Master Thesis Irma Harms

Visualizing Human Values for Design

Understanding, creating and analyzing human value visualizations

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Abstract

In the design domain, it has become increasingly important in the past years to take human values into consideration because they are part of the user requirements of a design. Human values are what a person or group of people consider important in life. However, many designers and their stakeholders struggle with this abstract concept. This project aims at finding a way to best visualize human values such that they can help in a discussion between a designer and a stakeholder in a design process to get a better grip on the concept and thus improve the discovery and the discussion of the stakeholder's values. Through three studies, several core aspects to these visualizations have been researched, identified, and defined. The results show that visualizations of human values should include four elements: the name of the value, the description of the value, the visualization (imagery) of the value, and other written context such as synonyms. The imagery used must be a digital illustration that is neither too simple nor too overwhelming. The level of detail that was found to produce the best illustrations contains: five to ten flat but saturated colors that should be of a medium tonal range; there should be no textures, patterns, shadows, or background; the lines used can be both curved and straight but should not be too detailed; and the people in the illustrations should have facial details. The illustration is to be combined with the written information in a clear and easily discernable manner, by means of visual hierarchy, to form the value visualization. Several value visualizations that were created in this way were tested among various state of the art products. The outcome of this test indicates that the created visualizations, along with one of the state of the art products, are preferred over the other products. The visualizations could not be analyzed in a designer-stakeholder interaction to ensure that they can provide support in a discussion between a designer and a stakeholder. Therefore, it was concluded that it can be assumed that the approach taken in this thesis works satisfactory to visualize human values. Whether these visualizations help in a discussion between a designer and a stakeholder in a design process to get a better grip on the concept and thus improve the discovery and the discussion of the stakeholder's values is yet unknown. This is because the created product could not be tested in such a situation. Improvements to the current cards, expansions of the card set, quantitative analyses, and in-person testing are needed in the future to validate the results. If the value visualizations perform well, they can guide a user through the design process of a product or service with a focus on human values, which would greatly contribute to the incorporation or human values in design.

Acknowledgements

This final phase of my master's degree in Interaction Technology at the University of Twente has been full of ups and downs. Due to COVID-19, I had to do this thesis from home and had to push myself through some tough times. A slower pace throughout this project and the support from my surroundings helped me to finally complete this thesis. Luckily, I got to work on a very interesting and new topic that spans multiple disciplines, which taught me a lot about the subjects involved and about myself. Nonetheless, this thesis could not have been completed without the help and attention of several people.

First of all, I would like to thank my supervisors Geke and Birna for their endless support and feedback. Their continuous reminder that this is not a PhD thesis and I should therefore really demarcate my research allowed me to not lose sight of the end goal.

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1. Introduction

This report describes all the work done for the Master Thesis of Irma Harms. The thesis is about creating a validated set of visualizations of human values such that they can be used in a design process to help the designer better understand the values of the stakeholders and can include these in their design.

1.1 Research Purpose and Motivation

A design process involves many different and elaborate steps. One prominent step is for the designer to know and understand the stakeholders of their product or service, and to take into account their wants, needs, and wishes in the design of this product or service. These are sometimes also known as that person's values, because values in the design domain can be described as "what a person or group of people consider important in life" (Friedman, Kahn, Borning, & Huldtgren, 2013). In this case, the values are part of the requirements of the design as they relate to the fundamental needs of the stakeholders based on what they regard as essential. Section 2.1 will more elaborately explain what values are and how they are related to a design process.

However, the preliminary literature research performed for the Research Topics Report (Harms, 2021) shows that there are still some difficulties that are to be overcome when it comes to understanding and including these human values in a design. The three most prominent problems are shortly described below.

First of all, universally there is an ongoing debate in the literature about the exact definition of values in general and of each value individually (see for example De Greef, Mohabir, van de Poel, & Neerincx, 2013; Kheirandish, 2018; Sutcliffe & Thew, 2014). This is because the definition is highly depended on the context in which that value is placed (Kheirandish, Funk, Wensveen, Verkerk, & Rauterberg, 2020; Moonen & Tielman, 2020; Pommeranz, Detweiler, Wiggers, & Jonker, 2012).

Secondly, more specifically about values in design, most design methods are not sufficiently focused on the stakeholders' wants and needs. While each method offers guidelines or activities with a specific focus and goal to a designer to help them in their design process, most "do not adequately address the complexity of demands upon today's designers" (Jones, 1992). This leads to these values not being (sufficiently) included in a new design.

Finally, the incorporation of those values into a design has been found to be quite difficult. After the values are identified, they first must be translated to design requirements, to then be included in a design. Many people agree that the designer has the responsibility to consider these values in their design, especially with the more complex technological developments that have happened in the recent years (Pommeranz et al., 2012). However, the translation is subject to interpretation errors, as the translation is, just as the values, context specific and thus each designer must interpret in each case how these values would translate to design requirements. The chance of interpretation error increases also by the notion that values are to be taken into consideration in the very early stages of design (Van den Hoven, 2013), where the designer and the stakeholder only limitedly know each other and the specifics of the design.

It can thus be concluded that values are difficult to get a grasp on and to incorporate them correctly into a design. Therefore, this project will focus on helping a designer and their stakeholders to get a better grip on these human values.

1.2 Research Problem

The section above mentions three of the most prominent difficulties with including human values in design. Nonetheless, it is essential that they are taken into consideration in a design to ensure that a design meets the users' or other stakeholders' needs. The last of those points, the incorporation of values into a design, is a multifaceted problem, each of which should be research further and finally resolved. The three main problems of incorporating values correctly in a design are: 1) elicitation of the values from the stakeholders, 2) value translation to design requirements such that they can be included, 3) accounting for value change, which can come about due to either social developments or due to the introduction of new technologies (van de Poel, 2018) .

The research conducted for this master thesis will focus on the first problem, value elicitation, by focusing on the discussion a designer and a stakeholder might have about the stakeholder's values. Such a discussion usually happens in the early stages of a design process. As this is an explorative stage of the design, new and maybe difficult concepts can be introduced. With the concept of human values, this could be the case for some designers and stakeholders. To help understand this new or difficult concept, a (physical) visual tool, like cards, can be used. A visual aid is beneficiary as a person's vision is ones most diverse source of information of the world around us (Rieber, 1995; Ware, 2019) and a person's vision can grasp the content of a picture faster and more easily than from written text (Kamada & Kawai, 1991). Therefore, an image would do well in supporting any written information.

As section 2.2 will show, several tools like this exist that explain with text and imagery what a value means. However, the images used in these tools are not (academically) tested and validated to see if they contribute to or even enhance the written information that explains the value. If these tools were tested, they were tested as a whole and not the individual imagery separate from the written information. Not validating the imagery separately can be problematic. If the imagery used is not correct or if the written information and the pictured information do not match, the tool gives the wrong information, and it might also confuse the user. Consequently, it is paramount to test whether the imagery matches the written information to ensure that the correct information is conveyed.

1.3 Research Questions

To ensure a good foundation for a tool that can help in the elicitation of values from the stakeholder, the focus of this master thesis project is on creating and validating visualizations of human values. The main research question to be answered is:

> *"What is the best way to visualize human values such that they can help in a discussion between a designer and a stakeholder in a design process to get a better grip on the concept and thus improve the discovery and the discussion of the stakeholder's values?"*

Three sub research questions support the research to answer the main research question:

1. *Which elements of the visualization of values from the state of the art of the preliminary research contribute to the understanding of values?*
2. *What imagery should be used in the visualization of human values to improve the understanding of that value and such that people would use them in a discussion of that value during a design process?*
3. *Are the created visualizations preferred over the state of the art products?*

1.4 Research Method and Outcome

This master thesis is an explorative research that aims to find a starting ground for creating a tool that includes validated imagery of human values. The methods used in this research are therefore also of an explorative nature. The outcome of this research will, for ease of reference, be called 'the solution' from here on out.

The method used for the first sub research question is a survey. In this survey, the visual elements, which include the textual information as well as the visual (image) information, from state of the art products are explored. The objective of this survey is to identify the relevant elements that should be included in the solution and to deduce which type of imagery should be used. The results from this survey indicate that all identified elements should be included, as each of them contribute to the participants' understanding of that value. For the type of imagery there was not one definitive conclusion. The answers indicate that a balance should be found such that the images are simple enough to not be distracting, but also elaborate enough such that they can support and enhance the written information. For this, a balance needs to be found between the abstract 'icon' and the very detailed 'photograph' or 'elaborate digital illustration'.

Sub research question two focuses on this imagery. With the help from design experts, the illustrations that are to be used in the solution will be created. This is done by creating three version of visualizations of several human values which differ in the amount of detail that they contain ranging between an icon or a photograph/elaborate digital illustration. They are created with the help of a design expert. These are then tested among design experts, excluding the experts that helped during the creation phase, to find the best version. The outcome of this that the middle level of detail is the most preferred version. The corresponding chapter of this sub research explains what this level entails.

For the last sub research question, the created illustrations of the human values from sub research question two are combined with their respective written information to create (digital) card-like items. The goal of this sub research question is to compare these to several of the state of the art products to see how the solution compares to them by means of a survey. The solution and four state of the art products were tested. The results from this survey show that the participants find two of those five products considerably better than the other three, which are the solution and the BBC Digital Wellbeing cards. However, there is no great difference between these two products, so it cannot be concluded for certain that the solution is preferred over all the state of the art products. Nonetheless, the solution scores remarkably well. Additionally, in terms of composition and information on the card, these two products are very similar so it can be said that the approach taken for creating the visualizations works well since both products score favorably.

All sub research questions used a survey as method. The reason for this is twofold. First because the digital format allowed for more accessibility to more of the state of the art products, which are used in both the first and the third sub research question. While most products are in a physical card format, a majority of those could also be found in a digital format, which negated shipping time. Others were only available in a digital format. Secondly, the COVID-19 pandemic restricts physical testing. At the start of the master thesis project it was unsure how the pandemic would develop over time. So, to ensure that all studies could be done, it was decided to make all testing digital as this was the best, easiest, and safest way to adhere to the COVID-19 regulations.

The answer to the main research question, and thus the overall outcome of this thesis, is that the approach taken to create value visualizations works well. Although study 3 shows that the solution is not better than all state of the art products, it does show that the solution scores noticeably well. This means that that the characteristics determined throughout the thesis and the method used to implement these characteristics should be used in the future to create a complete set of value visualizations. The characteristics that should be included are all four elements (name of the value,

description of the value, visualization (imagery) of the value, and other written context), the imagery used should be a digital illustration which adheres to level three of detail as described in chapter 4, the composition and font should be simple but guiding, which can be done by making use of a visual hierarchy. Sadly, the solution could not be tested in-person so it cannot be said with certainty that it works as desired, however the results from sub research question three indicate that this will most likely have a positive outcome.

1.5 Structure of the report

This thesis report is structured as follows. First, chapter 2 will shortly explain the relevant research performed during the preliminary literature research, which includes a literature review on human values in design, the state of the art products and what can be learned from those. It also includes some further literature research that was needed for the continuation of this research. Then chapter 3, 4 and 5 serve to answer the three sub research question. Each of these chapters starts with providing the relevant information needed to perform the research for that sub research question, such as the requirements, overview of the products that are to be tested, or the creation of illustrations. This is followed by the method, data and results, and the conclusion and discussion. Subsequent is the overall thesis conclusion in chapter 6, where the answers to the three sub research questions are shortly summarized and the main research question is answered. Chapter 7 then discusses the conclusion of the main research questions, the requirements, and the future works for this thesis. The report ends with the references and the appendices.

2. Literature Research and Related Work

This chapter is largely based on the preliminary literature research performed by Irma Harms in advance of the master thesis (Harms, 2021). As that research was an extensive research of both the literature and the state of the art, some parts in this chapter are the completely the same and some parts are similar, but the information was shortened or rewritten.

The first part of this chapter (2.1) gives a summary of the most important information regarding human values in design. This is followed by the state of the art in section 2.2, which focuses on products that portray human values. Some of these products were already found during the preliminary literature research, but it is supplemented with additional products. The chapter is concluded with the requirements and the future works for the solution as identified during the preliminary literature research with a few changes as to adhere to the scope set for this master thesis.

2.1 Human Values in Design as Learned from Research Topics

Many people have come across the word values in their day-to-day life, but also many of those do not know exactly what values are. Universally, there is also an ongoing debate about the exact definition of values in general and each value specifically in the literature (see for example De Greef et al., 2013; Kheirandish, 2018; Sutcliffe & Thew, 2014). This is mainly because the definition is dependent on the context in which it is placed (Kheirandish et al., 2020; Moonen & Tielman, 2020; Pommeranz et al., 2012), like the specific case or domain in which people talk about values. Pommeranz et al. (2012) give an overview of how several people describe values in literature:

> *"Values have been described as abstract (see Bardi and Schwartz 2003; Maio 2010) motivational constructs that apply across contexts and time (Bardi and Schwartz 2003). They convey what is good (see Miceli and Castelfranchi 1989; Schroeder 2008) and important to us (see Bardi and Schwartz 2003; Friedman et al. 2006a). By conveying what is good, values can also be said to lead to behavior that supports them, since, as Miceli and Castelfranchi state, ''what is good should be pursued'' (Miceli and Castelfranchi 1989, p. 189). Values serve as guiding principles in peoples' lives (Schwartz and Bilsky 1990)."*

How this can be interpreted is that there is not one set definition for the concept of values. The definition of the concept, as well as the definition of each individual value, depends on multiple variables such as context, time, purpose, and each unique person. Therefore, the most prevalent understanding is where values are considered per individual person and they describe your fundamental aspects in life (Sutcliffe & Thew, 2014). Here they describe a person's motivations, wants, needs, desires, aversions, and other aspects that influence how a person lives their life. These types of values are also known as human values. In the domain of design, a similar definition is commonly used: "what a person or group of people consider important in life" (Friedman et al., 2013).

To work with the concept of values more easily many researchers, in a variety of domains such as psychology and anthropology, have created lists of values. Throughout the years this has led to a multitude of value lists, as most of these researchers or designers have created one for their specific purpose. The diversity among these lists is great. Some of these lists are created from scratch, while others tried to combine previous lists based on either commonalities between all previous lists or to give a grand overview of all possible values discussed in literature. Several researchers tried to organize these long and intricate lists, thereby creating value groups that form a kind of umbrella for several

similar values. Which value groups there are and which values belong to these groups differs also per researcher. Kheirandish (2018) gives an overview of all these lists (for an impression, part of that overview can be seen in Figure 1) and has also analyzed each one of them, as to also create a list for her own research. However, there is not one European or globally officially recognized list of values (Van den Hoven, 2013).

Time	Scholar	Discipline	Values list
1965	William A. Scott	PS	(1) Intellectualism, (2) Kindness, (3) Social skills, (4) Loyalty, (5) Academic achievement, (6) Physical development, (7) Status, (8) Honesty, (9) Religiousness, (10) Self-control, (11) Creativity, (12) Independence.
1970	Robin M. Williams	SC	(1) Achievement and success, (2) Individualism, (3) Activity and work, (4) Efficiency and practicality, (5) Science and rationality, (6) Progress, (7) Material comfort, (8) Equality, (9) Freedom, (10) Democracy, (11) Humanitarianism, (12) Racism and group superiority, (13) Education, (14) Religiosity, (15) Romantic love and monogamy.
1973	Milton Rokeach	SP	•Terminal values: (1) An exciting life, (2) Pleasure, (3) Mature love, (4) True friendship, (5) Inner harmony, (6) Social recognition, (7) A sense of accomplishment, (8) Family security, (9) National security, (10) Self-respect, (11) Health, (12) A comfortable life, (13) Freedom, (14) Salvation, (15) Equality, (16) Wisdom, (17) A world at peace, (18) A world of beauty. • Instrumental values: (19) Ambitious, (20) Broad-minded, (21) Capable, (22) Clean, (23) Cheerful, (24) Courageous, (25) Forgiving, (26) Helpful, (27) Honest, (28) Imaginative, (29) Independent, (30) Intellectual, (31) Logical, (32) Loving, (33) Obedient, (34) Polite, (35) Responsible, (36) Self-controlled.
1990	Shalom H. Schwartz	SP	(1) Power: (Social power, Authority, Wealth, Preserving my public image, and Social recognition.) (2) Achievement (Successful, Capable, Ambitious, Influential, Intelligent, and Self-respect.) (3) Hedonism: (Pleasure, and Enjoying life.) (4) Stimulation: (Daring, A varied life, and An exciting life.) (5) Self-direction: (Creativity, Curious, Freedom, Choosing own goals, and Independent.) (6) Universalism: (Protecting the environment, A world of beauty, Unity with nature, Broad-minded, Social justice, Wisdom, Equality, A world at peace, and Inner harmony.) (7) Benevolence: (Helpful, Honest, Forgiving, Loyal, Responsible, True friendship, A spiritual life, Mature love, and Meaning in life.) (8) Tradition: (Devout, Accepting portion in life, Humble, Moderate, Respect for tradition, and Detachment.) (9) Conformity: (Politeness, Honouring of parents and elders, Obedient, and Self-discipline.) (10) Security: (Clean, National security, Social order, Family security, Reciprocation of favours, Healthy, and Sense of belonging.)
2004	Christopher Peterson & Martin E. P. Seligman	PS	I. Wisdom and knowledge (1. Creativity, 2. Curiosity, 3. Open-mindedness, 4. Love of learning, 5. Perspective), II. Courage (6. Bravery, 7. Persistence, 8. Honesty, 9. Zest), III. Humanity (10. Love, 11. Kindness, 12. Social intelligence), IV. Justice (13. Teamwork, 14. Fairness, 15. Leadership), V. Temperance (16. Forgiveness, 17. Modesty, 18. Prudence, 19. Self-regulation), VI. Transcendence (20. Appreciation of beauty and excellence, 21. Gratitude, 22. Hope, 23. Humour, 24. Religiousness)

AN Anthropology PH Philosophy PO Political science PS Psychology SC Sociology SP Social psychology

Figure 1 Part of the overview table of value lists from several domains and people, created by Kheirandish, S.

A design process is in intricate procedure with many steps and many aspects to take into consideration. Consequently, many design methods have been created that offer guidelines or activities to a designer to help them in their design process. Each of these methods has their own focus and goal. However, as Jones (1992) states in his book 'Design Methods', the more traditional methods such as design-by-drawing "do not adequately address the complexity of demands upon today's designers". He explains that this is partially due to those methods not focusing enough on the user's needs. In the more contemporary methods, these are more and more taken into account. These user needs can,

amongst other, originate from the users' values. In this case, values can be described as part of the requirements of the design of a product or service, as requirements are based on the intended use and the wishes of the user (van de Poel, 2009).

