A platform for participant-centered research and personal data exploration. GigaScience, 8(6), giz076.

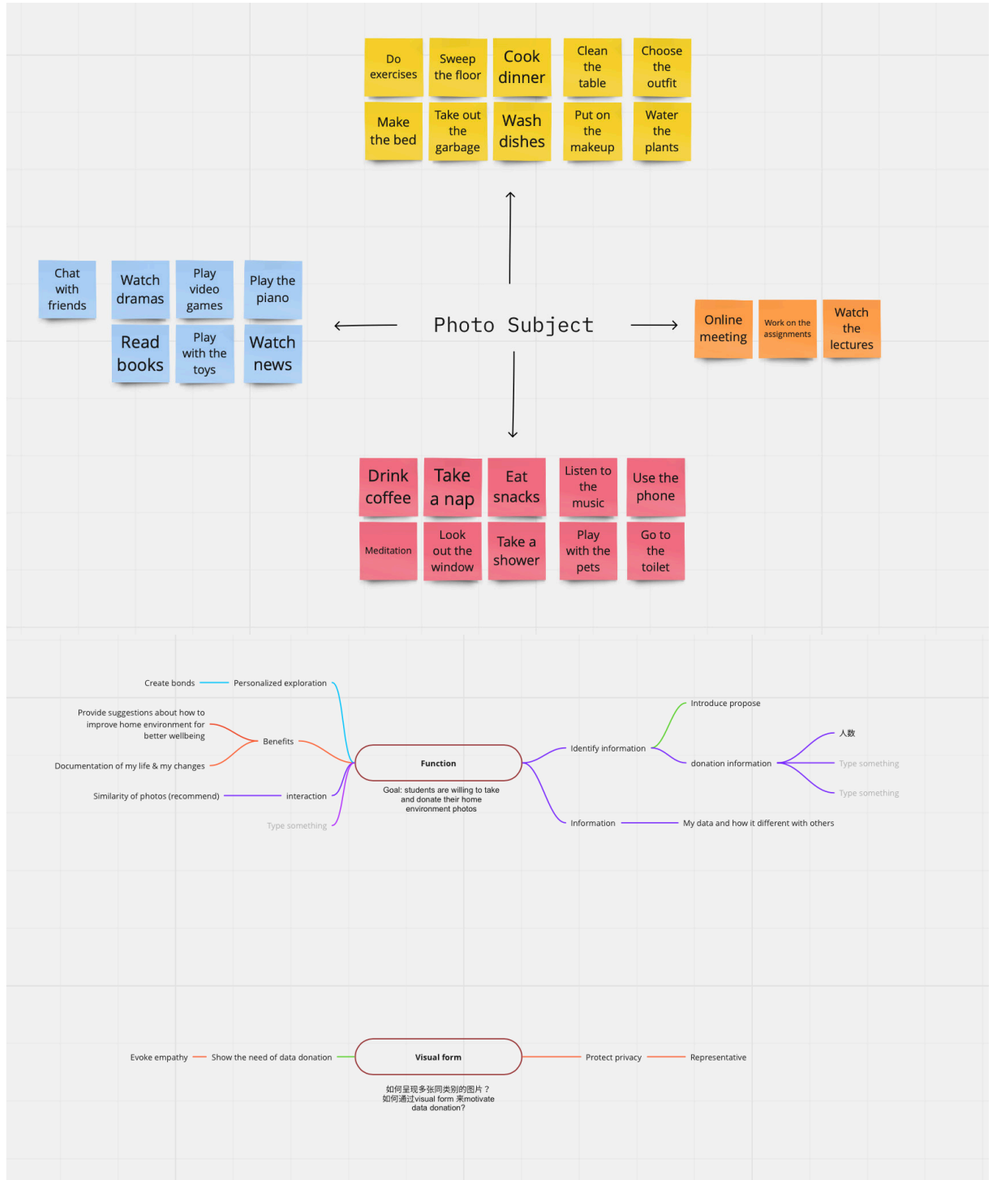
Appendix

Data visualization as a medium to motivate data donation

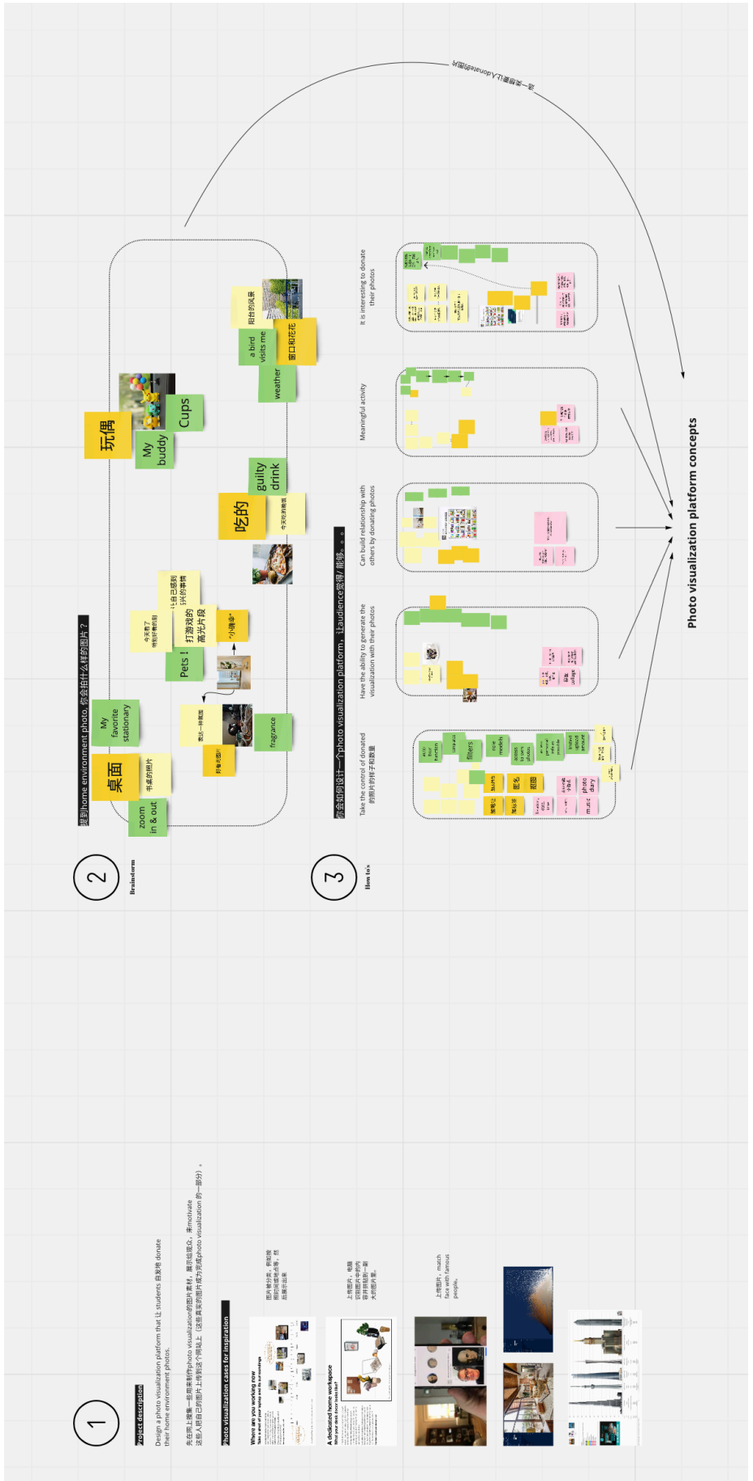
Master Thesis

Appendix A. Creative facilitation miro broad

Appendix B. Photo subject brainstorm



Appendix C. Co-creation miro board

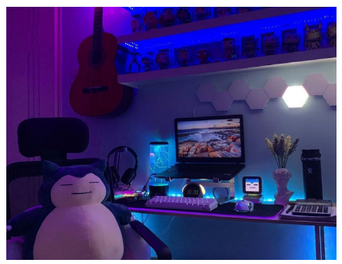


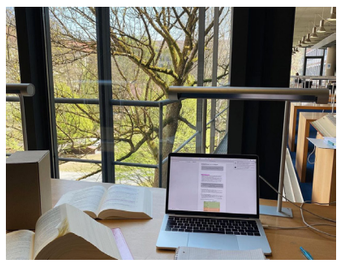
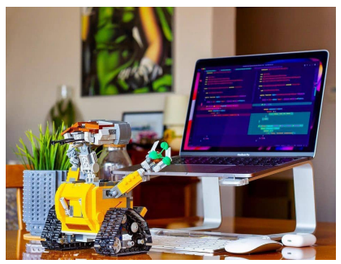
Appendix D. Collected sample photos