To be able to include the human values in a design, they have to be translated from values to requirements. As mentioned in section 1.1, there are several reasons why this is complicated to do. Although it is out of the scope of this research, a note should be made regarding one of these difficulties and the consequences thereof, which is value change. Changes to values can come about due to either social developments or due to the introduction of new technologies, and can cause one of the five kinds of value change (van de Poel, 2018): 1) the emergence of new values; 2) changes in what values are relevant for the design of a certain technology; 3) changes in the priority or relative importance of values; 4) changes in how values are conceptualized; 5) changes in how values are specified, and translated into norms and design requirements. Despite the fact that this thesis does not have its focus on designing for value change and all its causes and consequences, it is important to design a solution which allows for changes to its own design. The main reason for this is that, because of value change, it is impossible to create one exhaustive list of human values and their definitions (Friedman et al., 2013). This could for example mean that the solution should be easily extendible, or that (minor) changes can be made. This allows the solution to be adaptable to value change in a future version or expansion. By not including these options in the solution, a crucial aspect of human values is neglected and most of the work done might not be relevant in only a short period of time.

As including values in design has been becoming increasingly important over the years, several methods have been created by and for designers to create a more systematic approach to this challenge. Design methods can be defined as "tools which enable design activity through the knowledge they contain […], under the control of the designer who activates this knowledge in situated and pragmatic ways to support their design activity" (Chivukula, Li, Pivonka, Chen, & Gray, 2021, p. 1). One of the most well-known, used, and researched methods when it comes to including values in design is the Value Sensitive Design (VSD) method. VSD relies on an iterative process of three types of investigations (Friedman et al., 2013): 1) conceptual investigation, which includes researching the stakeholders and their values; 2) empirical investigations, which dives deeper into measurable quantities such as questions about which values a person prioritizes over other values in case of a value trade-off; 3) technical investigation, which allows the user of the method to look into how technological properties support or hinder the previously discussed values or how a technology can actively support the identified values. Many other methods have their origin in the VSD method (Smits et al., 2021) or are even part of the VSD method. Nonetheless, most methods have the universal problem of not clearly specifying how values can be identified as there is no accepted fundamental grounding for this (Kheirandish et al., 2020). Additionally, Pommeranz et al. (2012) argued that, when such methods are researched, they lack in providing the context and the means for reflection surrounding the gathered knowledge and requirements, which is needed to elicit situated values. This means that only the outcome (like the values) is given, but not the context in which they were found and extracted, and also not how a reflection was or should be conducted. Without this information, it is hard to reflect on the work done by others such that possibly a relevant method could be obtained from this. Furthermore, the more complex products and services that are created nowadays make it difficult for the stakeholders to understand the systems, therefore making it also more difficult to assess the stakeholders' views towards the design (Manders-Huits, 2011). And even when the stakeholders understand the design that the designer is talking about, they still might struggle with connecting important aspects in their lives with specific values (Pommeranz et al., 2012) or they do not even know how to find their own values (De Greef et al., 2013). As described earlier, some researchers have tried to create lists, but even these will not fully solve this problem because, as values change over time, these lists become outdated and maybe even inaccurate and faulty. Additionally, some lists are also context dependent (a list created

for a specific situation) or not complete. An example of this is the list used in VSD. Manders-Huits (2011) points out something that Friedman, the creator of VSD, also herself points out: the list of thirteen frequently implicated values in design with their definition based on literature that is incorporated in this method is not complete.

2.2 State of the Art of Visualizations of Values

The preliminary literature research (Harms, 2021) showed various types of state of the art products, including visualizations of values (both general and context specific), visualizations of other abstract concepts such as emotions or happiness, cards that can help in a certain part of the design process or with a specific method. The goal of that state of the art research was to see which products are similar to or even achieve the requirements of: "a product or tool with validated values and visualizations that is easy to use and supports the interaction between the designer and the stakeholders in a design process in discussing values as to include them in a design".

From this research it was learned that a large assortment of products exists, but none of these products have met the set requirements. The biggest problem was found to be that none of the products tested their visualization (the imagery used) separate from the written information to see if the visualizations contribute to or support the written information. The product that came closest to the requirements is 'HuValue' from Kheirandish (2018).Their PhD report describes the literary backing for the choices made in the creation of a multifaceted product, which includes, among others, 45 value cards. The other components are an A2 sized wheel with card-like images that show nine value groups (see Figure 2) and 207 picture cards that show activities, persona, and products/services.

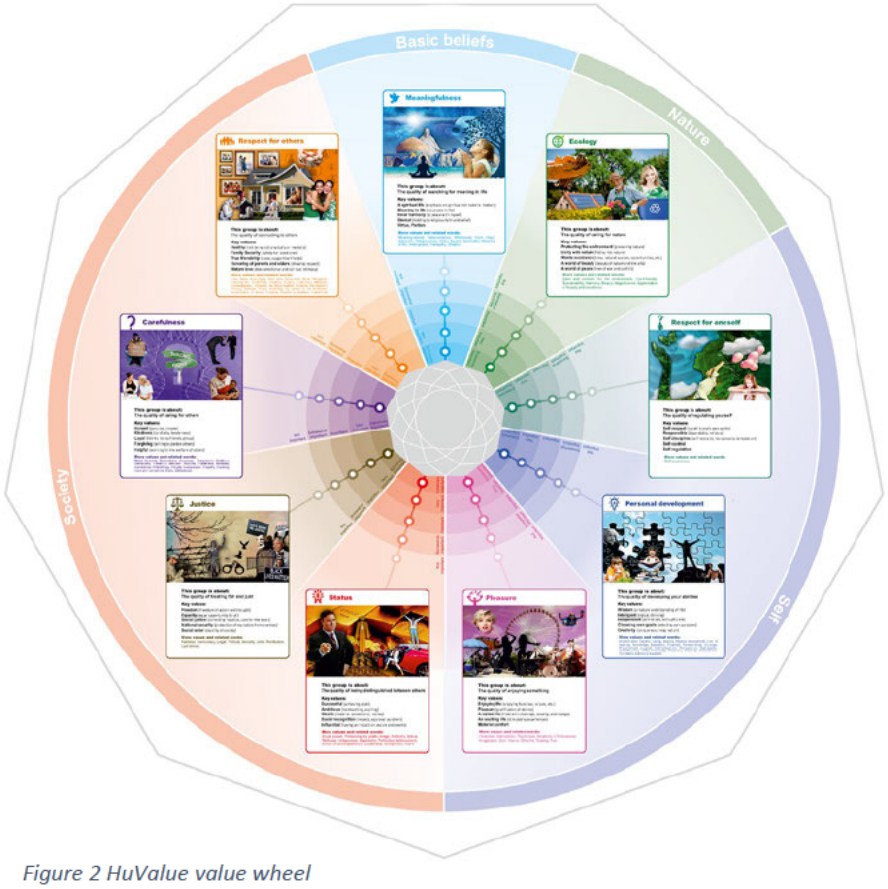


Figure 2 HuValue value wheel

However, also their images were not evaluated separately from the written information; only the full product as a whole was tested. There were also some other aspects that did not match the

criteria for this research and the creation of the solution. Most importantly, only the value groups have their respective imagery (both a symbol to the left of the value group name as well as a larger image below) while the individual values on the cards do not have their own imagery that represents the value. The individual value cards only show the value group symbol on one side of the cards (see Figure 3).

Figure 3 HuValue individual value card

The state of the art review for the master thesis will show several products that visualize human values. Some of these products were already found during the preliminary literature research, while others were discovered during further research for the master thesis. The purpose of this overview is, in the first place, to give a more complete overview of these products. Secondly, a more extensive list of products that visualize values is needed to conduct the research for master thesis. To conduct proper academical research, it is necessary to find sufficient overlap between several products on multiple features. For example, a diverse style of imagery such as icon, photo, and digital illustration is needed in sub research question one to find out which is preferred, while those same products also need to display the same, or at least similar, values. As not all products make use of the same value list, or only portray value groups as opposed to individual values, a wide variety of products is needed to find sufficient overlap. For the third sub research question this variety of products to find sufficient overlap is also needed to compare the created solution to some of the state of the art products while also showing the same, or similar, value.

Table 1 shows the overview of the state of the art products. For each product, an example image and the product name are given, including the respective reference to that product as a footnote, and any research conducted regarding that product if this was done. It also indicates which value type or value list is used and whether the product displays individual values or value groups. If a product visualizes both, then these are separate entries in the table. Some products, such as 'Find Your Values, version 1', 'HuValue, version 2' , and 'The Start of Happiness' show both the individual value and the value group in their visualization. In these cases, it is assumed that their images portray the value group and therefore they get the label 'group'.

The table also shows the elements that are present in the product. The four elements that could be present, as identified during the preliminary literature research, are '(value) name', '(value) description', '(value) visualization', and 'other written context' such as synonyms, motivational goal, more values and related words. For the products of 'Find Your Values, version 1' and 'The Start of Happiness', the individual values that are covered by the value group are put down as description, as they could help describe what the value group entails. Originally, the preliminary literature research also found the presence of the element 'color (coding)', which is omitted from this table and most of this research. This is because currently no official or academic recording exists that connect certain

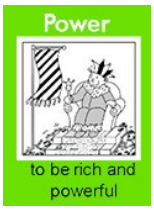
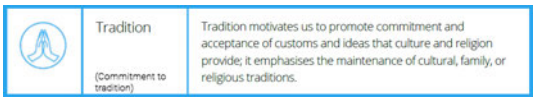
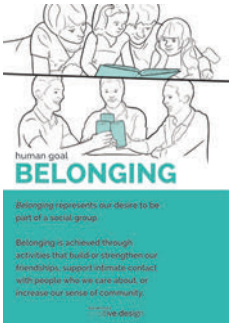
colors to certain values or value groups. Color association with various other topics has already been researched, such as, for example, with taste (see for example MAGA, 1974), smell (see for example Morrot, Brochet, & Dubourdieu, 2001), emotions (see for example Naz & Helen, 2004), music (see for example Cutietta & Haggerty, 1987), graphemes (see for example Asano & Yokosawa, 2013), marketing and consumer's choice of product (see for example Priluck Grossman & Wisenblit, 1999), and brand association and loyalty (see for example Jin, Yoon, & Lee, 2019). Study one, which aims to answer the first sub research question, will still include this element in the research to see what participants have to say about the use of color, as this might give some interesting results, but it will not be further analyzed or used in the other sub research questions.

The type of visualization (imagery) used in the products can be one of five options: 'None', 'Icon', 'Digital Illustration', 'Photograph', and 'Combination'. An icon can be defined as a "pictorial representation" (Merriam-Webster.com, 2022a) usually depicted in a two-tone color scheme. An illustration can be described as "a picture or diagram that helps make something clear or attractive" (Merriam-Webster.com, 2022b), where 'digital' distinguishes that the illustration was made with digital software as opposed to hand-drawn. A digital illustration is more elaborate than an icon: it has a wide range as to how detailed it can be. A photograph can be defined as "a picture or likeness obtained by photography" (Merriam-Webster.com, 2022c). Lastly, a combination makes use of two or more of the before described options and merges them to one image.

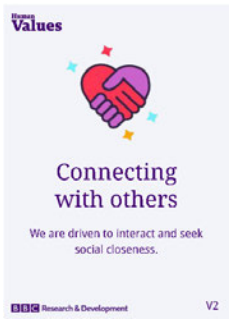
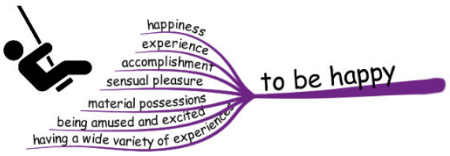
Table 1 State of the Art products overview

Product name	Type of value (list)	Individual or group values	Elements	Type of visualization	Example image
Discover Your Values: the Deck[1]	Schwartz	Individual	Name, Description	None	
Values Deck by Studio Carreras[2]	Schwartz	Individual	Name, Description, Visualization	Icon	
Find Your Values, version 1[3]	Schwartz	Group	Name, Description (= individual values), Visualization	Icon	

[1] https://www.discoveryourvalues.com/tvd
[2] https://studiocarreras.com/values
[3] https://www.findyourvalues.com/ and https://www.findyourvalues.com/research/

Find Your Values, version 2[3]	Schwartz	Group	Name, Description, Visualization, Other written context	Digital illustration	
Frontiers for Young Minds[4] (Martin, 2018)	Schwartz	Group	Name, Description, Visualization	Digital illustration	
The Values Project[5] (The Values Project, 2019)	Schwartz	Group	Name, Description, Visualization	Icon	
HuValue, version 1[6] (Kheirandish, 2018)	Own list, tested	Individual	Name, Description, Visualization (of value group, not of the individual value)	Icon	 (two-sided cards)
HuValue, version 2[6] (Kheirandish, 2018)	Own list, tested	Group	Name, Description, Visualization, Other written context	Combination	
Design for Happiness[7] (Delft Insitute of Positive Design, 2017; Desmet & Pohlmeyer, 2013; Pohlmeyer & Desmet, 2017)	Own list, but also other categories than values, assumed tested	Individual	Name, Description, Visualization, Other written context	Digital illustration	

[4] https://kids.frontiersin.org/articles/10.3389/frym.2019.00115
[5] https://www.thevaluesproject.com/
[6] https://huvaluetool.com/
[7] https://diopd.org/design-for-happiness-deck/#:~:text=The%20Design%20for%20Happiness%20Deck,analyses%20of%20your%20design%20project.

BBC digital wellbeing cards[8]	Own list /unknown	Unknown	Name, Description, Visualization	Digital illustration (closer to icon)	
The Start of Happiness[9]	Own list /unknown	Group	Name, Description (=individual values), visualization	Icon	
DNAv cards[10]	Own list /unknown	Individual	Name, Visualization	Photograph	

Also the newly added products, compared to the ones already researched during the preliminary literature research, do not have tested visualizations. Again, some products make use of known and tested value lists and value descriptions, but none have tested the imagery separately or even tested the product as a whole. Most of the products are physical cards, with access to a digital version. The products that are not physical cards, such as Find Your Values, The Values Project, and The Start of Happiness, are from websites or online surveys that use imagery along with written information to inform the user of the values. To ensure that the solution and the information which it contains is valid, the imagery should be tested separately from the product as a whole. To be able to compare the solution to the state of the art products, the solution should be in a digital format and in a card-like style. This will also allow the digital cards to be easily transformed into physical cards if this is desired in the future.

2.3 Requirements from literature

The preliminary literature research identified a multitude of requirements for a tool to help talk about human values in a design project. As the master thesis focuses on the elicitation of values during a discussion between the designer and the stakeholder and the time constraint for the thesis should also be kept it mind, not a full tool can be created. Therefore, some of the previously identified requirements will now be future works. Both the requirements for this thesis, as well as the future works, will be explained below. Additional requirements based on the research done during the thesis might arise and will be pointed out as they emerge during the research.

[8] https://www.bbc.co.uk/rd/projects/digital-wellbeing
[9] https://www.startofhappiness.com/understanding-your-values-part-2/values-mind-map/
[10] https://dnav.international/downloads/

2.3.1 Requirements

- Definition: The concept of the value needs to be clearly articulated.
- Value elicitation: The solution should aim for the value elicitation of the stakeholder.
- Values:
  - Individual values: individual values should be portrayed as opposed to (only) value groups, as this gives the user more specified information per value.
  - Values list: as there is not one universal value list, the solution can deviate from the most used list created by Schwartz (1992).
  - Value information: the written information provided per value should be valid.
- Visualizations:
  - Information: As the preliminary literature research showed, the state of the art products make use of several elements, such as a name or title, a description and a visualization (imagery). The solution should also include these elements. How many elements, which elements, and what information the elements should contain is to be researched in this thesis.
  - Type: although the literature suggest that the visualizations (imagery) should be kept simple, the state of the art from the preliminary literature research shows that different types of visualizations (imagery) are used, some of which could be considered as non-simple. Therefore, the best type of visualization (imagery) should be researched.
  - Visualization testing: Most of the imagery used in the state of the art products are not separately tested from the product as a whole. This means that the validity of the visualizations (and more specifically its imagery) is not guaranteed. For the solution, the imagery should be tested separately from the product as a whole.
- Format: the solution should be in a digital, card-like format to have a similar format to the state of the art products so that it can be compared. This also means that only the front of the card-like product has to be created.
- Accounting for value change: the values of the stakeholders can change over time. The solution must focus on discovering and discussing the values of stakeholders at one point in time but should keep in mind that the design of the solution is changeable or extendable.

2.3.2 Future work

Due to time constraints, it is not possible to create a full tool or method that covers all important aspects as mentioned in the literature. The list below gives an overview of the aspects that will not be covered in the solution as they are out of the scope of the project but should be worked on in the future. The list includes the point that will be future work as well as a description after it that describes what it means and the implication this has for the solution. Some of the points below cannot be found in the literature discussed in this report, but can be found in the report from the preliminary literature research (Harms, 2021).

- Definition: definition of human values. A future complete tool, such as a complete card set, should describe the concept of human values as introduction to the value cards. As a complete set will not be created for the thesis, this card will not be created and tested.
- Context: place the stakeholders' values in context; in the future it should be tested if the solution helps the stakeholder to place their mentioned values in context so that the designer can better understand what the stakeholder means and to check if designer understood the stakeholder correctly. This will not be tested during the thesis.
- Set: a complete card set of all the values. This will not be created during the thesis.

- Stakeholder identification: for the designer to know which people and their values should be taken into account in their design, the designer has to identify the stakeholders of the design. For the solution we assume that the stakeholders of a design project are known.
- Between stakeholder value conflict and trade-offs: the values from different stakeholders might conflict with one another and thus accommodations have to be made. The solution will only focus on identifying values of stakeholders and discussing them.
- Translation of values to design requirements: how the stakeholders' values would be translated to design requirements and thus how they can be included in design. This will not be included in the solution.
- Test the solution with (complex) products and services: the product should be tested with designers and their stakeholders to conclude if the solution has the desired effect. Complex products and services might be more difficult for stakeholders to understand and that could thus create another barrier in the discussion of the stakeholders' values. Due to the COVID-19 regulations and the time-constraint of the thesis, the solution will not be tested with users.
- Full method: Create a full method to guide the whole design process of including values. The thesis and its solution will provide the start of the creation of a card set that aims to help with value identification and discussion. The future work could use this work to create a complete method or tool.
- Additional features that help support the interaction between the designer and the stakeholders of a project besides the current goal and intended use of the cards (which is that the solution should be used as collaboration between a designer and a stakeholder to discuss the stakeholder's values). Some examples of such feature could be suggested activities and/or talking points, or game-like activities. This will not be created for this thesis.
- Interaction: Interaction (collaboration) between the designer and stakeholder should be supported so that the current societal state can be taken into account, and it is thus not based on history, literature, or stereotypes but based on current circumstances and the stakeholder at hand. This will not be tested in this thesis as not a complete tool will be created.
- Format of complete tool: Easier interaction could be supported by a digital solution as it would give more communication freedom. This would allow for use when the users are in the same room but also for when this is not possible, for example when travel restriction (like with COVID-19) do not allow for this or when financials do not allow for the designer and stakeholder to physically meet. However, there are also many arguments in favor of having a physical tool. The implications of a digital versus a physical tool should be further researched in the future before a decision is made. This thesis will not research or test this.
- Reflection: The designer and the stakeholder should be able to reflect on what has been discussed at the end of their discussion to check if everything was understood correctly and so that the stakeholder can see the full picture of what they said in the context of the design. This will not be tested in this thesis as not a complete tool will be created.

3. Study 1: Preferred Visual Elements and Imagery Style from the State of the Art Products

This chapter serves to answer the first sub research question:

> *Which elements of the visualization of values from the state of the art of the preliminary research contribute to the understanding of values?*

It is essential to find out what the cards for the solution should look like. An important step in this process is to first learn from history, which are in this case the state of the art products. The previous chapter has already shown that there are many products out there, each with varying amounts of information, or elements, on them, using various imagery styles, and even showing different values. The goal of analyzing these products is to determine how many and which elements should be included, what type of imagery should be used (if any), and if there are any other preferences or notes that should be taken into account.

Section 3.1 shows the products from the state of the art and their characteristics that will be used in this study. Section 3.2 explains the method used in this study, including the measurements, the participants, the procedure, and the analysis that will be applied. This is followed by the data and results from the study in section 3.3 and the conclusion and discussion of this chapter in section 3.4.

3.1 Products from State of the Art to be used in the Survey

As can be seen in section 2.2, ten products were identified during the state of the art research. However, not all of these can be tested in this research. This is for two reasons: 1) testing ten products on their elements and their imagery would cost a considerable amount of time; too much time for the master thesis, and this would also 2) strain participants a lot, which would most probably result in very few responses, and this would then not depict a fair representation of the population.

To decide which products are to be tested, several points have to be taken into account. First of all is that an overlap in the values that are represented has to be found such that similar values among the products can be tested. The products do not all portray the same values, mainly due to not using the same value list. Additionally, some products portray value groups, whereas others portray individual values. Secondly, the products must be available to the researcher. Most of them can be found online, but there are several products that only provide a limited number of their cards, or none at all. Ordering the physical cards to then digitize them is not an option, as the shipping from overseas would take too long and thus hinder the progression of the research too much. Thirdly, it is important to test the different variations of the number of elements. This ranges from two elements to four elements. Lastly, all imagery styles (photograph, icon, digital illustration, and combination) should be included to test the full range of imagery. The state of the art also identified the option for no visualization, which is left out in this research, as the aim of the main research question is to find out the best way to visualize values.

Bearing in mind all the points described above, a selection of four products was made. Table 2 shows an overview of these products and their characteristics. The selection includes two products that portray individual values and two products portraying value groups. Although the solution will portray only individual values, it was decided to include the products that portray group values in this research because otherwise there would not be a product that uses the ‘multiple’ imagery style. The

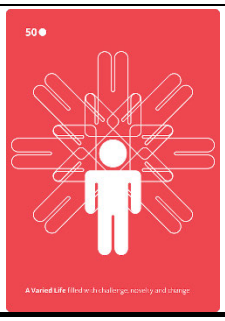
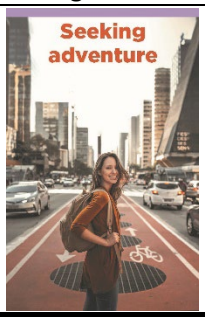
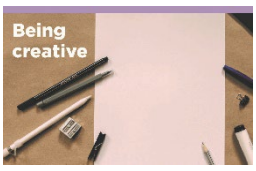
four products all use a different imagery style, and the elements they contain vary from two to four elements.

Table 2 Products and their characteristics used in study 1

Product or company name	Group or individual values portrayed	Elements				Imagery
		Name	Description	Other written context	Visualization	
Values Deck by Studio Carreras	Individual	X	X		X	Icon
Find your Values	Group	X	X	X	X	Digital illustration
HuValue	Group	X	X	X	X	Multiple
DNAv	Individual	X			X	Photograph

Among these products, an overlap could be found for three similar values or value groups, of which also the cards were digitally available. Whether values or value groups were similar, is based on the name given to the value (group), the description, the other written information provided if this is present on the product, and on the own judgement of the researcher. The three values and the (digital) cards of these products can be seen in Table 3. The similar values can be viewed per row. The first group of similar values, as named by their product owners, is 'a varied life; pleasure; stimulation; seeking adventure', the second group is 'creativity; personal development; self-direction of thought; being creative', and the third is 'true friendship; respect for others; benevolence – dependability; building friendships'.

Table 3 Cards of the four state of the art products for study 1 showing the three similar values

	Values Deck by Studio Carreras	HuValue	Find Your Values	DNAv
Value 1	A varied life	Pleasure	Stimulation	Seeking adventure
				
	Values Deck by Studio Carreras	**HuValue**	**Find Your Values**	**DNAv**
Value 2	Creativity	Personal development	Self-direction of thought	Being creative
				

	Values Deck by Studio Carreras	HuValue	Find Your Values	DNAv
	True friendship	Respect for others	Benevolence – dependability	Building friendships
Value 3				

3.2 Method

To find an answer to the first sub research questions, a digital survey was created and sent out. The sub sections below will explain the measurements that are included in this survey, the participants which the survey is aimed at, the procedure, and the steps for analyzing the survey. The survey was created using Google Forms, which can also be found in Appendix A.1.

3.2.1 Measurements

The survey is aimed at finding the relevant elements from the state of the art for the solution, and the preferred imagery style. The elements that can be distinguished in the products are 'name of the value'; 'description of the value', usually the definition of that value; 'visualization of the value', the imagery used to portray the value; 'other written context', which is other written information besides the value name and the value description, such as synonyms; and 'color (coding)', which indicates the use of color for a certain reference or link. As already explained in section 2.2, the element of 'color (coding)' was explored in the state of the art research for the preliminary literature research, but not in the state of the art research for the master thesis. However, it is still included in this survey to see how the participants might view this, but it will not be further analyzed. It is not reasonable to argue that color coding can be detected when a participant cannot see all the cards from a product, as usually color coding does not only happen on one card but is commonly applied across the full set. This can for example be seen in products that make use of both individual values and value groups, where the individual values that belong to the same value group get 'color coded' the same to link them all to this group. Additionally, there is not yet any literature to support the association between color and values. Therefore, the option 'color (coding)' is included in the survey, mainly to see if any participants would observe anything notable regarding color, but this option is not further analyzed.

The other measurement in this survey is the imagery type. The four types that can be identified in the products are 'icon', 'photograph', 'digital illustration' and 'multiple/combination'. The definitions of these types are explained in the State of the Art research section (2.2), on page 17.

The first three questions that are asked in the survey are statements, which can be answered by filling in a 7-point Likert Scale, where 1 is 'not at all' and 7 'very much'. Each statement question is followed by an optional question where the participant is asked to explain their answer. The statements are:

1. This image is aesthetically pleasing.
2. This image helps me understand the meaning of the value.
3. I would use this image as support when discussing this value with someone.

After this, four questions regarding the elements in the product are asked. These questions are check-box questions, where the participant can select one or more of the answers to indicate their answer. The options of the checkboxes are: 'Use of color (coding)', 'Name of the value', 'Description of the value', 'Other written context', 'Visualization of the value', 'None of the above', and 'Other'. 'None of the above' refers to the five options that are given before the 'none of the above option'. If this option is selected, it means that the participants indicates that none of the five elements apply to that question. The 'other' option includes a text field where the participant could fill in their 'other' answer. The questions that were asked where this:

1. Which elements do you see in the image?
2. Which elements that are contain in the image contribute to your understanding of the value?
3. Which elements are missing that could contribute to a better understanding of the value?
4. Which elements do not contribute to your understanding of the value and could thus be omitted from the image?

3.2.2 Participants

The complete population for the products of the State of the Art and therefore this research would be any person, as everyone can be a stakeholder of a product or service (to be) created by a designer. The target population for this research is demarkated to students at a university or university of applied sciences of at least 18 years old for the ease of finding participants and to keep a narrower scope, of which conclusion can be drawn better. Students that follow a design study are preferred, as they might have already encountered the designer-stakeholder interaction in one of their projects, but this distinction will only be taken into account once the target number of one hundred participants has been reached. The survey can be filled in by anyone, but questions regarding the participant's study makes it so that students can be distinguished from non-students.

The aim was to have one hundred participants fill out the survey, but this goal was not reached. In consultation with the supervisors, it was decided that the new aim was to have thirty participants, ten for each version. The intention of these versions is explained in the next section (3.2.3).

3.2.3 Procedure

Before the research could be conducted, the procedure had to be approved by the Ethical Committee of the Faculty of Electronic Engineering, Mathematics and Computer Science (EEMCS) at the University of Twente. The research was approved and can be found under reference number 'RP 2021-233'. After this, the survey was spread mainly via email and WhatsApp, where it was also asked to spread this survey further.

The people that wanted to participate, would open the link to the google form. As can be seen in Appendix A.1, the participants were greeted with a welcome message, information regarding the content of the survey, and information regarding consent.

The next section asked for the participant's demographic information. This included the questions for age range, gender, nationality, and whether one is a student at a university or university of applied sciences. If the participant indicated that they are a student, they got two follow-up questions. The first asked whether their study included design, and the second the level of study, such as bachelor, master, or PhD.

Following this, the participants got more information regarding the survey. They were told that they would see four products that visualize human values and that each product contains several elements. Example images showed what these elements could look like. At the end of this section, a question was included that sorted the participant into one of the three versions of the survey. These versions were included to avoid bias towards any of the products, as each version shows the products in a different order. This ensures that not one particular product is always seen first by the participants,

which could lead to skewed results as one might has to get used to the questions asked or because the attention span at the start of the survey is higher than at the end. The question that was used for this was 'what is your favorite color'. Their favorite color is thus not associated with any of the research but was a means to divide the participants over three versions of the survey. An overview of the survey versions can be seen in Table 4. The columns indicate the versions, both in number, color, and over-arching value name. Each version only showed one (similar) value. The rows show the order in which the products are shown to the participants. The products are abbreviated in this table, which will also be done for the rest of this chapter. 'SC' stands for Values Deck by Studio Carreras, 'HuV' stands for HuValue, 'DNAv' is not abbreviated, and 'VF' stands for Values Finder (the subtitle for Find your Values).

Table 4 The order in which the products are shown in the three version of the survey for study 1

	Version 1 (yellow – varied life)	**Version 2 (green – creativity)**	**Version 3 (red - friendship)**
Product 1	SC (Varied life)	DNAv (Being creative)	VF (Benevolence – dependability)
Product 2	HuV (Pleasure)	VF (Self-direction of thought)	DNAv (Building friendships)
Product 3	DNAv (Seeking adventure)	SC (Creativity)	HuV (Respect for others)
Product 4	VF (Stimulation)	HuV (Personal development)	SC (True friendship)

Each version has the same setup: four products are shown, with each several questions about that product. These questions can be found in the measurements section (3.2.1). Before the questions about that product start, another question is asked first. This is an attention check question, aimed at filtering out 'not-valid' responses, such as surveys filled in by bots or by people that did not pay attention but simply filled in some random answers. These questions asked for specific information that was on the image of the product, such as "What is the number in the top left corner of the image?", and the participant could choose between three answers. None of the questions asked anything regarding color, in case any of the participants would be color blind. If a participant answered two or more of these four attention check questions wrong, that entry would be considered as not valid and excluded from the research. After the participant answered the questions for all four of the products, they were led to the final page of the survey that thanked them for their participation and included references to the products used in this survey.

3.2.4 Analysis

To analyze the survey, the data was exported into excel. Here, the data was sorted, transcribed, and analyzed. One entry was deleted because a participant indicated that they did not give consent and they answered two or more of the attention check questions wrong. Several answers given by the participants were transcribed to ensure that all answers are uniform before the start of the analysis. For the nationality question in the demographics section, all answers that indicate the same nationality were rewritten to one format. For example: the answers of "NL", "the Netherlands", "Nederlandse" were all changed to "Dutch". Regarding the question 'does your study involve design', the answers from the participants that answered "other" and wrote their own answer were all converted to a 'yes' or 'no'. These conversions were:

- my master doesn't, my bachelor's did → yes
- TCS, but I did a year of ID → yes
- Creative Technology → yes
- Computer science → no
- Philosophy of science technology and society → no
- Psychology → no

In total, three types of questions, each with their own type of data, are asked throughout this survey: the Likert scale questions, the checkbox questions, and the open answer (text) questions. Each of these has their own method of analysis.

Likert scale questions

Likert scale questions are considered to produce ordinal data with a non-normal distribution. The most used Likert scales are the 5-point and 7-point Likert scales, where the number represents the number of categories on that scale range. They are usually ranked from least to most, with the middle category being neutral, and they ask people to indicate how much they agree or disagree, approve or disapprove, or believe to be true or false (Allen & Seaman, 2007). As these scales produce ordinal and non-normal data, most researchers would argue that parametric statistics cannot be applied because this might lead to wrong conclusions. However Norman (2010) argues that this does not have to be the case, as the increased chance of an erroneous conclusion (the so-called 'robustness' of a method) was left out in this argument. In his paper he shows, using both empirical literature and his own research, that parametric statistics "can be used with Likert data, with small sample sizes, with unequal variances, and with non-normal distributions, with no fear of 'coming to the wrong conclusion'" (p. 631). He points out that parametric statistics are not restricted by sample size, but that smaller sample sizes do have other consequences such as that external validity is a concern, the distribution of the data might impact the outcome, and that they require larger effects to achieve statistical significance. External validity, however, is not an issue of statistics, but of judgement. And "require larger effects" means that it might be more difficult to prove statistical significance on a proven or disproven hypothesis, but this is not unachievable nor a reason to not use parametric tests. Regarding the distribution he points out that an important detail is usually overlooked. Where most know that textbooks teach one that "parametric tests are based on the assumption of normality", the last part of the sentence is often forgotten: "of the distribution of means". This indicates that not the data itself has to be normally distributed, but the means of that data. The Central Limit Theorem then shows that, "for sample sizes greater than 5 or 10 per groups, the means are approximately normally distributed regardless of the original distribution" (p. 628).

Taking the above into consideration, it was decided to also apply parametric statistics on the Likert scale data in addition to showing the descriptive statistics such as bar graphs. Although this is not commonly done in explorative research, it does provide additional insights. Therefore, section 3.3.3, will show various parametric tests and their outcomes, such as the means and the comparison of the means using a two-sample t-test assuming unequal variances, alongside descriptive statistics.

Checkbox questions about elements

The data from the checkbox questions will not be statistically analyzed, but rather the data will be visualized using bar graphs. By comparing these numbers with the given statement, inferences can be made regarding the elements in the products based on the researcher's own judgement.

Open questions to explain an answer

Several participants filled in the open text field where they could explain the answer they gave for a Likert scale question or a textbox question. Not all participants did this, as this was not mandatory in the survey. Therefore, this data will only be used to support, explain, or counter previously made inferences where needed or desired.

3.3 Data and Results

This section describes the data and the following results from the survey. It starts with an analysis on the answers from the students versus the non-students in section 3.3.1, to prove that they give similar answers and thus that the following analyses can be done on the full participant pool. Then an overview of the demographics of the participant is given in section 3.3.2. Following, the survey questions are analyzed in sections 3.3.3 and 3.3.4.

3.3.1 Students versus non-students

As section 3.2.2 explains, the target participants for this research are students. As the survey was also filled in by non-students, it is important to check if their answers differ significantly. If they do not differ, then the answers from the students and the non-students can be combined for the analysis.

To check this, both the Likert scale data and the checkbox data was analyzed. For both type of questions, the answers were split up in three groups, so that they can be compared to one another: all answers, only student answers, only non-student answers. Appendix A.2 explains how this was tested. The outcome is that the answers of the students and the non-students do not differ and that thus the answers from all participants can be used in the analyses performed in the subsequent sections.

3.3.2 Demographics

In total, thirty-three participants filled in the survey, with each version having at least ten entries. However, only thirty-two of those entries were valid. This resulted in one of the versions only having nine entries, which was version 1 ('varied life'/'yellow'). Table 5 gives an overview of the thirty-two participants of which the data was used in this study.

Table 5 Demographics overview of the participants from study 1

Age					
18-25		26-35		36-50	51+
25		5		1	1
Gender					
Female		Male			Prefer not to say
18		13			1
Nationality					
Dutch	German	Indian		Irish	Bangladeshi
25	3	2		1	1
Students					
University					University of Applied Sciences
21					3
Study involves design		Study does not involve design			Study does not involve design
10		11			3
Bachelor	Master	Bachelor	Master		Bachelor
5	5	5	6		3

The distribution of participants' characteristics in each of the versions are in all categories comparable to the distribution of the characteristics of the complete participant pool. Version 1 of the survey was filled in by nine participants, of which seven were students. Version 2 of the survey was filled in by thirteen participants, of which eleven were students. Version 3 of the survey was filled in by ten participants, of which six were students. The complete overview for each of the versions can be found in Appendix A.3, in Table 18, Table 19, and Table 20.

3.3.3 Likert scale questions

Per product, the participants were first asked to rate several statements by filling in a 7-point Likert scale. To analyze this data, the means are taken per product, statement, version, and in total. This can be seen in Table 6.

Table 6 Study 1 mean values from the three Likert scale questions per product and the total mean per product. Color coded per product. Red numbers indicate scores below 4 (midpoint between 1 and 7). Bolded numbers indicate the highest mean per statement.

State-ment → / Survey version ↓	DNAv - Aesthetically pleasing	DNAv -Understand meaning	DNAv -Discussing	DNAv – Total means	VF- Aesthetically pleasing	VF- Understand meaning	VF- Discussing	VF – Total means	SC - Aesthetically pleasing	SC - Understand meaning	SC - Discussing	SC – Total means	HuV - Aesthetically pleasing	HuV - Understand meaning	HuV - Discussing	HuV– Total means
Version 1	5,9	4,7	5,1	5,2	5,9	5,0	5,1	5,3	4,4	3,6	3,4	3,8	2,1	5,2	3,2	3,5
Version 2	4,8	4,1	3,2	4,0	4,8	4,4	4,1	4,4	4,2	3,5	3,5	3,7	3,4	5,7	4,3	4,5
Version 3	4,7	5,1	4,1	4,6	4,6	3,9	3,0	3,8	5,0	4,0	3,4	4,1	1,5	2,5	1,4	1,8
All	**5,1**	**4,6**	**4,0**	**4,6**	5,0	4,4	**4,0**	4,5	4,5	3,7	3,4	3,9	2,4	**4,6**	3,1	3,4

The top row indicates to which product and which statement (or total) the means belong, and are color coded per product for easy differentiating between the products. 'Total' refers to the combined means of the three statements per versions. For example, the mean of 5,2 in column 5(DNAv – Total means) row 2 (Version 1) indicates that the mean for all three statements combined from version 1 is 5,2. The statements are abbreviated. 'This image is aesthetically pleasing' has become 'aesthetically pleasing', 'This image helps me understand the meaning of the value' is 'understand meaning', and 'I would use this image as support when discussing this value with someone' is 'discussing'. The table shows the means for each of the statements per version. The last row indicated with 'all' shows the mean total from all versions combined for that particular statement. For example, the mean in column 2 (DNAv - Aesthetically pleasing) row 5 (All) indicates that the mean for all three versions of the survey combined regarding the 'aesthetically pleasing' statement for DNAv is 5,1. As such, the intersections of the 'total' columns and the 'all' rows show the overall mean from all versions and all statements regarding that product. Thus, the means of 4,6 in column 5 (DNAv – Total means) row 5 (All) is the overall mean of DNAv. All numbers below 4 are red to indicate that they scored below the mid-point of the Likert-scale. In the 'all' row, the highest score per statement or in total is bolded. If two products scored the same, they are both bolded. So, regarding the 'aesthetically pleasing' statement DNAv scored the highest, regarding the 'understand meaning' statement DNAv and HuV scored the highest, regarding the 'discussing' statement DNAv and VF scored the highest, and the highest overall score (the intersection of the 'total mean' and 'all') also belongs to DNAv.