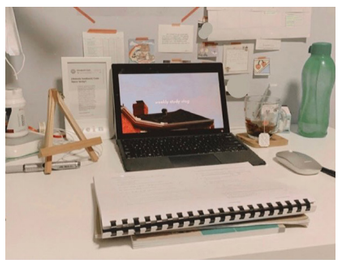


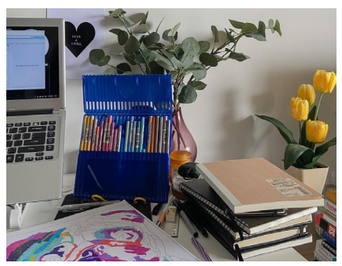




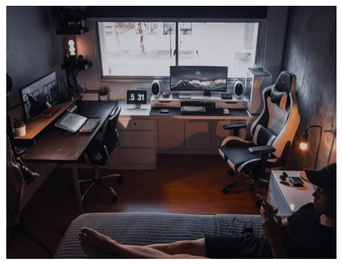



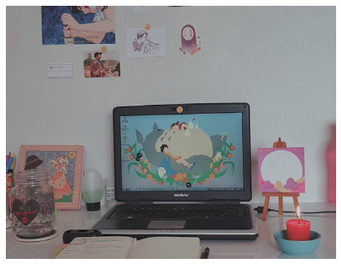
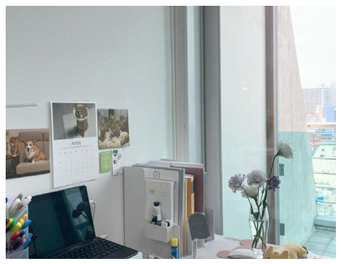



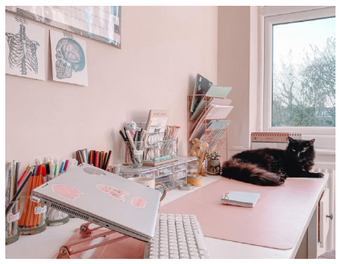
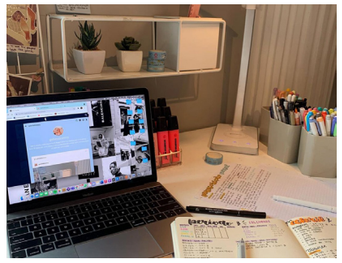