The same information from the 'all' row from Table 6 is also visualized in a bar graph, which can be seen in Figure 4. Here the same color coding per product is used as in Table 6. Although Table 6 points toward DNAv being the unanimous best, having scored highest in on all statements, Figure 4 more clearly shows that the results of VF are not much lower, and even SC is not far behind. The odd one out is HuV, which scores very low on aesthetically pleasing but combined highest on 'understand meaning' with DNAv.

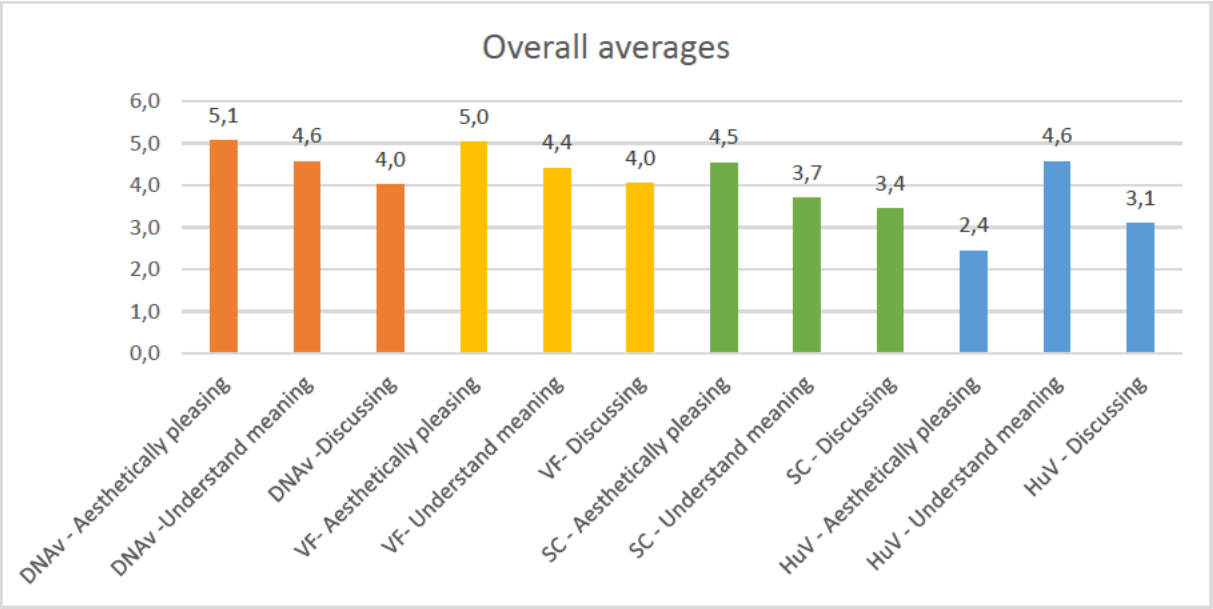


Figure 4 Study 1 bar chart of 'all' means per product and statement

To further analyze the data, these means were statistically tested. First, a one-way ANOVA was performed on the four products per statement at different alpha levels. This analysis is used to determine whether there are any statistically significant differences between three or more means. The null hypothesis of such a test is that the means are the same. Therefore, the desired result for this study is that the null hypothesis can be rejected, indicating that the means are different. The one-way ANOVA test only points out whether there is a difference or not; it does not show where this difference is. For this, a t-test is necessary.

Several levels of alpha were used to see where differences occur. A smaller alpha, also known as the significance level, means a smaller probability of making the wrong decision when the null hypothesis is true (Type 1 error). The smallest alpha level that was tested is 0.1%, which is very low as the most commonly used alpha level is 5%. The alpha levels at which the tests were performed for each of the statements in order are: 0.1%, 0.5%, 1%, 5%, 10%, 15%. 'Aesthetically pleasing' shows a difference in the means at 0.1%, or possibly even smaller. 'Understand meaning' and 'Discussing' show a difference at 10% and 15%, respectively, which is higher than the standard 5%. This means that, although the test indicates that at this percentage there is a difference in the means, there is a higher chance that this is the wrong conclusion.

After this, for each statement a two-sample t-test assuming unequal variances was performed for each possible pair of products at the alpha level at which a difference was indicated. This test indicates between which products the difference in means can be found.

For the 'aesthetically pleasing' statement, the tests show that there is a significant difference at the following pairs: DNAv-HuV, VF-HuV, and SC-HuV. This indicates that HuV is significantly less aesthetically pleasing than the other products, but the other products between themselves do not show significant differences.

For the 'understand meaning' statement, the tests show that there is a significant difference in the following pairs: DNAv-SC, VF-SC, and SC-HuV. This indicates that SC is significantly less contributing to the understanding of the meaning of the value than the other products, but the other products between themselves do not show significant differences. Though, at the 10% alpha level, there is a one in ten chance that this conclusion is wrong.

For the 'discussing' statement, the tests show that there is a significant difference at the following pairs: DNAv-HuV and VF-HuV. This indicates that HuV is significantly less considered for use in

a discussion compared to DNAv and VF, but not significantly less with SC. The other products between themselves do not show significant differences. Though, at the 15% alpha level, there is an increased chance that this conclusion is wrong.

The written explanations from the participants regarding this part of the survey offer some additional insight. Table 7 shows per product and statement one or two of the most insightful written explanations, according to the researcher's judgement. What can be learned from this is that the participants like a balance between enough information and context without the image or text becoming too busy or too much. They also like a product that looks nice, otherwise they might not use it.

Table 7 Study 1 several written explanations from participants for the Likert scale statements per product

	Aesthetically pleasing	**Understand meaning**	**Discuss**
DNAv	Whilst I don't see it as the greatest artwork ever made, it could be a postcard/poster image I wouldn't necessarily mind hanging in a space where I spend time. I would (if I were to hang this up) possibly (want to) remove the purple bar at the top, as it , to me, doesn't seem to add to the image	It immediately gives an example of what being creative might entail. However, I believe it might mislead the viewer, as there are more ways of being creative than writing and drawing.	Clear image to show for conveying a general impression. I could, for instance see this on a slide pulled up to prompt a discussion or as a background to accompany a discussion and if useful occasionally refer to illustrate points
VF	I like the art, the text looks a bit boring and smaller that necessary followed by awkward white space on the bottom right	Had to read all the text to understand the value The description is quite clear and the impression of the artwork compliments the text nicely	Love the image, the value group is just not clear to me I would use a "calmer" image, like clip art or a 3d rendered image
SC	It's a relatively simple and clean image, which therefore makes it easier to process and is quite nice to see.	Just the image by itself won't work. Could be representing support or dependability or unity. It doesn't really show me much about the value	I think there are better images to represent the same value There might be a case where this could be brought up in a discussion, but I don't think this would be a 'go-to' resource for me when discussing varied-ness of lives (as a value or otherwise)
HuV	The design is just awful. The colour choice is definitely a choice, so to speak. The photoshopping job is outdated and there's too much information. Both visually, and textually. The collage part is very busy whereas the bottom part has a lot of white space, which feels a bit unbalanced. It's alright for an info-graphic kind of thing, I wouldn't frame it and hang it on my wall. The icon/diagram next to the title looks cool.	The icon and the pictures in the collage give a varied impression of examples in which one might see/recognize values of the value group - having (visual) examples is nice because that makes it possible to connect the value group as a concept to practical examples and non-abstract experiences	The image would support the discussion which is why it would be useful, but I'm sure I could find a more visually pleasing image by Googling it. Examples abstracted from the image are useful for illustrating arguments and such in a discussion; description is concise -> easy to share in a discussion and then for instance discuss from different angles/interpretations or contrast to different definitions; the more values/related words list could be a source of inspiration for ways a discussion could branch off to.

3.3.4 Elements questions

After the Likert scale statements, the participants were asked to check the boxes of the elements that answer the question in their opinion. The questions and their options are explained in the

measurements section of this chapter (section 3.2.1). For ease of reference, the questions are abbreviated, which can be seen below in the square brackets.

1. Which elements do you see in the image? [present]
2. Which elements that are contain in the image contribute to your understanding of the value? [contributing]
3. Which elements are missing that could contribute to a better understanding of the value? [missing]
4. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? [omit]

An important note about the data is that it is not always consistent. For example, one participant answered that a certain element was not present in the product (question 1) but then afterwards indicated that this same element did contribute to their understanding (question 2), or that an element does contribute to their understanding (question 2) but also that it should be omitted because it does not contribute to their understanding (question 4). This analysis assumes that the participants 'filled it in correctly', meaning the data is taken at face value and the discrepancies in the data are ignored. If this is not done in any part of the analysis, this is mentioned. Which elements the researcher deemed to be present per product can be found at the start of this chapter in Table 2.

Below several charts are presented, showing the number of times an element has been selected per product by the participants to be present/contributing/missing/omit. The three different versions of the survey were combined for this, which means that each product has been seen by thirty-two participant. This can be done because all cards within one product contain the same elements, and thus the same elements are reviewed per product regardless of the version.

DNAv

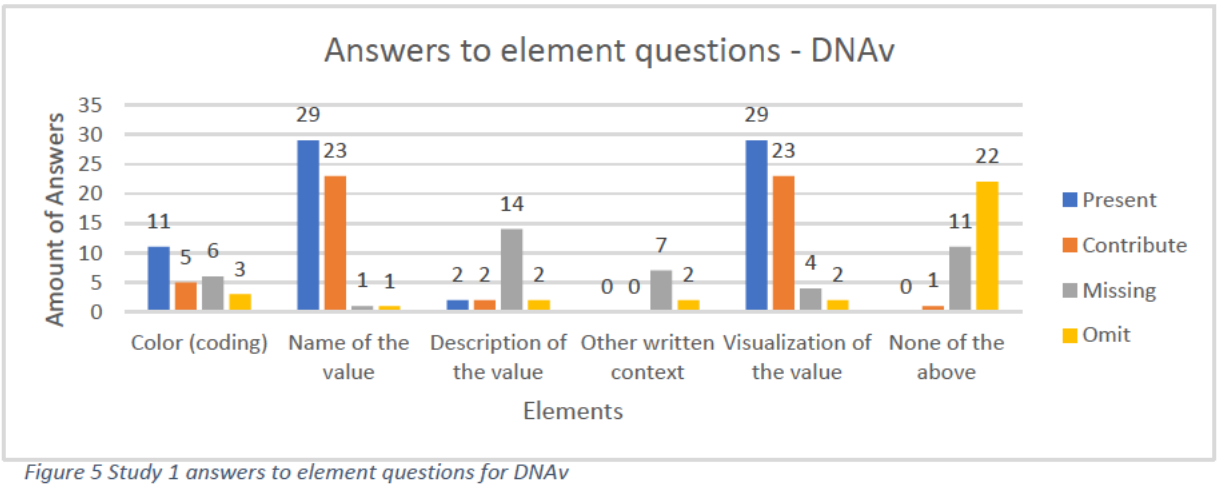


Figure 5 Study 1 answers to element questions for DNAv

Figure 5 shows the outcome of the element questions for DNAv. What can be seen in this is that the most present elements are 'name of the value' and 'visualization of the value', as expected. These elements are also the most contributing, both about 80% of the time. This percentage is calculated by considering that the element can only contribute when it is present. For example, with the name of the value this will be: 23/29*100% = 79,3%. Almost half of the participants indicated that they miss a description of the value, and about 20% of the participants missed other written context. Several written explanations:

- [missing] Having a description available would perhaps give some more context for the interpretation and understanding of the value, but I fear it would probably detract from the

aesthetic value and my interest to reflect on how I see the value the image prompts me to think about

- [missing] A description or other written context that explains what "being creative" is or gives a list of examples on how to be creative, might show that there are a lot of ways on how to be creative.
- [omit] I think the image could be better

VF

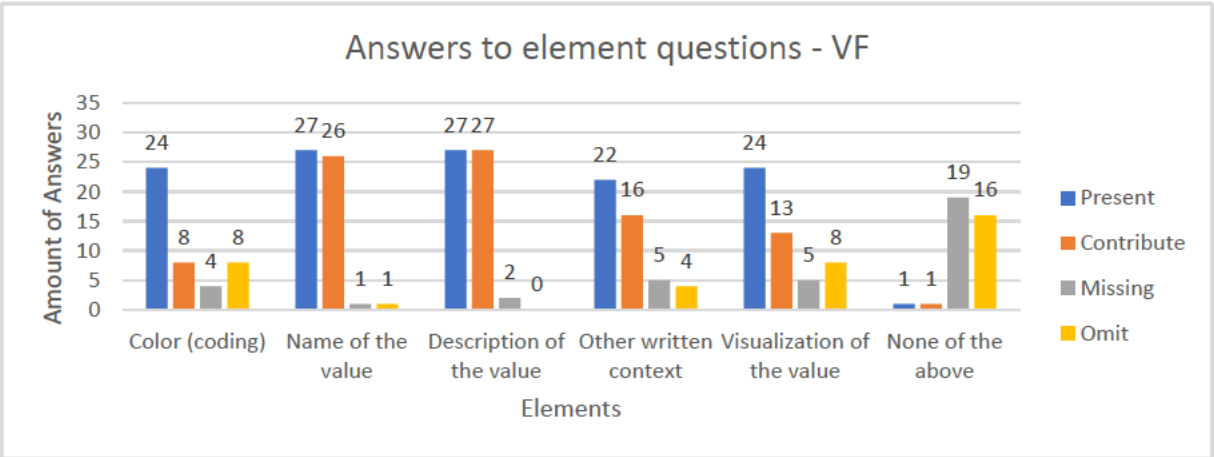


Figure 6 Study 1 answers to element questions for VF

From Figure 6 it can be learned that for VF the 'name of the value' and the 'description of the value' are the most present and most contributing elements, scoring 96% and 100% respectively. This is again calculated by considering that an element can only be contributing if it is present. 'Other written context' was found to be present by a large number of participants, of which most also found this to be contributing to their understanding. The 'visualization of the value' was also noticed a lot, but only about half of those participants found it to be contributing to their understanding, and eight participants pointed out that this could be omitted. Several written explanations:

- [present, benevolence-dependability] If I remember correctly blue is a trustworthy colour which would make sense for the value benevolence. Though I (as a gamer) would probably have made it green. There is quite a lot of written text
- [present] I could not tell you the text shown without looking at the actual image. The picture is way more powerful compared to the text.
- [contribute] The visualisation is too chaotic to help
- [missing] A different, more subtle visualisation.

SC

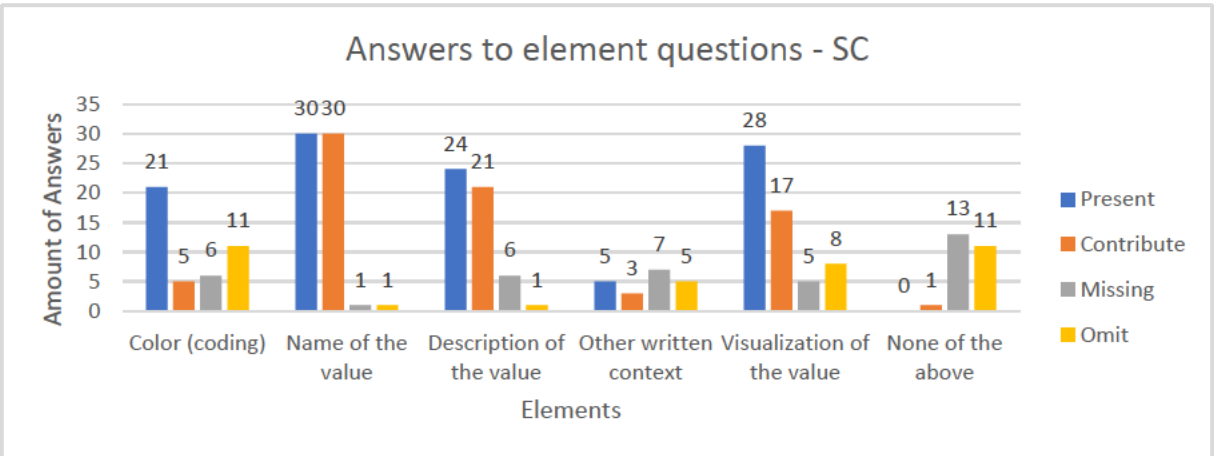


Figure 7 Study 1 answers to element questions for SC

Figure 7 tells us that the most present elements in SC are 'name of the value' and 'visualization of the value', followed by 'description of the value'. This might indicate that people found it difficult to distinguish the value name from the description. 'Name of the value' and 'description of the value' are the most contributing elements. The 'visualization of the value' was only found to be contributing to the understanding of the value 61% of the time it was recognized to be present. Several written explanations:

- [present, creativity] The colour yellow seems to infer creativity, everything else is quite visibly present in the image.
- [present, a varied life] I think the red colour may be used to appeal to more sentimental topics (and with that the value); the name and extension (description) of the value are also included; lastly, there is an image that somewhat relates to the value
- [contribute] I thought the explanation in text was much clearer and more helpful than the visualization
- [missing] point 'description' - there is a description present but a more elaborate description could maybe help me get a better understanding than what can be inferred from the very short text
- [missing] I think a better visualization of the value should be included instead of the current one

HuV

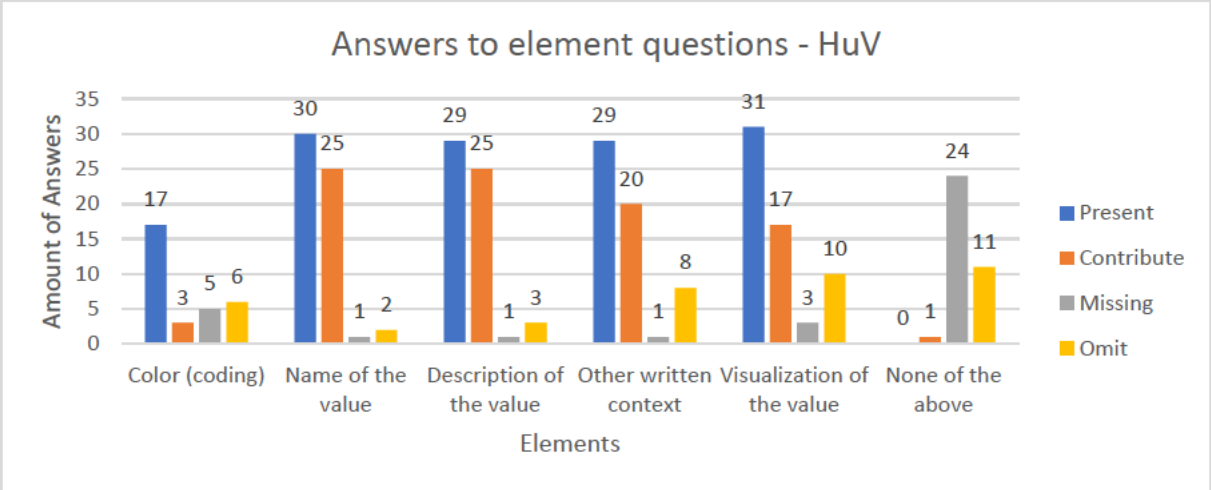


Figure 8 Study 1 answers to element questions for HuV

In HuV, almost all elements were spotted by the participants, as can be seen in Figure 8. The most contributing of those elements, in relation to if they are found to be present, are the 'name of the value' and 'description of the value', followed by 'other written context' and 'visualization of the value'. Only about half of the participants found the visualization to be contributing to their understanding of the value, and ten participants would omit this from the product. Also 'other written context' has several participants that indicate that this could be omitted, but the majority indicates that it does add value. Several written explanations:

- [present] My mind is bombed by just all the images and the atrocious colour choice and outdated design that I just can't remember the subtext. I had to scroll back several times, and I still can't remember what it's trying to tell me.
- [contribute] As in previous images, the visualizations are mostly just very distracting without adding much context.
- [missing] There's nothing missing here, there's too much information already.

- [omit, pleasure] There's more than enough information on this topic without it, it only confuses me. And the words mentioned make me feel like it's an 18+ scam add at the side of your unpaid mailbox subscription.
- [omit] The visualization does not show all things in the written context, and is distracting.

Per element

Further insights can be gained by studying the elements separately from the products. As each participant answered questions to four products, an element could get 128 acknowledgements in total. Figure 9 shows an overview of this.

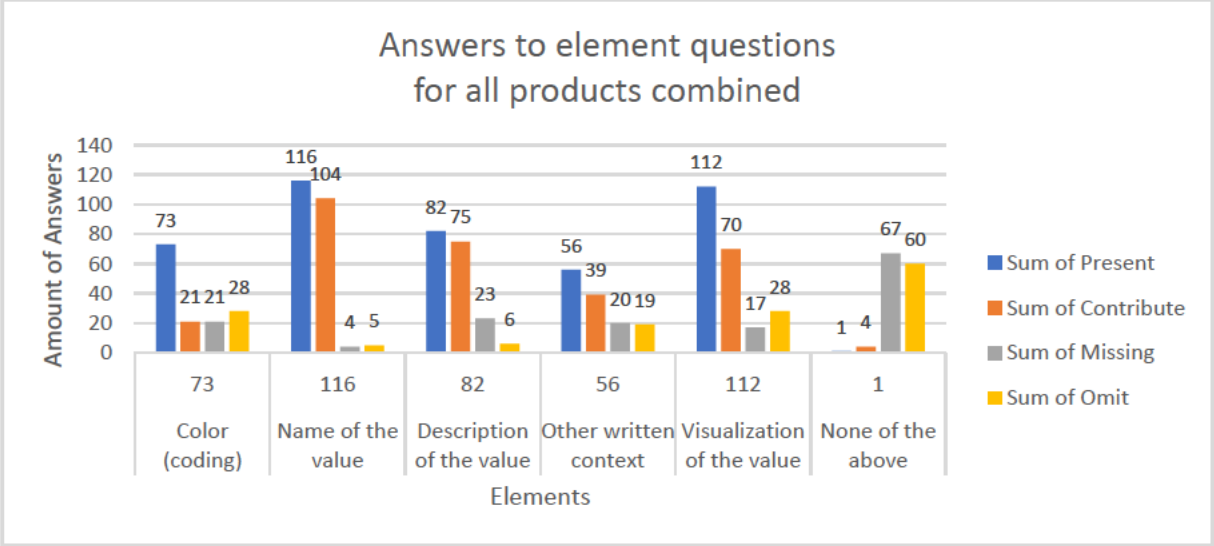


Figure 9 Study 1 answers to element questions for all products combined

What can be learned from this is that the most present elements are 'name of the value' and 'visualization of the value'. The most contributing elements (contributing as percentage of present) are 'name of the value' (90%) and 'description of the value' (91%), followed by 'other written context' (70%). The visualization contributes about 63% of the time. The most missed element is the 'description of the value', which was pointed out 23 times. The participants find that the 'visualization of the value' and 'other written context' could be omitted in some cases, but for both there are more participants that indicate that these elements are contributing to their understanding.

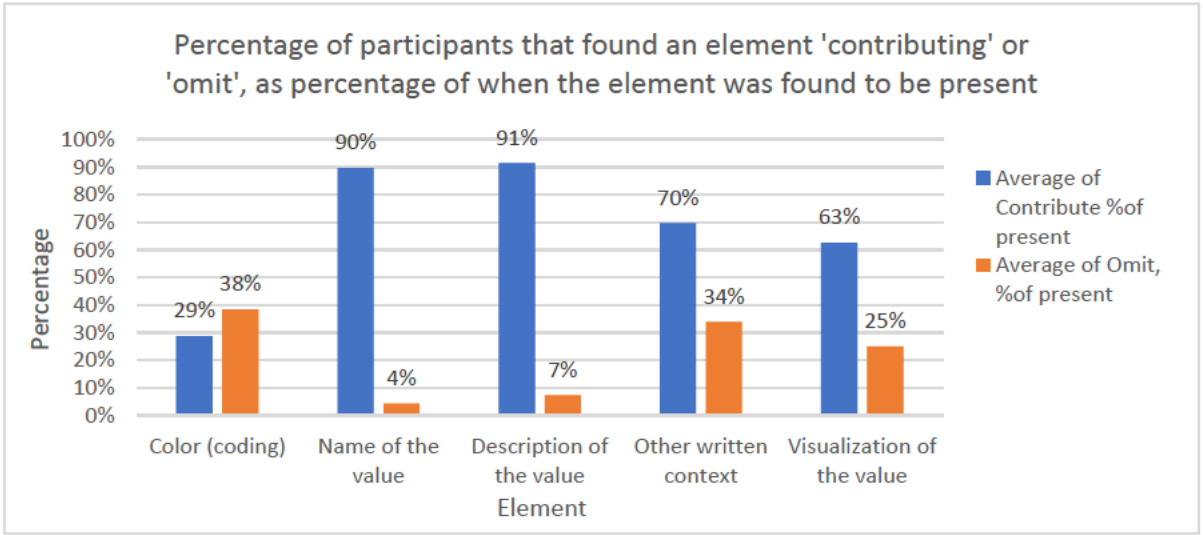


Figure 10 Study 1 percentage of participants that found an element to be contributing or that it should be omitted, as percentage of when the element was found to be present

Figure 10 focuses on the 'contributing' and 'omit' elements. The numbers in this chart are calculated based on the number of people that found an element present in the product. For instance: if 116 participants found the element "name of the value" present in the products and 104 participants found this contributing to their understanding of the value, then the percentage is 104/116*100% = 90%. Both 'name of the value' and 'description of the value' score high on this analysis, with more than 90% of the participants that found these elements to be present expressing that these elements contribute to their understanding. Also, the 'visualization of the value' and the 'other written context' score relatively high, with 63% and 70%, respectively. However, for both those elements there is a considerable number of participants that signal that these elements could be omitted.

3.4 Conclusion and Discussion

The two sub sections below will conclude and discuss the results from study 1. The conclusion summarizes the chapter and answers the sub research question related to this study. The discussion will discuss discus this conclusion and describe the future works that arise from this.

3.4.1 Conclusion

This study focused on answering the first sub research question: 'Which elements of the visualization of values from the state of the art of the preliminary research contribute to the understanding of values?'. For this, various products from the state of the art with diverse characteristics (imagery type, number and type of elements, and type of value) were analyzed by means of a survey. The thirty-two entries are from a diverse pool of participants, but the pool was skewed in the age and nationality aspect: the majority of the participants were between eighteen and twenty-five years old, and most of the participants were Dutch. The demographics per version of the survey was also skewed, but each was skewed in approximately the same way as the overall demographics.

At first glance, the means from the Likert scale statements indicate that the products DNAv and VF are preferred over HuV and SC. The subsequent statistics confirm that HuV is significantly less aesthetically pleasing than the other products. The statistics also show that SC contributes less to the understanding of the value, but this is at an alpha level of 10%, which is higher than the usual 5% at which tests are performed. The participants also indicated that they would consider HuV less as support when discussing a value with someone, compared to DNAv and VF, at an alpha level of 15%. Via the written explanations the participants expressed that they like the good and clear image of DNAv, but the image does not always encompass all the aspects of the value. Most liked the art used in VF, but there were a few that found it too busy. They found the written text to be clear, but its layout compared to the image made the text less interesting. For SC, the participants noted that they like the clean and simple image, but that it does not support the understanding of the value and that the image itself does not always represent the value well. Many participants found HuV to be too busy and even ugly, which was said mainly about the image itself but also about the product as a whole because the image was too distracting from the text. The text itself was good and the more value/related words list (other written context) was described by one participant as "could be a source of inspiration for ways a discussion could branch off to". So, it can be concluded from this part of the survey that the solution should have enough elements that together can convey the information about the value that is needed and that the image should be balanced, both in itself (the image itself should not be too bland or too busy) but also in coherence with the text such that one does not overpower the other.

From the element questions it can be concluded that the most important elements are the 'name of the value' and the 'description of the value', but that the 'other written context' and the 'visualization of the value' can contribute to the understanding of the value as well, but more notes were made about that this should be done right. For example, the image should encompass all aspects

of the value and not just parts of it. An overall comment made here as well is that balance is important. For example, with SC it was mentioned that the description was missing. However, the description is present, which indicates that the font difference between the name and the description was not distinct enough. Also, with VF it was mentioned that the balance in size between the image and the text should be better, as the image was too large and too busy compared to the text. The participants in general liked it if the product was relatively simple, such as DNAv and SC, but this could also lead to not enough information being provided, such as the limited description in SC.

Overall, it can thus be concluded that at least the "name of the value" and the "description of the value" should be included. If done right, "visualization of the value" and "other written context" can also greatly contribute. The image needs to accurately portray the value and the other written context should complement the description by, for example, giving examples or giving synonyms for the value. Balance is the key word for the design of such cards: balance between text and image (size and busyness), but also balance within the image (it should portray enough information without being overwhelming). Image styles such as photos or digital illustrations allow for a better depiction of the value, since it can contain more information that a simple icon. On the other hand, many participants also appreciate the simplicity of SC, because a simple and clean image is "easier to process and is quite nice to see". When too much information is put together, such as in HuV, this becomes overwhelming and 'ugly'. Therefore, a middle ground will have to be found between an icon and a photograph or very detailed digital illustration to create a balanced image.

3.4.2 Discussion

There are several points regarding this research that should be taken into account when drawing the above-mentioned conclusions.

Limitations of the method

With this survey, only three values/value groups and four products were tested. Depending on the value list that is considered, there are roughly 5-10 value groups and 10-56 individual values. The state of the art identified 10 products, but there are likely more (similar) products that could also be considered in a research such as this. Thus, only a small selection of the full range was tested.

As the products do not all use the same value list, the researcher had to indicate similar values based on her own judgement. Her own judgement was also used to detect and attribute the four visualization (imagery) styles to the product and the elements present in the products.

A Likert scale is an easy way for people to indicate their opinion towards a given statement, but it is not the best and easiest method to analyze. Additionally, it should be taken into account that not all people treat the scale the same way. Some people shy away from attributing the extremes to a statement while others are more likely to answer only in extremes (see for example Berg & Collier, 1953; Borgatta & Glass, 1961; Crandall, 1973; Eid & Rauber, 2012; Hui & Triandis, 1989; Light, Zax, & Gardiner, 1965).

The survey was not designed with colorblindness in mind, although the attention check questions that were used were specifically chosen in such a way that the participants never had to answer questions regarding colors, such as 'what is the background color of this image'. Also, the demographics section of the survey did not ask the participant about this. So, it could be the case that some participants were colorblind, which could affect the results, as they might not have been able to view (part of) the elements in a product correctly. On the other hand, as these products were not designed by the researcher, the responsibility of accounting for colorblindness lies with the respective designers and not the researcher.

Although color (coding), as element, was not analyzed, this was included in the survey as an option for the elements' questions. This element was also less explained to the participant at the start

of the survey, so this could have confused the participant. Nonetheless, it is expected that this did not have an influence on the results of the other questions and therefore the conclusion.

The participants only filled in one of the three versions of the survey, which was done to avoid bias in favor or against any of the products because the versions changed the order in which the products were shown. As the demographics between the survey versions differ slightly, this could create skewed results between the versions. Some of the written explanations were also only specific to the image or other element used in that version. Still, most conclusion were drawn based on the complete set of answers as to mitigate this issue.

Discussion of the results

The actual population of these products and the solution is all people, as anyone could be either a stakeholder or a designer in a design process. This study however focused on students, preferably with a design aspect in their study, as the target population. This means that not the real population was tested, and these conclusions only apply to this demographic. About two-third of the participant is a student, of which the majority studies at a university, but it was tested and concluded that the answers from the students and the non-students do not differ. Still, not the full population was tested, and the sample size was fairly small with 32 participants. Additionally, the characteristics of the participants were diverse but not evenly distributed. For example, mainly 18-25 year old people filled in this survey and the participants were predominantly Dutch. Both of these can lead to skewed results. Also, there is great possibility that not all minority groups are fully represented, not just compared to the actual population, but also within the target population of the students.

The distribution of the number of participants among the versions was not completely equal (thirteen versus ten versus nine). Also the demographics within those groups was not distributed evenly (see above).

Although it was tested that the answers from the non-students do not significantly differ from those of the students, this was tested on a small population (24 students versus 8 non-students). Also, as these groups were not equal, the values for each group had to be adjusted so they could weigh the same in the analysis (Appendix A.2). Both of these practices are not highly reliable when it comes to statistical significance.

For two of the statements the level of significance (alpha) at which differences were identified was higher than is commonly accepted. The most commonly used and accepted alpha level is 5%, whereas the ‘understand meaning’ was tested at an alpha level of 10% and ‘discussing’ at 15%. Both are above this 5% level, which not only indicates that the chance of drawing the wrong conclusion is higher, but this is also commonly not used and accepted in research.

The Likert scale part of the survey is subject to interpretation. Only the extremes on this scale were given a name. These names are subject to interpretation of the participant. Additionally, the middle values (two through six) were not given a name. This leaves these points on the Likert scale even more open for interpretation.

Some of the answers from several participants to the elements section did not add up. As explained in section 3.3.4, some participants, for example, indicated that an element was not present but did contribute to their understanding, or that an element contributes to their understanding but should also be omitted because it does not contribute to their understanding, and so on. For the analysis the data was taken at face value, but as these errors in the data exist, it could be that the wrong conclusions are drawn.

For the whole survey, there is a chance of social desirability bias, meaning that participants might have answered in such a manner that they think pleases the researcher. As the survey only tests existing products and not something created by the researcher, there is low chance that this happened.

Lastly, not all participants explained their answers to the questions. Approximately between a third and half of the participants sometimes gave their explanations, but most did not do this consistently for all questions. Therefore, the given explanations might not be truly reflective of all the participants, although it was attempted by the researcher to give a wide variety of answers to the questions to show the diversity of the answers.

Future work

There are several actions that can be taken in the future to improve or expand the research as done in study 1.

This survey tested only four of the ten identified state of the art products. Although these tested products were very diverse in their characteristics, it would be interesting to also analyze the other products to see if the outcome remains the same. They can also be tested to gather additional insights especially through the written explanations. Furthermore, there are most likely more products that can be considered for the state of the art, and these should be identified to get a more complete overview.

This study did not account for any colorblind participants. While it was ensured that the attention check questions never asked anything regarding the colors in the images so that they would not answer these question wrong due to their colorblindness, there could possibly have been participants that are colorblind that filled in the survey. However, since this is not asked about and because they are not excluded from the survey, it is unknown whether this was the case and how this could have influenced their answers. In the future it, they should not be excluded from the research as they are part of the stakeholders, but it is suggested that future research asks about this trait to see if and how this has an effect on the answers.

Although it was not further analyzed or used in the following studies, some products make use of color coding, for example to classify individual values that belong to the same value group. Usually such color coding also makes use of the associations people have with that color, but since the color association with human values is not yet researched, this cannot yet be applied to value visualizations. Accordingly, this must be researched to identify which colors are association with which values, such that this can be used in any future designs.

Lastly, it is recommended to also perform quantitative tests in the future to confirm whether this gathered (explorative) data is true for the complete population. This also means that such tests should be performed with a better representation of the population, instead of mainly (Dutch) students. To improve these future tests even more, it would be better if future research asks for the explanations from all participants instead of having this as an optional question as was done in this study. When such a question is optional, it usually results in only a few participants giving their explanations consistently, thus providing a skewed view. If it is not possible or reasonable to ask all participants to explain their answer, then it important to take into account that the explanations might give a skewed view, like done in this study.

4. Study 2: Creation of the Illustrations

Chapter 4 focusses on the creation and the testing of the illustrations for the solution, as to answer the second sub research question:

> *How can human values be visualized in such a way that designers and stakeholders can identify or recognize them so that it creates a set of validated visualizations?*

The chapter starts with pointing out the requirements that should be adhered to regarding the value visualizations in section 4.1. These are the requirements identified in the literature research, as well as the requirements that have arisen from study 1, and other requirements for the design. This is followed by a description process the creation process and its outcome in section 4.2. As part of this process, three sets of illustrations are created that differ in the amount of detail they contain. The level of detail ranges between the very abstract 'icon' and the very detailed 'photograph' or 'elaborate digital illustration'. After this, these illustrations are tested among design experts, of which the method and results are shown in sections 4.3 and 4.4, respectively. The chapter is closed in section 4.5 with a conclusion and discussion.

4.1 Requirements

The literature research has identified several requirements that apply to the creation of the illustrations for the solution. First, the values that are to be included in the solution, and thus also the illustrations thereof, should be of individual values as opposed to value groups. Secondly, although a value list is not per se desired, the value lists of Schwartz can be used as inspiration as this is the most used list among the state of the art products and helps give a starting point for choosing the values and their names. Thirdly, these created illustrations should be tested separately from the full product to make sure that the illustrations support the written information and thus are valid illustrations. Lastly, as the solution is to be in a digital format and will be in card-like format, the illustrations should be created in such a way that they fit this requirement.