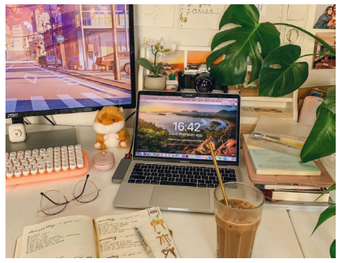


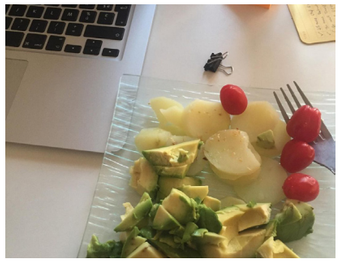


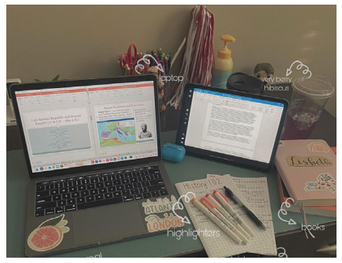



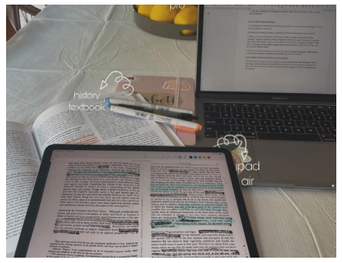




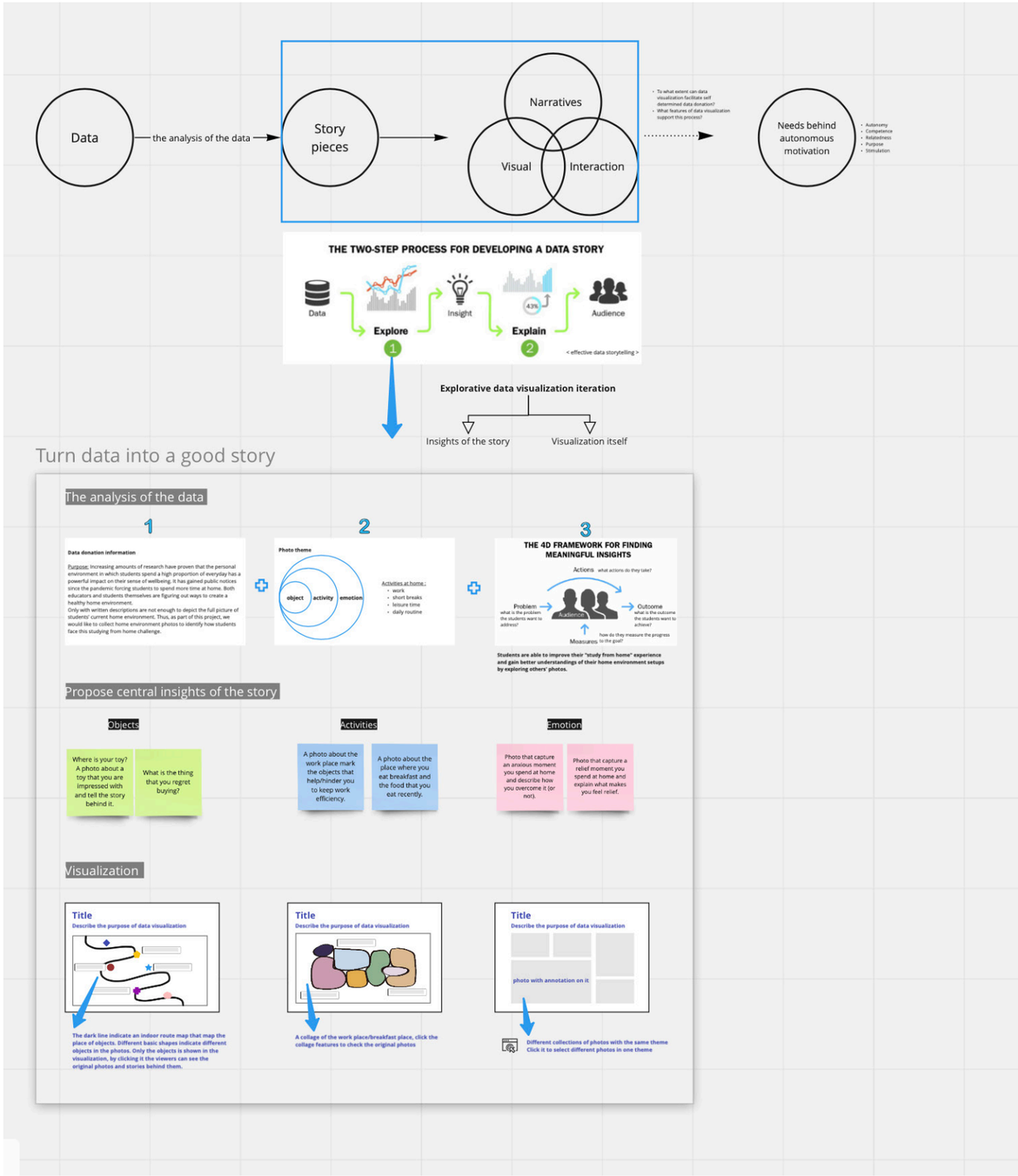







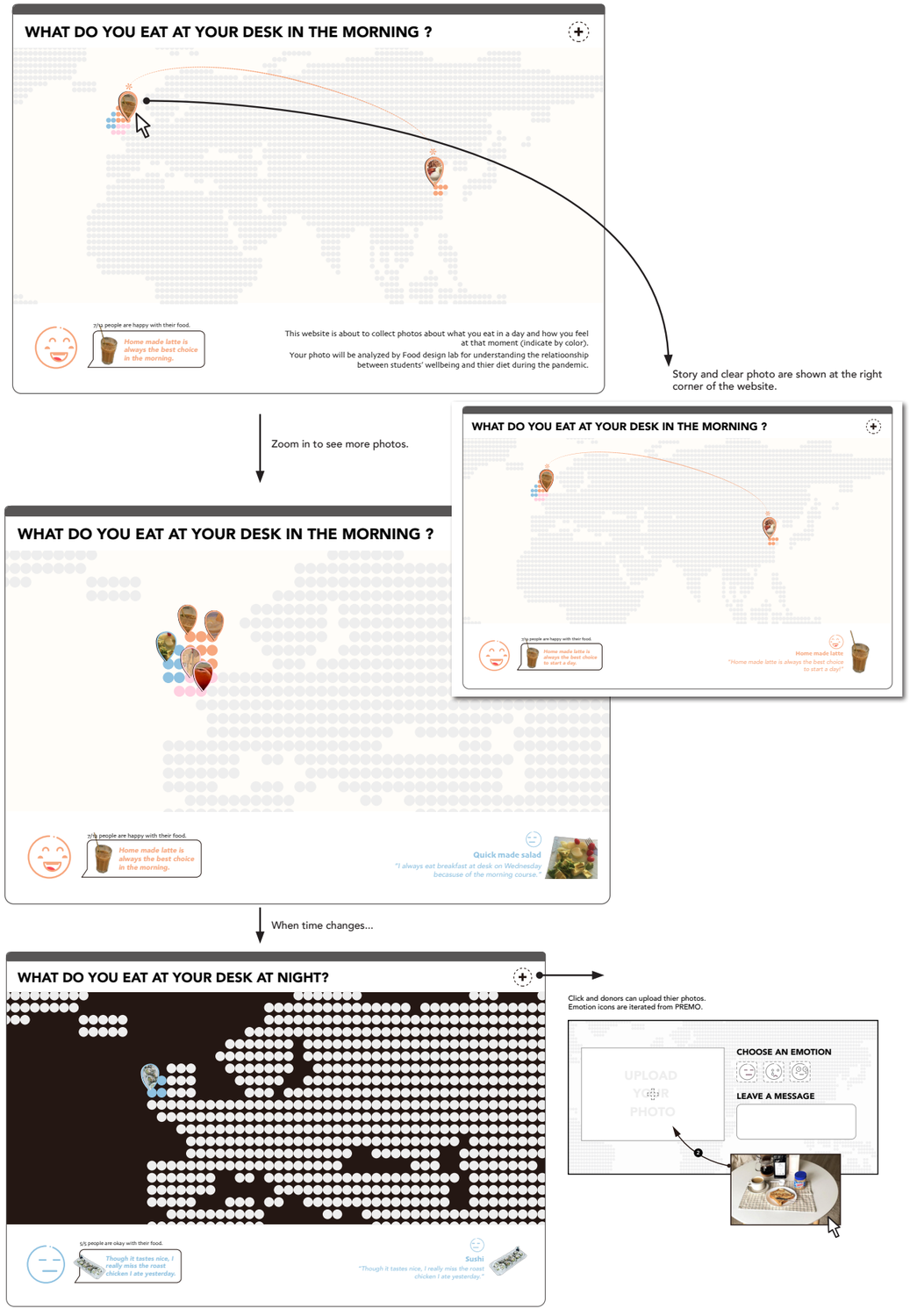


Appendix E. Theories for photo analysis



Appendix D. Concepts experience flow

Pragmatic concept



Ambient concept

WELCOME TO THE FICTIONAL HOME WORKING ENVIRONMENT !

WORK IN DAVID HOCKNEY'S WORLD

No.01 Home working environment
5 DFI researchers download this photo.

No.03 Home working environment
Waiting for downloads

50 PHOTOS ARE NEEDED TO ESTABLISH THIS EXHIBITION

Mr and Mrs Clark and Percy
Percy is the name of one of the Clarks' cats and refers to the cat sitting statue-like on Mr Clark's knee, looking out of the window.

Check the information of this artwork.

After exploring for a while.

WHY NOT TRY WITH YOUR HOME WORK ENVIRONMENT PHOTO ?

CHECK MY
HOME WORKING ENVIRONMENT
IN _____ STYLE
IN _____

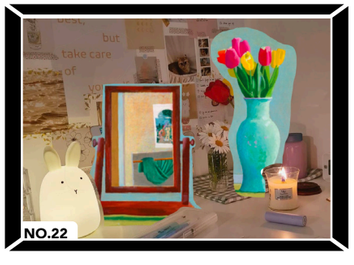
Click and choose the year.

2005
2010
2015

POP ART
TRACT EXPRESSION
IMPRESSIONISM

Click and choose the art style.

Check the generated art.



Title will be changed after an artist's work is matched

HOME WORKING ENVIRONMENT IN DAVID HOCKNEY'S WORLD

David Hockney: My Parents, 1977

Hockey completed this work after two failed attempts at painting his parents, Kenneth and Laura Hockney. They were frustrated when Hockney gave up on previous versions, having spent hours posing for him.

RETRY

DONATE

After donation, it will go back to the default page and the progress bar will update.

No.22 Home working environment
Waiting for downloads

NO.22 CURATOR
WELLCOME TO THE HOCKNEY'S WORLD !

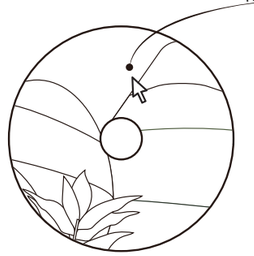
49 PHOTOS ARE NEEDED TO ESTABLISH THIS EXHIBITION

Artistic concept

Introduce this website

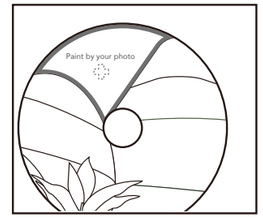
We are now collecting your home working environment photos to create some records. Your photos' theme color will fill the black and white cover graphic. Specific emotion represented by your photo's color atmosphere will be analyzed by the algorithm and be the basis of the melody.