Study 1 identified additional requirements from its survey. First off, the written information and the imagery used need to portray the value accurately. Several participants of the first study indicated that some of the state of the art products did this did not happen in their opinion. The most given argument is that the image does not full cover all the aspects given as written information, such as all the synonyms or other key words given. This was mostly the case with the products that portrayed value groups, but also some individual values were not depicted fully. Therefore, this study should ensure that the portrayal of the values chosen is accurate. This will be done by selecting a value description and other written context that complement the value name, by focusing on the question that inquires about the contribution to the understanding of the value, and by analyzing the explanations given by the participants in the survey to see if there is any indication that this requirement was not met. The second requirement that can be extracted from the first study is that there should be balance in the solution. Balance between text and image (size and busyness), but also balance within the image (it should portray enough information without being overwhelming). The consequence of that for this study is that the illustration should be the happy medium between icons, which are liked for their simplicity but do not convey enough information, and elaborate (detailed) digital illustrations or photos, which could become too busy. This will be done by defining several levels of detail between these two and creating the illustrations according to these levels. Subsequently, these created illustrations will be tested to see which level of detail is most preferred.

Other requirements for this study are the following. First, to be able to test the created solution in the next study against some state of the art products, an overlap of similar values has to be found. The values for the solution will be based on the values that are found in the overlap. It is preferred that at least three values across three state of the art products are found in order to have enough products and values to compare the solution against. Secondly, it was decided to exclude several state of the art products in the search of overlapping (similar) values as these products either contain characteristics, especially regarding their imagery, that were proven in study 1 to not be preferred or because the product does not contain imagery of the value, which is the aim of this thesis (creating value visualizations including imagery). 'Discover your values: the deck' is not included because it does not use a visualization. 'HuValue (version 1)' is not included because it also does not have imagery of the value but only of the value group of which this individual value is a part of, and only on the backside of the card. 'HuValue (version 2)' is not included as study 1 already indicated that this is not a good visualization. As such, it is expected that this products will score low in the next study and is therefore not a good candidate for comparing the solution against. Lastly, the levels of detail between icons and elaborate (detailed) digital illustrations, to which the imagery of the solution must adhere to, are to be defined with the characteristics of each level. This can contain information such as the type and number of colors that are to be used, the detailed in lines, and the background. Which characteristics are to be defined will be determined with the help of design experts. Defining the characteristics of each level of detail not only ensures that the images within that level of detail are more likely to be similar in style, but also will help answer the main research question of this thesis and any future research in this field by providing guidelines to which the imagery in value visualizations should adhere to.

4.2 Creation

This part of the chapter will show how the illustrations were created. However, before the illustrations could be created, a few things have to be established. First, as mentioned above, an overlap of several similar values between at least three of the state of the art products has to be found. Next, from those similar values, the value name, value description, and other written context for the solution need to be established. The chosen value name, description and other written context determines which values will be illustrated. This can be found in section 4.2.1. Subsequently, the levels of detail for the illustrations are defined in section 4.2.2. By combining the gathered information regarding the values (section 4.2.1) with the defined levels of detail (section 4.2.2), the illustrations for the solution can be created. This is shown in section 4.2.3.

4.2.1 Chosen values

The products from the state of the art, except for 'Discover your values: the deck' and 'HuValue', were compared to find similar values. Four products were found with five similar values. Of these four products, two make use of the value list from Schwartz and two do not, and two do have the element of 'other written context' and two do not. To determine whether values between products were similar, both the value name and value description were used to compare the values. These four products and their characteristics can be found in Table 8. This table also shows the characteristics that are intended for the solution in the last column. As can be seen, the visualization style will be a digital illustration, as this is the middle ground between an icon and an elaborate digital illustration or photograph. The visualizations for the solution will include the 'other written context' element and show individual values.

Table 8 Products, their characteristics, and the human values per product for studies 2 and 3

Product name → /Characteristics ↓	Find your Values	Values deck, by Studio Carreras	BBC digital wellbeing cards	Design for Happiness	Own Creation
Abbreviation	VF	SC	BBC	DfH	Harms
Visualization style	Digital illustration	Icon	Icon/digital illustration	Digital illustration	Digital illustration
Value list	Schwartz	Schwartz	-	-	Own, based on Schwartz
Value type	Group	Individual	Unknown	Individual	Individual
Other Written Context element present?	Yes	No	No	Yes	Yes
Values	Benevolence - dependability	True Friendship	Connecting with others	Honesty	Friendship
	Self-direction of thought	Curious	Exploring the world	Curiosity	Curiosity
	Achievement	Successful	Achieving goals	Mastery	Achievement
	Personal security	Sense of belonging	Belonging to a group	Belonging	Belonging
	Societal security	Family security	Having stability	Safety	Security

Since the solution is a new product, a decision had to be made regarding which value list or value names to use. Although there is not one established universal value list that is used throughout the design domain, many products make use of the list from Schwartz (1992). However, it was chosen to not completely copy these values as there is no proof that this list is better than the other available list (which can be seen in the research from Kheirandish (2018)) and to avoid that the solution would look too similar to the state of the art products. Instead, the researcher looked at the four products to which the solution will be compared and examined what the overarching theme was within the similar values. Based on this overarching theme, a one-word value name was decided upon for each of the values aiming to reflect the core of each value.

Table 9 Chosen human value names, descriptions, and synonyms for the solution

Value name	Description	Synonyms (other written context)
Friendship	[n] The emotions or conduct of friends; the state of being friends.	relationship, friendly relationship, close relationship, attachment, mutual attachment, alliance, association, close association, bond, tie, link, union
Curiosity	[n] A strong desire to know or learn something.	inquisitiveness, interest, spirit of inquiry
Achievement	[v] Successfully bring about or reach (a desired objective or result) by effort, skill, or courage	accomplishment, attainment, feat, performance, undertaking, act, action, deed, effort, exploit, manoeuvre, operation, enterprise
Belonging	[v] Be a member of (a particular group or organization)	affiliation, acceptance, association, attachment, connection, union, integration, closeness
Security	[n] The state of being free from danger or threat.	safety, freedom from danger, protection, safe keeping, shielding, guarding, care

Table 9 gives the further information for the values used in the solution by displaying the value description and the synonyms. Since synonyms were praised by several participants of study 1 to be supportive, the other written context that will be included in the solution is synonyms. The Lexico

dictionary from Oxford Languages[11,12] is used for both the description and the synonyms. By using a dictionary, it is ensured that this information comes from a validated source, which means that the validity does not to be tested further and that the description and the synonyms are correct. Additionally, using the dictionary information instead of value descriptions or other written context from the state of the art products, such as those from the products that make use of the value list from Schwartz, helps to further distinguish the solution from the state of the art products. For each value, one could either use the definition from the verb or the noun. Both of the options were checked by the researcher to see which description would fit the value best in her opinion, and the choice for either the noun '[n]' or the verb '[v]' is reflected in Table 9. The synonyms for each of the values are based on the noun version. If the dictionary provided multiple lists of synonyms, only the first list was chosen so that the list of synonyms did not become too long.

4.2.2 Image characteristics

As mentioned previously in this chapter, three types of illustrations will be created, which differ on the level of detail they contain. This ranges between the icon with very limitedly detailed and the highly detailed elaborate digital illustration or photograph. So, in total five levels of detail will be established and described. Of this, level one and five are the icon and the elaborate digital illustration or photograph, respectively. The levels in in between (two, three, and four) range between these two ends on the detail scale and are the levels at which the illustrations for the solution will be created. By defining the levels of detail, a method is established for creating the illustrations.

To define the levels of detail, several characteristics for the illustrations need to be described. With the help of a design expert it was decided that the colors, line details, facial details, and the background should be characterized, and they also helped the researcher determine what these should contain for each of the levels.

The characteristics regarding color was split up in multiple dimensions. First, the number of colors used in the illustration must be established. The lower the level of detail is (towards the icon level), the fewer colors it should contain. Secondly, the type of color must be defined. This is done by describing the flatness of the colors, which refers to whether colors are solid, uninterrupted, and completely uniform, which is flat, or whether they contain textures, gradients, etcetera. Sometimes an extra description is added to further elaborate the type of color used. Following this, the tonal range of the colors needs to be specified. The tonal range refers to the number of shades between the lightest and darkest areas of an image. For example, if only black and white are used in an image, there is a low (or no) tonal range as there are no shades between the darkest and the lights shades. If there are a large amount of shades of grey between these two, than this is considered a high tonal range. Lastly, for each level of detail it needs to be determined whether there are shadows (and highlights) included in the image. Shadows and highlights give a sense of depth to an image, which can make it feel more three-dimensional.

The line details are explained by describing the shape of the lines and how many lines will be included in the illustration. Lines can be straight or curvy, and an image can contain both. The ratio between the two will determine how realistic (photograph-like) or fictional (icon-like) the illustration will look like. More lines in an illustration allow for more details to be present while fewer lines limit the amount of details.

If a background (non-white) is included in an illustration, this will provide more context to the depicted scene. This is commonly found in highly detailed images such as photographs and elaborate

[11] https://www.lexico.com/, accessed in April of 2022

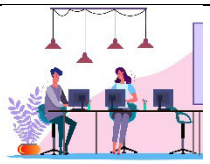
[12] Nowadays, the Lexico dictionary does not exist anymore, but instead redirects the visitor of the website to its original operator, dictionary.com, where the content and the layout is different.

digital illustrations, while simple imagery commonly refrains from this and instead only include the object of interest.

The characteristics of 'facial details' expresses whether the people in the image contain facial features, such as eyes, nose, and mouth. Facial features can contribute to conveying important information, such as the emotions of the person. However, they can also be a distraction as faces generally are highly detailed parts of an image.

Below in Table 10, the levels of detail are defined along these characteristics.

Table 10 Levels of detail for the illustrations defined

Level	**1**	**2**	**3**	**4**	**5**
Create	No	Create and test	Create and test	Create and test	No
Example images	 13	 14 (but fewer colors)	 15	 16	 17
Amount of colors	2	3-5	5-10	10-30	Infinite
Flatness of color	Flat, no textures and patterns	Flat but saturated colors, no textures and patterns	Flat but saturated colors, no textures and patterns	Textures and paterns, gradients	Not flat, all possible options
Tonal range	No/low	Limited	Medium	Large	Unlimited
Shadows	No	No	No	Yes	Yes
Line details	No line details (only shapes)	Mostly straight lines, limited and simple curves. (Black) outline to distinguish shapes (more icon like)	Curves and straight lines	Curves and straight lines, highly detailed	All details
Background	No	No	No	Yes	Yes
Facial details	No	No	Yes	Yes	Yes
Methods of simplification used	Simplifying the geometry, Rendering external outlines	Simplifying the geometry, flattening almost to the extend of rendering external outlines	Simplifying the geometry, flattening	Simplifying the geometry but very minimal	None

One other item is included in Table 10, namely the 'methods of simplification used'. The design expert recommended that the illustrations are to be created by working from the most detailed illustration to the least detailed illustration (from level five to level one). This means that the illustrations will be simplified throughout this process. Hsu and Wang (2018) explain several methods for simplifying images. The simplification methods they describe are extractions of the complete form, which are suitable for the illustrations of the solution because they should be used on "objects at the basic level of categorization, such as dogs, cows, and even people, whose silhouettes are easily distinguishable from each other" (p. 19). Each of these methods simplify a form in a different way and thus has a different outcome. The first method described by them is 'Rendering external outlines', where "all one

[13] https://thenounproject.com/

[14] https://www.dreamstime.com/happy-family-colorful-vector-icon-cartoon-style-happy-family-colorful-vector-icon-cartoon-style-group-smiling-people-image136687865

[15] https://i.pinimg.com/originals/67/fd/97/67fd976cb00eba14ab64c77b17e11fa8.jpg

[16] https://www.freepik.com/free-vector/corporate-discussion-illustration-set_6161207.htm

[17] https://www.elle.com/uk/life-and-culture/a32880043/six-people-social-bubble-lockdown/

has to do is to directly render an outline of the subject" (p. 20). For this, it is important to select the angle of the object which is most used and thus most recognizable. This method is not suitable for objects with a similar shape or a non-unique shape, such as a soccer ball and an orange, as the outline is the same: a circle. The second method is called 'Preserving structural relationships', which focusses on maintaining the relationships and proportions of the subject's structure. For example, parts of an object can be substituted for basic shapes, but the relationships between those parts are maintained as per the original object. The third method, called 'Flattening', omits lines, textures, and other attributes of an object that create an impression of three-dimensionality. Here one uses simple lines and colors to present the most important features of the subject. The last method, 'Simplifying the geometry', is similar to flattening, but retains the three-dimensionality. It simplifies organic shapes into straight lines and geometric curves.

After the details per level were determined, the reference images for the icons and the photographs were chosen. These reference images for each value are needed as a visual guide, as the illustrations for the solutions are created by starting from the photograph and simplifying this image to work towards the icon. The reference images can be seen in Table 11.

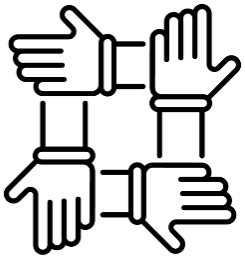
Table 11 Icon and photograph reference images for the human values that are to be illustrated

Value name	**Icon**	**Icon symbology description**	**Photo**
Friendship		People with arms around each other	 18
Curiosity		Lightbulb, question mark, magnifying glass, person searching for 'information'	 19
Achievement		Person happy with medal/cup	 20

[18] https://www.dnaindia.com/lifestyle/report-friendship-day-2021-date-history-significance-and-other-important-details-you-need-to-know-2903561

[19] https://www.crushpixel.com/stock-photo/magnifying-glass-examines-idea-young-642280.html

[20] https://www.istockphoto.com/nl/foto/silhouet-van-een-mens-die-een-trofee-bij-zonsondergang-houdt-gm1202740292-345421347

Belonging		Holding/ overlapping hands (show group forming)	 [21]
Security		Lock, security/ police badge	 [22]

First, the icon images were selected by inserting the value name into the website thenounproject.com. This website has a large and comprehensive icon collection made by their community of designers. For each inserted value name, the researcher looked at the first page of results to see what the most used symbology was for that value. For instance, the value of friendship showed mainly two or more people together with their arms around each other (on the shoulder). It was then checked if this symbology would fit the definition given to that value (see Table 9), based on the researcher's own judgement. Then, one of the images using this symbolism was chosen to be the icon reference for that value.

Following this, the icon symbology found in the aforementioned search was put into words to give a description of the symbology. To determine the photograph reference images for those values the value name was put into a google image search. Here the researcher searched for photographs that fit the icon symbology description. As human values are going to be portrayed in the illustrations, the researcher searched for photos that contain a human as well as the symbolism.

4.2.3 Created illustrations

The creation of the illustrations was an iterative process, which included feedback from design experts. The illustrations on the three levels were created with the help of the reference images and the value name, description, and synonyms, using Adobe Illustrator. Figure 11 shows the five value images for each of the five values, thus including the reference images of the icon and the photograph. The created illustrations for the solution are levels two, three, and four. For practical reasons, the illustrations are partially made up out of already existing vector images, which are credited in Appendix B.1.

As mentioned before, the illustrations are created by starting from the photograph (level five) and are simplified each level to finally reach level one. The inspiration of the composition of the images thus comes from the photograph in level five. First, level four was created for each value by inserting the needed vector images and adding or removing aspects, such as shadows, background, gradients, patterns, etcetera. During this process, the color scheme for level four was established. After this, level three was created using the previously created illustration from level four and removing details such that the illustrations adhere to the level of detail ascribed to level three per Table 10. Five to ten of the most prominent colors from level four were selected while trying to maintain as much of the original

[21] https://www.shutterstock.com/video/clip-10067621-happy-joyful-friends-forming-circle-their-hands
[22] https://www.dreamstime.com/business-man-covering-security-data-lock-shield-safety-gdpr-web-business-man-covering-security-data-shield-safety-image119264136

color composition of level four. For example, if it was possible, a yellow shirt stayed yellow. This same process was applied to create level two.

Figure 11 Adobe Illustrator working file including the five levels of detail, five human values, and the color scheme for each of the created levels (2 through 4)

In an iterative process of feedback, changes were made to ensure that all the images comply with the level of detail that they should have, which was mostly further simplifying lines and shapes. One other change was made along the way: changing the amount of zoom on the subjects in the illustrations (more zoom towards the icons). This is not described in Table 10, but was deemed as a necessary element to include. If an image is more zoomed out (level four), there is more space for other (context) details. By zooming in towards the icon level, unnecessary details were removed from the image, which means that the images were simplified more.

There are several design choices made on top of the levels of detail that were set beforehand. First of all, many of the compositions within the illustrations are the way they are because of the reference photograph that was used. The composition is thus not based on any design reasoning, but based on the reference photograph. This can lead to some unusual or unexpected choices. For example, the background in the 'friendship' value (level 4) contains yellow grass or wheat, which is not expected per se in a friendship-type situation. Also, the magnifying glass in the 'curiosity' value illustrations could be interpreted as a floating magnifying glass or some other person looking at the girl through the magnifying glass. Secondly, it was chosen to display the people in the clothing that suits the situation, such that the images are relatable. For example, in a friendship-like situation, one would

expect people to wear comfortable and informal clothing, whereas when security is concerned, people would consider the situation to be more formal. Furthermore, although the reference photographs were largely dictating whether the faces can be seen in the image, active thought and work was put into the facial expressions when they could be seen. For instance, for the 'curiosity' images it was aimed to show a surprised but happy face, intending to link to the positive feeling that one might feel when you discover something new. It was chosen to not make this a thinking-face because that facial expression contains a certain level of frowning, which could be interpreted as angry or unhappy. Lastly, for the values of 'friendship' and 'belonging', where more than one person was needed in the image, it was decided to include at least four people in the image. The reason for this is that one might associate two people with a romantic relationship. Additionally, the chosen number of people was aided by the available vector images: for friendship a vector image that included four people was found, and for belonging one was found that included ten arms/hands.

The final version of the illustrations can be found in Figure 12. The result is three sets of cards, one for each level of detail. A set contains the illustrations for each of the five values.

Figure 12 Final versions of the illustrated values. Set 1 = level two, set 2 = level three, set 3 = level four.

4.3 Method

After the illustrations were created, they were tested among design experts via a digital survey to see which level of detail, and thus which set, is the best. The survey can be found in Appendix B.2. This section further explains the setup of this research, such as the measurements, the participants, the procedure, and how the analysis will be done.

4.3.1 Measurements

This part of the research aims to find out which of the created levels of detail of the illustrations is preferred. There are three sets of illustrations which differ on the level of detail they contain, as explained in the previous section. The participants will first answer several questions regarding each of the values, meaning that they will see the three illustrations created for that value and answer

questions regarding those three illustrations for that value. This is repeated for each of the five values. After this, they will answer several questions regarding the sets. After each question, they can also explain their answer. The questions that are asked are:

- "Which of these images/sets do you find most aesthetically pleasing?"
- "Which of these images/sets do you find most contributing to your understanding of this human value?"
- "Which of these images/sets would you consider most to use during a discussion of this human value with someone else during the design process?"

It was decided to include questions similar to the statements asked in study 1 (see section 3.2.1 Measurements) because this would make it easier to compare the answers, if this is desired. The questions ask only about a participant's 'most' liked image, as opposed to 'most' and 'least' or a ranking, both of which take more time to fill in, to safeguard the time it takes to fill in this survey.