Hover mouse

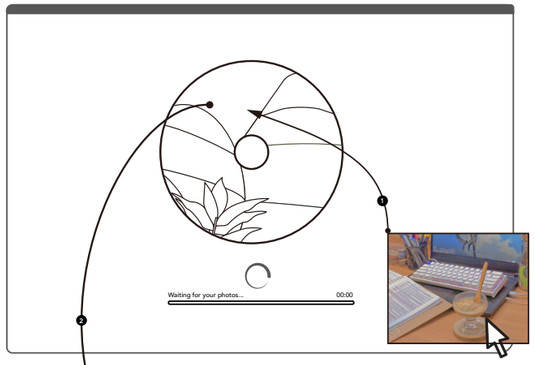


Waiting for your photos... 00:00

Corresponding interactions



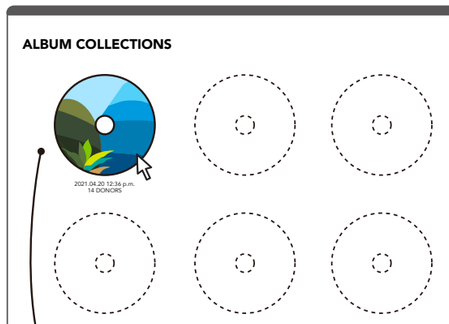
Donor upload photo



Color is filled,
New melody is generated.

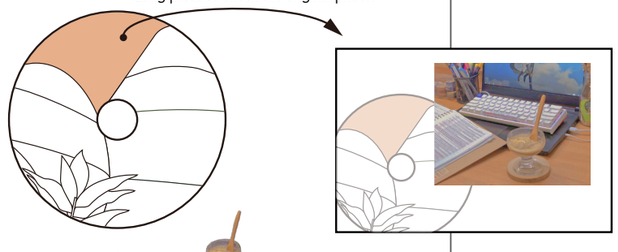
Check previous work

ALBUM COLLECTIONS



Listen to what others make

Long press to check the original photo.



Object cut from the original phto.

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Li
initials: C given name: Chengtian
student number: 5045312
street & no.: Michie
zipcode & city: 2628 J
country: Nether
phone: +3161
email: C.li-15

Your master programme (only select the options that apply to you):

IDE master(s): IPD / DfI / SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: Honours Programme Master
pecialisation / annotation: Medisign / Tech. in Sustainable Design / Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Kortuem, G.W. dept. / section: SDE/IOT
** mentor: Romero Herrera, N.A. dept. / section: HCD/DCC
2nd mentor:
organisation:
city: country:
comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Kortuem, G.W. date - - signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed
NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED / NOT APPROVED
Procedure: APPROVED / NOT APPROVED
comments

name date - - signature

Initials & Name C Li Student number 5045312
Title of Project Public data visualization as a medium to motivate data donation

Public data visualization as a medium to motivate data donation — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 25 - 01 - 2021 — 11 - 06 - 2021 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

While we are living in an increasingly convenient society dominated by intelligent technologies, our data information has been widely used by industry in exchange. Recommender systems are applied in the e-commerce market to feed news and target us with ads in line with our interests. On the other hand, collecting and processing data representing our everyday activities is a major component in data-driven design projects and is valuable for knowledge generation. Personal data as a research material providing collective information receives especially significant attention in the health field. For example, the number of steps indicates the degree of physical activity, sleep time duration can be an index to measure mental wellbeing, the number of takeaway orders reveals eating habits. Input from those data could contribute to more effective design interventions that support a transition to a healthier lifestyle.

Data donation is about sharing personal data of one's free will for the purpose of benefiting the public. And with the introduction of Right to Data Portability which enables data subjects to acquire their data collected by companies, the public is gaining a level of autonomy to transfer data for academic research. However, similar to other prosocial activities undertaken for public good like crowd-funding and volunteer work, donating personal data needs incentive. Some preliminary researches were conducted to understand the specific motivations for data donation. Skatova & Goulding (2019) proposed that people are likely to donate their data around three main groups of psychological factors. Social duty and need to understand the purpose of data donation positively correlate with the intention to donate data, while self-serving interests hinder this intention. To help people form actions to donate their health data for research purposes, designers can take these three motivators as a starting point.