4.3.2 Participants

As this research, both the main research question as well as all the sub research questions, is explorative, the goal is to get in depth information on the topic. Therefore, it useful to get feedback from experts in the field of design, as they can adequately indicate which design (illustration) is best in their professional opinion and describe why. They might also provide other insights into what could be changed to improve the design further. People who are considered to be design experts are working professionals in the design domain, PhD candidates in the design domain, teachers in the design domain, and master students that do a design study such as industrial design engineering or graphic design.

The target number of entries for this survey is at least five, but preferably ten. It is expected that about half of the participants will give explanations to their given answer. These could then also be considered as small expert interviews. Therefore, this number of participants will give a decent amount of insight. The search for these experts will be done at the University of Twente and close circles thereof. This is not a complete representation of the full population, but since a diverse spectrum of experts are asked to participate in this study and since this is an explorative research, this was deemed to be acceptable for this stage of the research.

As this survey is conducted at the university at which the thesis research takes place, there might be participants with knowledge of this master thesis or the illustrations. Participants with this pre-existing knowledge will not be fully excluded to increase the likelihood that enough responses are gather, but their answers will be checked to see if they differ greatly from the other answers. This cannot be done with statistical significance due to the small number of participants, so these inferences will be made with the researcher's judgement.

4.3.3 Procedure

The plan for conducting this research was approved by the Ethical Committee of the Faculty of Electronic Engineering, Mathematics and Computer Science (EEMCS) at the University of Twente and can be found under reference number 'RP 2022-42'. Once it was approved, the survey was spread via email.

The link to the survey led the participants to a google form, which can also be viewed in Appendix B.2. First, the participants would be greeted and informed about the contents of the survey, after which they were asked for their consent. Following this, the participants were asked whether they had any pre-existing knowledge of this master thesis and in which way they are a design expert. Then the questions regarding the illustrations as described in section 4.3.1 were asked. Additionally, at the end of each section of the survey, the participant had the chance to write any other remarks or

feedback regarding the illustrations. At the end of the survey, the participants were thanked for their participation. If a participant filled in their email address for the sake of retracting consent, this email address removed 48 hours after the submission as was assured to the participant in the consent section at the start of this survey.

4.3.4 Analysis

The data of the survey was sorted, transcribed, and analyzed using excel. None of the entries was invalid, and only one answer had to be transcribed to fit the rest of the given data: one participant answered 'other' when asked in which way they are a design expert. From the information given in their given explanation, this was changed to 'working design professional'.

Due to the small number of entries, the answers cannot be analyzed statistically. Therefore, the data will mostly be visualized and the data will be interpreted with the researcher's judgement.

4.4 Data and Results

This section outlines the data and results from the survey that was conducted for sub research question two where the three sets of illustrations of values were tested among design experts. It starts with describing the participants in section 4.4.1. This is followed by the data and results of the survey itself in sections 4.4.2 and 4.4.3.

4.4.1 Demographics

In total, eight participants filled in the survey, of which two had pre-existing knowledge of the master thesis or the illustrations themselves. The answers between those with and without pre-existing knowledge do not differ, based on the researcher's judgement. Additionally, the explanations from the participants with pre-existing knowledge indicate that their entries were as bias-free as one can be with already knowing some of the information regarding this research. Therefore, their entries will remain part of the analysis.

The participants were asked to indicate and explain in which way they are a design export. The options given were 'working design professionals', 'design teacher/professor', 'PhD (design) student', and 'master (design) student'. Multiple answers could be selected, and this was also done by some of the participants. Some participants selected multiple options because they currently fulfill more than one of those roles, such as working design professional as well as teacher/professor, other selected their full background, such as first a master student, followed by PhD thesis and now working in the design domain. The outcome from all these answers can be seen in Figure 13.

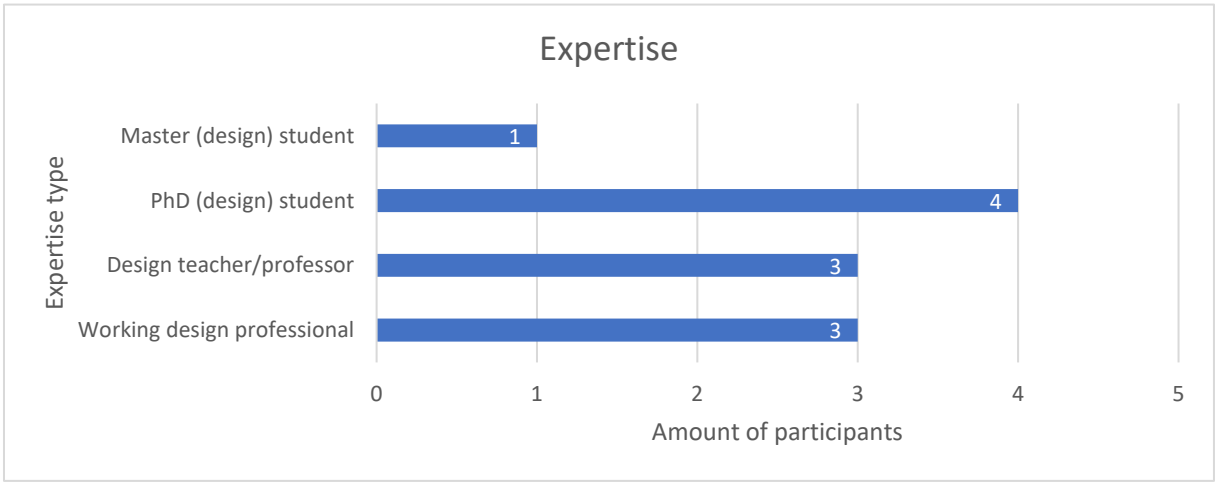


Figure 13 Expertise of participants of study 2

As not all participants filled it in this way, it was chosen to also show only the 'end expertise', meaning the expertise they currently fulfill or the most prominent one if there are multiple roles currently being performed by one person. For this last case, a hierarchy had to be established to determine which of the selected answer to use. This hierarchy is based on the assumed order one would work through their career ladder: (bachelor), master, PhD, teacher/professor or working professional. If a participant filled in both teacher/professor and working professional, then working professional was used, as this can be seen as the umbrella term that also encompasses teaching. The results of this can be viewed in Figure 14.

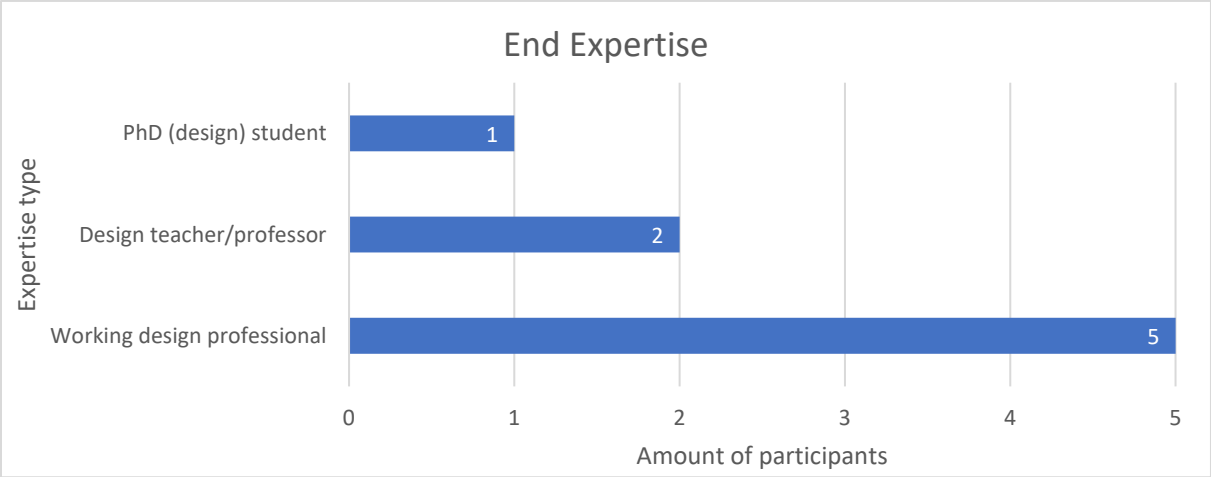


Figure 14 End expertise of participants of study 2

The descriptions given by the participants shows that they work in various design fields. Some of the answers that were given are: (motion) graphics designer, UI, video, 3d design, user-centered design, emotional design, healthcare, integrated product design, values in technology, design drawing, industrial design engineering, design researcher.

4.4.2 Per value

This section shows the answers given to the three questions for the separate values. Figure 15 shows the results to the question 'which of these images do you find most aesthetically pleasing?', which is abbreviated to 'most aesthetically pleasing'. Figure 16 shows the results for the second question asked, which is 'which of these images do you find most contributing to your understanding of this human value? '. This question is abbreviated to 'most contribute to understanding'. Lastly, the results to question three, 'which of these images would you consider most to use during a discussion of this human value with someone else during the design process?' can be seen in Figure 17. The abbreviation for this question is 'most use during a discussion'. In these figures, image 1 refers to the corresponding illustration in set 1 (level 2), image 2 refers to the corresponding illustration in set 2 (level 3), and image 3 refers to the corresponding image in set 3 (level 4).

Each of the figures shows how many times the image at that level of detail was selected for that question. For example, Figure 15 shows that for the value of friendship three participants found image 2 (which is based on level 3 of detail) to be the most aesthetically pleasing image of the three, and five participants found image 3 (based on level 4 of detail) to be the most aesthetically pleasing.

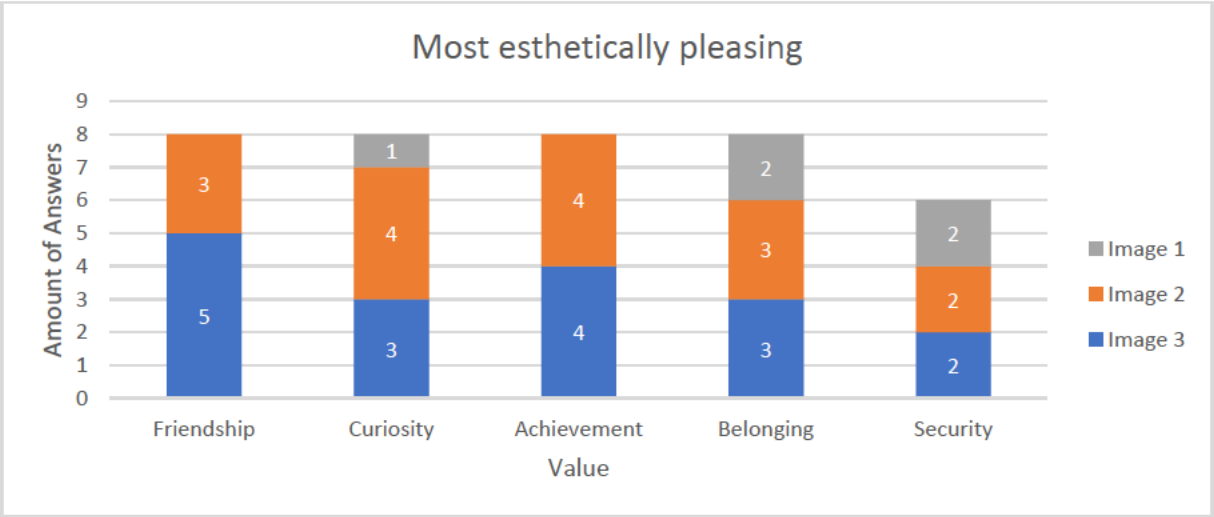


Figure 15 Study 2 answers to the question 'which of these images do you find most aesthetically pleasing?' for each of the values

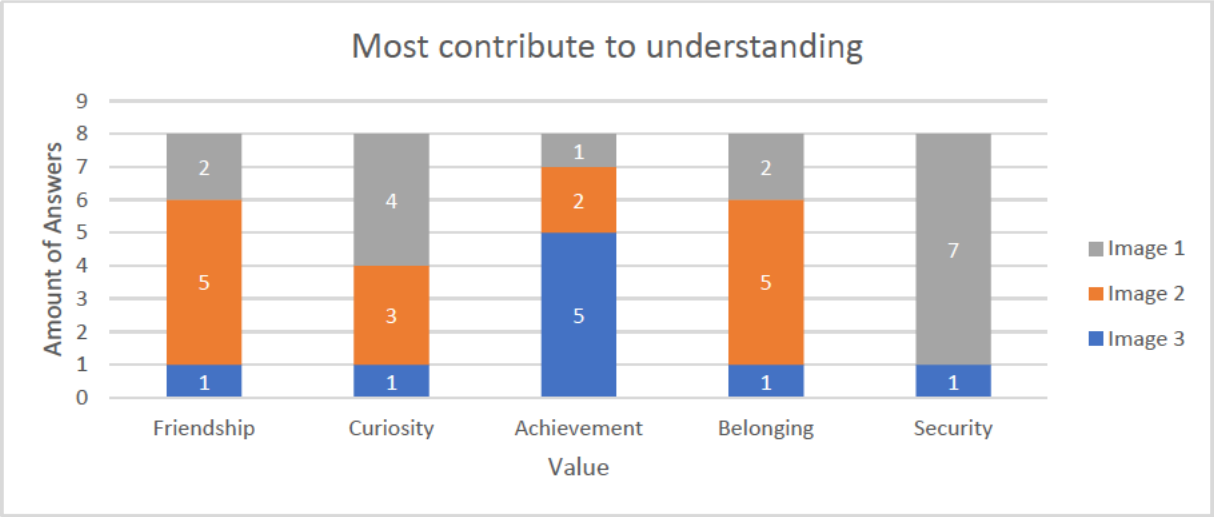


Figure 16 Study 2 answers to the question 'which of these images do you find most contributing to your understanding of this human value' for each of the values

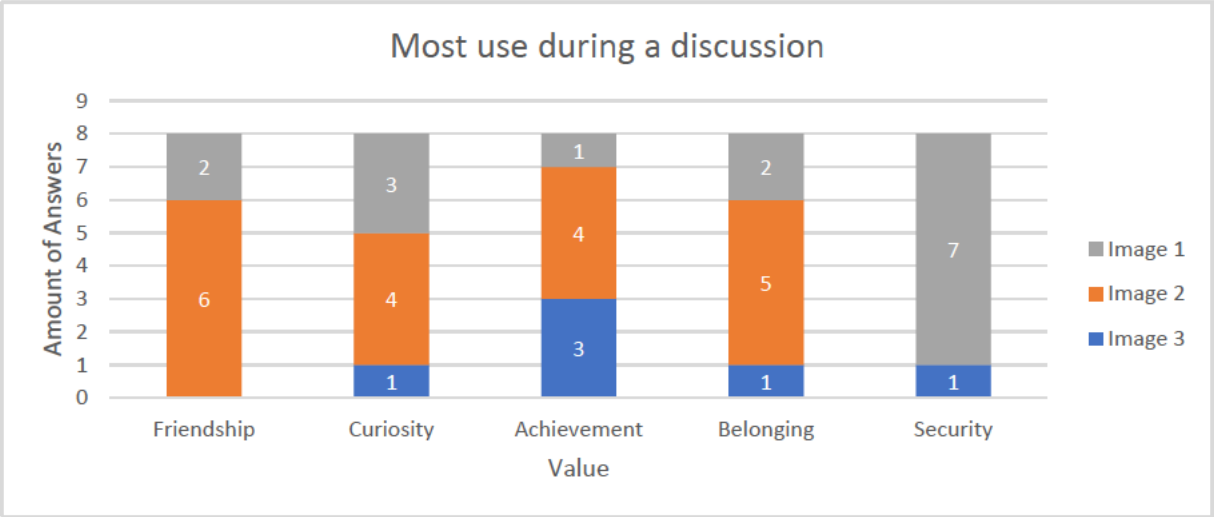


Figure 17 Study 2 answers to the question 'which of these images would you consider most to use during a discussion of this human value with someone else during the design process' for each of the values

The most remarkable findings are the following. Images 2 and 3 (which are level 3 and 4 of detail, respectively) score very similar on the aesthetically pleasing aspect, while image 1 (level 2) scores relatively low. Image 3 (level 4) is not as much contributing to the participant's understanding, except for the achievement illustration. At this question, images 1 and 2 (levels 2 and 3, respectively) score very similarly, but this is not evenly distributed over the values. Image 2 (level 3) scores best regarding the 'use during a discussion'. Overall, image 1 (level 2) scores low on all values except for security, where it is similar at the aesthetically pleasing question, and by far the best at the other questions.

The written explanations clarify some of the answers given by the participants. An overview of some of these explanations can be found in Table 12. This table shows for the three images what some of the advantages and disadvantages are that were mentioned. If an explanation is for a specific value only, this value name is included in square brackets before the explanation.

Table 12 Several written explanations from participants from study 2

	Advantages	**Disadvantages**
Image 1	[security] Least distracted by face	Too empty with no expression
	Easiest recognizable	Needs more contrast
	Best framing	Too general, no facial expressions
		Why facial expressions excluded? Play important role of emotional value
Image 2	Facial expressions (compared to 1)	Not enough contrast with background
	Balance between looking nice and explaining the value (indicated 2x)	[curiosity] Face doesn't add to understanding the value (said 2x)
	Better focus on the subject and better contrast	[belonging] Too many hands
Image 3	Nice colors	Too much
	Contrast in shading, color combination	[friendship] Confusing background (what does it symbolize, what is added value of this background?)
	Most detail, looks most put together	[belonging] Face doesn't add to understanding the value
	[achievement] Background (mountains) remind of mountain climbing, which is used as symbolism for great struggle and such	Image 3 maybe not compatible with color blindness
		In this illustration, the contextual exploration in the background helps but it would have been nicer if what the person was holding matches with the background (e.g., Olympic)

One overall comment several participants made is that some of the illustrations could also represent another word or value and that some of the symbolism or details used in the illustrations do not specifically embody the value that it is representing. For example, some participants indicated that they did not like any of the images for the value of belonging, because the face and overall picture does not convey curiosity in their opinion. On top of that, some suggested that it would be helpful for the future to ask oneself (who is creating such illustrations) if the added details really contribute to conveying the meaning of the value and as such eliminate the unnecessary details. If a detail is necessary to convey the meaning, it then should be thoroughly investigated how this should be done. For example, if facial expressions are crucial to the understanding to the value, it should be tested what these should look like. Finally, one other comment one participant made is that some of the images are not proofed on color blindness, which is something that should be considered and incorporated in future research.

So far, there is no clear winner as there are great differences between the questions and also between the values. Even when the values are combined by merging the responses, as can be seen in Figure 18, not one of the images is certainly better than the other two. This figure shows that the images 1 are considered less aesthetically pleasing than those of image 2 and image 3, which are comparable. Images 1 and 2 are comparable, and higher than image 3 when it comes to contributing to the understanding of the value. The images 2 do score higher than the others on the question whether one would use this in a discussion. Still, the difference between this and the runner up, which are the images 2, is not a large difference. The one thing that could be concluded so far is that 2 does score relatively high on all three questions. This can even more clearly be seen when the scores of each image are added, thus combining all the questions. The total of image 1 is thirty-eight, the total of image 2 is fifty, and the total of image 3 is thirty-two.