Data visualization serves as a design approach to identify patterns, transfer data into information, and communicate insights. When presenting it to the public, the design process and outcome becomes tangible and understandable, and this meets people's desire to know the reasons and consequences of donating personal data. Besides, public data visualization genuinely informs the demand for data in design projects to the audience. Different types of personal data convey information that needs to be visualized differently. In order to maximize the benefits of public data visualization to data donation, specific information and interaction should be provided to compensate for people's concerns for sharing personal data.

The stakeholders in this project are the IDE community, including students as data donators and designers and researchers as data users.

space available for images / figures on next page

introduction (continued): space for images

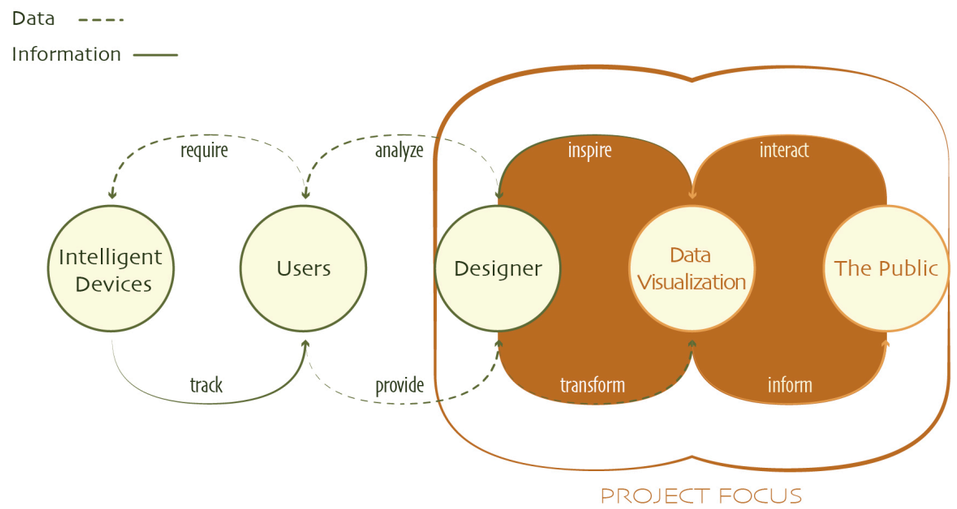


image / figure 1: The position of this project in the whole picture

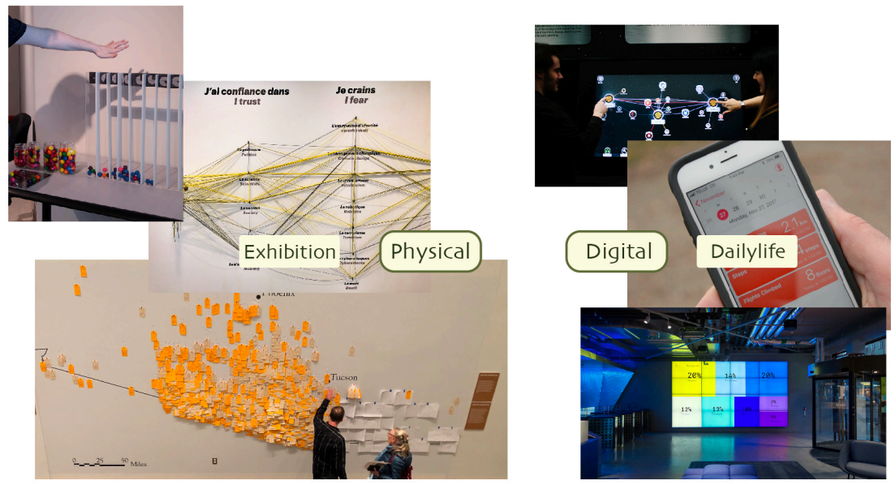


image / figure 2: Types of public data visualization

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Students' wellbeing attracts more attention in this pandemic period. Online questionnaires were distributed to understand how studying-from-home bears on students' health and wellbeing, and some online activities were organised to rebuild the social connection. IDE is now working on the 'Building Rhythms' project in which data is treated as a medium for awareness, reflection, and innovation. And, there is an increasing demand for detailed everyday data actively provided by students with restrictions on data collected by physical sensors. However, the major limitations of current measures are that few research results reach data providers and little is known about the improvement of the overall level of happiness. Over time, students are holding back to share personal data for the common good.

According to the psychological findings leading to personal data donation, the possible consequences of sharing personal data is still vague to the public. And whether they would like to donate also depends on the type of data and the corresponding information derived from it. Public data visualization is a practical approach that enables data contributors to realize the impact of their behaviour and get relevant knowledge benefiting themselves. In order to apply this approach to motivate students to share data about their lifestyle for better understanding the public health, here are some research questions need to be answered in this project:

- How can the health-related public data visualization facilitate data donation among IDE students?
  - Which type of health data would students like to share, and what are their concerns?
  - What do students expect from this visualization when they share their data?
  - What information do students need when they interact with this visualization?

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

My design goal is to understand the role of public data visualization in motivating people to donate data for design purposes.

Through an iterative design process, prototypes will be developed to meet the needs from data contributors and call for data donation. Also, to what extent the visualized information is helpful to the designers will be evaluated. The key activities happening around the interaction with the public data visualization will bring something to students that goes beyond a sense of autonomy toward individual data but complements it, like social responsibility, belonging, and inspiration. Further, the faculty will be more aware of students' health and wellbeing, and develop corresponding strategies. Key insights summarized during the design process will contribute to the data-driven design field to better cooperate with target groups by communicating data to the public.

Graduation project outcomes:
1. Interactive data visualization prototypes designed on smartphone or website.
2. A storyboard or video explaining the interaction with the prototype.
3. A report documents all the details of the design process and insights emerging from the research and test session.
4. (If possible) An academic paper about public data visualization designing for data donation.

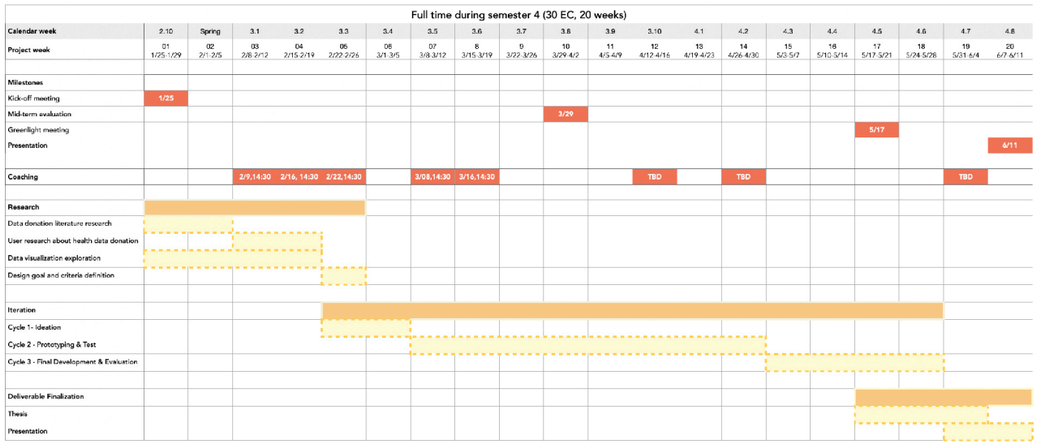
Personal Project Brief - IDE Master Graduation

TU Delft

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 25 - 1 - 2021 11 - 6 - 2021 end date



This project will run through a research-through-design process, it will focus on understanding data donation and students' attitudes and expectations toward sharing their health data. In the meantime, I will explore the data visualization field in preparation for applying theories and tools to develop the prototype. An improved and more concrete design goal and criteria will be defined as the result of this phase.

In the iteration phase, the speed dating method will be first used to select inspiring design directions from ideation results. Then, I expect three rounds of rapid design conceptualization and evaluation to test these ideas and collect insights, which will form the foundation of the final development. Validation of the final design will be measured by the number of criteria met in the user tests.

In the last 4 weeks, the knowledge gained from previous sessions will be generalized into a list of guidance or framework for future research, with a detailed project report and a pre-produced video.

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

In the past year, everyone experienced the transition to studying-at-home every day. We have tried various methods to guarantee our study productivity and to adapt to the integration of life and study. We changed ourselves to fit into this new normal. When we seem to manage these tangible problems, the mundane home environment and irregular daily routines have caused an increase in our psychological and emotional workload. A large number of tools are under development to support us stay productive in online classes, but the changes in our daily life and the impacts on our health are overlooked.

As a DFI student, I was taught to understand people's experiences and design for a better society. Under this situation, I feel the need to gain awareness of and design for students' well-being problems taking advantage of the big data era. Further, the behaviour of sharing personal data touches upon the theory of psychology and philosophy, which allows me to conduct interdisciplinary research and adds new knowledge beyond the design field.

As I am planning to earn a PhD in communication in the following years, I want to take this project as the basis to dive into this field and practice data visualization skills. And executing a fully self-paced project is helpful to overcome procrastination and form a broad perspective.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Thanks!