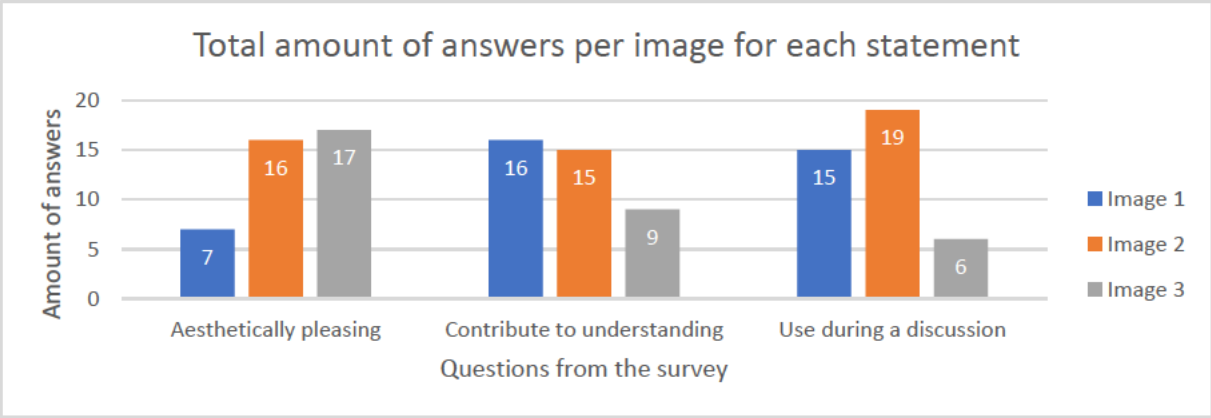


Figure 18 Study 2 answers to the three questions for each image (values combined)

4.4.3 Sets

The answers to the questions regarding the image sets are shown in this sub section. Figure 19 shows the result of this. As the participants were asked to indicate which image or set they found most aesthetically pleasing, most contributing to their understanding, or would consider most in a discussion, each question will in total have eight responses, because there were eight participants that filled in this survey. What can be seen in this figure is that set 1 scores very low on all three questions. Also set 3 is not chosen often by the participants to be the best of the three sets regarding the three questions. Set 3 only scores high on the aesthetically pleasing question, where it scores the same as set 2. On the other two questions, set 2 scores by far the best.

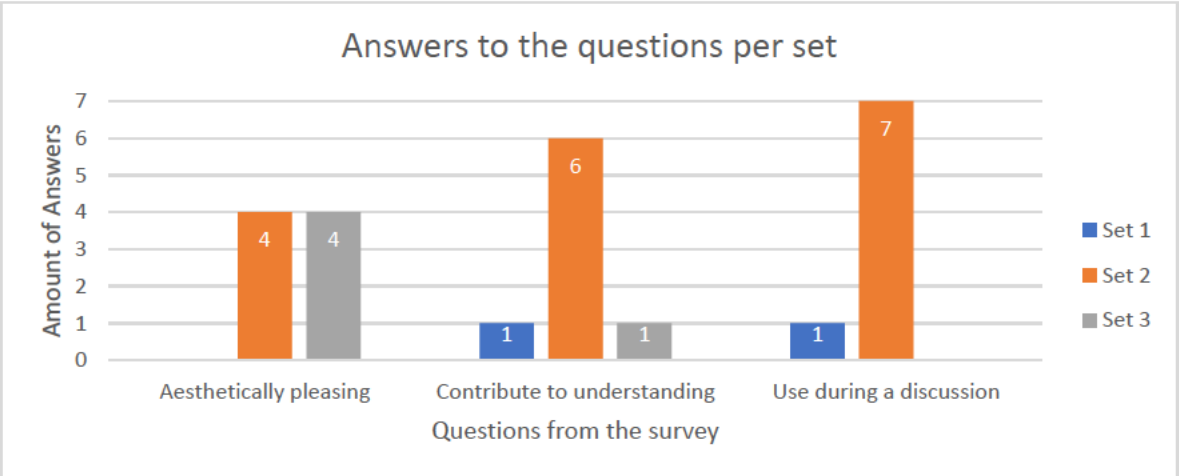


Figure 19 Study 2 answers to the three questions from the sets

The written explanations also support this. On set 1 no comments were given. For set 2, a participant explained that this set is the 'perfect balance between nice looking and not too much information that it becomes distracting', another adds to this that it is 'easy to understand'. A third person contributes that the images in this set are kept simple but do make use of expressions. For set 3, several participants explained that they like the use of color, and that this makes the images in the set look more complementary to each other. One participant indicates that they like that this set has the most detail and has 'nice gradients'. One general comment one participant made is that 'without introduction, I would not have been able to distill the values from the images'. However, as the images are not intended to be used separately from their written information in the form of cards, this becomes less of a concern.

4.5 Conclusion and Discussion

The above shown data and results are concluded in this section. This is then followed by a discussion, which includes the discussion of the creation process, the limitations of the method, the discussion of the results, and the points that should be taken into consideration in future work.

4.5.1 Conclusion

This study aimed at finding an answer to the second sub research question of this thesis: 'How can human values be visualized in such a way that designers and stakeholders can identify or recognize them so that it creates a set of validated visualizations?' First, the levels of detail ranging from 'icon' to 'photograph' were established. Based on this, the illustrations for five values were created through an iterative process. A digital survey was held among design experts where these images were analyzed to find the most preferred level of detail. In total, eight participants with various design expertise and backgrounds filled in this survey. Of those eight, two had pre-existing knowledge of this thesis or the illustrations themselves.

From the analysis of the images per value, there was no decisive conclusion yet. The data points towards a preference of level 3 of detail (which can be seen in images 2), but with only eight entries to this explorative survey, no statistical analysis can be done to back this up. This data also shows that there are differences between the values. For example, image 1 (level 2 of detail) generally scores relatively low at all the values, except for security, where it scores highest at both the 'contribute to understanding' question and the 'use during a discussion' question. The written explanations not only support and further explain the answers of the participants, but also provide useful feedback and suggestions for future works.

The analysis of the questions regarding the image sets more clearly confirms that the participants have a preference for set 2, which is level 3 of detail. The written explanations again provide insight into the answers given and provide points for future works.

As both parts of the analysis point towards image/set 2 (level 3 of detail) being the most preferred, it can therefore be concluded that this is the most preferred level of detail overall. Accordingly, the illustrations from this level of detail will be used in the next part of this thesis, where the images are combined with their respective written information to form a card-like product. As the participants indicate that these illustrations can (and should) be improved, these images should not be considered as the best and final version. Nonetheless, it does provide a good base line and instructions for how such illustrations can be made, thereby answering the second sub research question.

Most of the requirements set and explained at the start of this chapter are met. The created illustrations portray individual values, which are inspired by the values of Schwartz. These illustrations are tested separately from the full product, as the illustrations were tested in this study and the testing of the full product will be done in the next study. The format of the illustrations is a digital format, and

they can be easily incorporated in a card-like product. Also, as clarified by the participants in the written explanations, there is a good balance within the image, meaning that they like that just enough details are given to provide enough information regarding the value, that they like the look of the illustrations, and they are overall not too busy. However, some participants have indicated that these illustrations do not yet accurately portray the value. This is due to unnecessary detail or that the illustration could also portray a different word or value. Since none of the participants indicated that one of the illustrations does not embody the value at all, it can be argued that this requirement is not fully met but steps in the right direction were taken.

4.5.2 Discussion

There are several points and actions in this chapter that need to be pointed out and discussed.

Limitations of the creation process

First, to be able to perform the research of study 3, an overlap between products and their values was needed. This overlap was found based on the judgement of the researcher, which included looking at the value name and value description used by the products. However, someone else might find a different overlap due to their understanding of the value being different. This could result in not only different products and values that could be tested at this stage, but also the values created for the solution, which were also chosen by the researcher herself, could be different.

Secondly, the value description and synonyms were taking from an online dictionary. This dictionary was chosen because it had both the definition (description) and the synonyms, but there might be dictionaries with a more comprehensive definition or better synonyms.

Several participants indicated that some of the details in the illustrations are not contributing to the understanding of the value, or that the relation between objects in the illustration is unclear. This could be due to the use of the reference photograph, which was leading in the composition of the objects in the illustration. Additionally, there might be symbolisms that fit the illustrated values better, because only a very limited research into this was done, as described in section 4.2.2.

Lastly, as the written explanations from the participants point out, the illustrations were created without the possibility of a user being colorblind in mind. Without accounting for this, some images could be unclear or misinterpreted by those people.

Limitations of the method

Although it is common practice for explorative research to have only a small number of participants, this did make it harder to draw (significant) conclusions at this stage. Additionally, the participants were attained through the University of Twente network, which means that most of those participants are somehow affiliated with the University of Twente. Although their skills and domains vary, this is not a full representation of all design experts. This is less of an issue if one considers the survey as a small expert interview, in which case it is normal to not be able to represent the full population.

The research was further limited by the minimal number of products and values that could tested, due to the overlap that is needed for study 3. Therefore, the conclusions are drawn based on only five values instead of a full set of illustrations.

As the survey did not have multiple versions where the order of the values was switched, the answers might be slightly skewed. However, the analysis of the separate values was not the only analysis performed, but also the totaled outcome of all the values combined and the sets were analyzed. As all three indicated towards the same answer, this skewedness can mostly be disregarded with regards to the conclusion of this sub research question.

The survey asked the participants to indicate which of the images they found most aesthetically pleasing/contributing to their understanding/would use in a discussion, meaning that it focused

only on the positive side of question. Although the questions did thus not explicitly ask about their 'least' liked illustrations, there were fortunately a few participants that were very elaborate in their written explanations. They not only explained why they chose the image for the 'most' question, but sometimes also explained what they did not like about the other images.

Lastly, although several iterations were performed throughout the creation process, only one composition idea (from the reference photograph) was created. Thus, only one composition option for each illustration was tested. Therefore, it is unknown whether this composition is the best, but the written explanations indicate that several improvements can be made.

Discussion of the results

Of the eight participants that filled in the survey, two had pre-existing knowledge of either the thesis or the created illustrations. Even though the answers and written explanations of those two participants were checked, it could still be that they had a bias for any of the images. This problem is slightly negated by the fact that all illustrations were created by the researcher, and they were not tested among products from other people. In this last case, bias is a larger concern as then a bias can be formed in favor of or against the illustrations created by the researcher.

The data and results section shows that the answers differ per value. This could indicate that the illustrations are not of the same quality and that some might represent their respective value better than others. This can be most prominently seen in the value of security, where image 1 scored much higher than with the other values. If the illustrations are of comparable quality, it would be expected that the answers between the values are also comparable. This thus indicates that the illustrations are not yet of similar quality, which is needed to ensure that good (validated) illustrations are used in the solution. This should be improved in the future, but this will not be done for study 3 due to time constrains of the thesis.

From the data it is concluded that level 3 of detail, as used in set 2, is the most preferred among the participants. For this research that means that this level of detail and its illustrations will be used in the next study. However, this does not necessarily mean that the illustrations in this set are the very best they can be, it only means that they are the best from the given options. What it does imply is that this is the most preferred level of detail. This is also supported by the written explanations from the participants, where several people explain that they like the balance in this image: nice looking with enough information, but not overwhelming.

Lastly, not all participants explained their answers. Therefore, the written explanations do not fully show the opinions of all the participants, but only of a selection of the participants. It could be that the participants that did not explain their answers have a different viewpoint or would give other recommendations.

Future work

Finding an overlap between values from different products was based on the researcher's own judgement. In the future, this overlap should be tested to ensure that indeed similar values are tested. Additionally, in the future it would be better to either use an existing (tested) value list or create a new value list that must be tested before it is used.

It would also be good to further explore what (detailed) information should be included in the visualization, or differently phrased: what the four elements that are to be included should embody exactly. For instance, different value definitions (and synonyms) for the written context should be further researched to see which fits the values best. The same should be done for the symbolism used for each value, as there might be better symbolisms that fit the values illustrated in this chapter. And this would also improve the illustrations for additional values for which value visualizations still have to be made in the future. This more in-dept research can also be extended to other details used in the

illustrations, as some details can be confusing or not contributing to the understanding of the value. All of this will also lead to a different approach regarding the composition within the illustrations, as this should then not be done based on a reference photograph but based on the symbols and other details that should be included in the illustrations and based on what contributes to a person's understanding of that value.

For this study, only five values were illustrated and tested. However, many other human values exist that should also be illustrated and tested to create a full set of value illustrations, which will form a full set of value visualizations. Both the current illustrations and any illustrations that are to be created in the future for the other values should be designed in such a way that a person with colorblindness can still distinguish the needed details and symbolisms to understand the value. The illustrations should adhere to the details of level 3 (see Table 10), as this was found to be the best. However, as the survey showed that the created illustrations were not yet perfect, in the future they should be improved and tested, and any newly illustrated values should also be extensively tested.

The survey can be improved by having different versions of the test, so that bias or skewed answers due to the order in which the values are shown can be avoided. By also including questions that ask about the 'least' liked illustration, a more comprehensive overview of the participants' opinions can be formed. This can be even further improved by using ranking or Likert-scale questions. By including/changing this, the survey might give more insight into why a certain level of detail or a specific detail in the illustration is either liked or disliked.

Furthermore, it would also be good in the future to test multiple illustrations for each of the values to see which composition works best to convey the meaning of the value. For example, objects can be (re)moved, the perspective and zoom can be altered, various ways to illustrate the same object can be tested, and so on. It is then also important to test whether the created illustrations are all of the same quality such that they would perform similarly across all values.

All future tests should also ensure that they are performed by participants that more fully represent the complete population. It might then also be beneficial to exclude participants with prior knowledge of the illustrations, to fully ensure that the participants are not biased.

Lastly, all explorative research conducted should be confirmed by quantitative tests to ensure that the outcome is valid. If written explanations can be given by the participants, this should either be filled in by all participants or, like done in this thesis, it should be noted explicitly that the written answers are not representative of the full population, thus maybe providing a skewed view.

5. Study 3: Comparing the Created Visualizations Against the State of the Art

This chapter creates and tests the solution, aiming to answer the third sub research question:

Are the created visualizations preferred over the state of the art products?

To be able to test the final solution, it has to be created by combining the illustrations created in the previous chapter with the accompanying written information. First, the requirements for the solution will be explained in section 5.1. This is followed by the creation of the solution in section 5.2, where the written information is combined with the illustration, and the choices regarding the composition of the elements and font for the written information are explained. Section 5.3 explains the method of the research, which is a survey that tests the solution against the state of the art products, and section 5.4 explains the results thereof. Finally, the chapter is concluded and discussed in section 5.5.

5.1 Requirements

Many of the requirements for the solution have already been met in the study 2, because this study is a continuation of the previous one and in anticipation of this study many of the preparations have already been completed. This includes that the values for the solution are individual values, the definition of the values need to be tested or previously validated, the illustrations are to be tested separately from the full product, the solution must be in a digital card-like format, and the values of which the visualizations are to be created for the solution must stem from an overlap of similar values among several state of the art products.

There are several additional requirements that have arisen that apply to this study and to the solution. First of all, the solution should include the illustrations that results from level three of detail (also called set 2) from the previous study, as those were found to be the best. These illustrations are not to be changed before conducting this survey, as that would add another variable to this test that is not tested separately or beforehand. However, it is recommended, as is also stated in section 4.5.2, that these are to be improved in the future. Secondly, the number of elements included in the solution should comply with the outcome from study 1. This means that at least the value name and value description should be included, but preferably also other written context and a visualization of the value. Thirdly, the accompanying written information for the solution should be the written information as chosen in the previous study, which can be found in Table 9. Lastly, only the front of the card has to be created and tested. This is because this study will only test a digital version of the solution and thus only the front of the card-like products will be tested.

5.2 Creation

The solution will consist of the illustrations from level three of detail (set 2) and their accompanying written information, as described in chapter 4. This means that all four elements that were ascertained from study 1 to be contributing to the understanding of a value will be included in the solution. The elements will only be displayed on the front of the card.

For the composition of the elements, several layouts were created. Figure 32 in Appendix C.1 shows several of these options. Only a handful of options is shown in here, but all possible options were reviewed before the final choice was made. In the end it was decided to use the first version, which is the simplest composition. It makes use of visual hierarchy: the font size decreases as the level

of importance of the element decreases. The order of importance for the written elements is first the value name, followed by the value description, and finally the synonyms. All the written information is kept together and placed in one spot of the card. The choice to keep it as simple as possible with regards to the composition is also supported by the findings from the preliminary literature study, which describes that there are several authors that argue that the best way to design such visuals is to keep it simple (see for example Gagnon, 2018; Rieber, 1995).

One minor change to one of the illustrations had to be made: the illustration of 'belonging' is the only illustrations where objects are present at the top of the illustration, in this case the arms reaching down. The other illustrations all had no objects placed at the top. For these four that results in an easy transition between the white background of the illustration into the white background of the card itself. As this was not the case for 'belonging', a white/transparent gradient was added to the top of the illustration to mimic this transition.

In total, six fonts were tested: the adobe standard in illustrator 'Myriad Pro', the favorite of the researcher 'Lato', two of the most used serif fonts 'Garamond' and 'Times New Roman', and two of the most used sans-serif fonts 'Calibri' and 'Futura'. These last four are based on the top ten most popular fonts from google used by publishers and marketers [23], which means they are easily available to designers as well as that they are good for printing. The top two serif and sans-serif fonts chosen from this list are the first two, for each respectively, found in order of the list that are readily available in Adobe Illustrator. The six different font options, which can be seen in Figure 33 in Appendix C.2, were tested informally among a few of the researcher's peers. They indicated that the sans-serif fonts were most preferred, as they look modern and professional, whereas the serif fonts feel old. Some specifically indicated that they liked 'Futura' the most, because this font uses a 'normal g', which means that the style of the 'g' is the same as when being handwritten, as opposed to style used for printing, which includes a little circle at the bottom of the 'g'. Therefore, it was determined that 'Futura' is the font that will be used in the solution.

The final look of the solution, where the 'simple hierarchy' of the elements and the font 'Futura' are implement, can be seen in Figure 20. These five (digital) value cards will be tested against the state of the art products.

Figure 20 Final value visualizations for the solution

5.3 Method

To test whether the created solution is preferred over the state of the art products, a digital survey was sent out. This survey was spread among the same target audience as the audience for sub research question one, namely students. The survey, created using Google Forms, can be found in Appendix

[23] https://www.copiprintsupport.com/2020-top-ten-fonts

C.3. The information regarding the method of this study can be found in this section, which includes the measurements, the participants, the procedure, and the analysis that will be performed on the gathered data.

5.3.1 Measurements

The four state of the art products used in the survey, as described previously in chapter 4 (see Table 8), are 'Values deck, by Studio Carreras' (SC), 'Design for happiness' (DfH), 'BBC digital wellbeing cards' (BBC), and 'Find your Values' (VF). The cards from these products and from the solution used in this the survey for this study can be found in Figure 21.

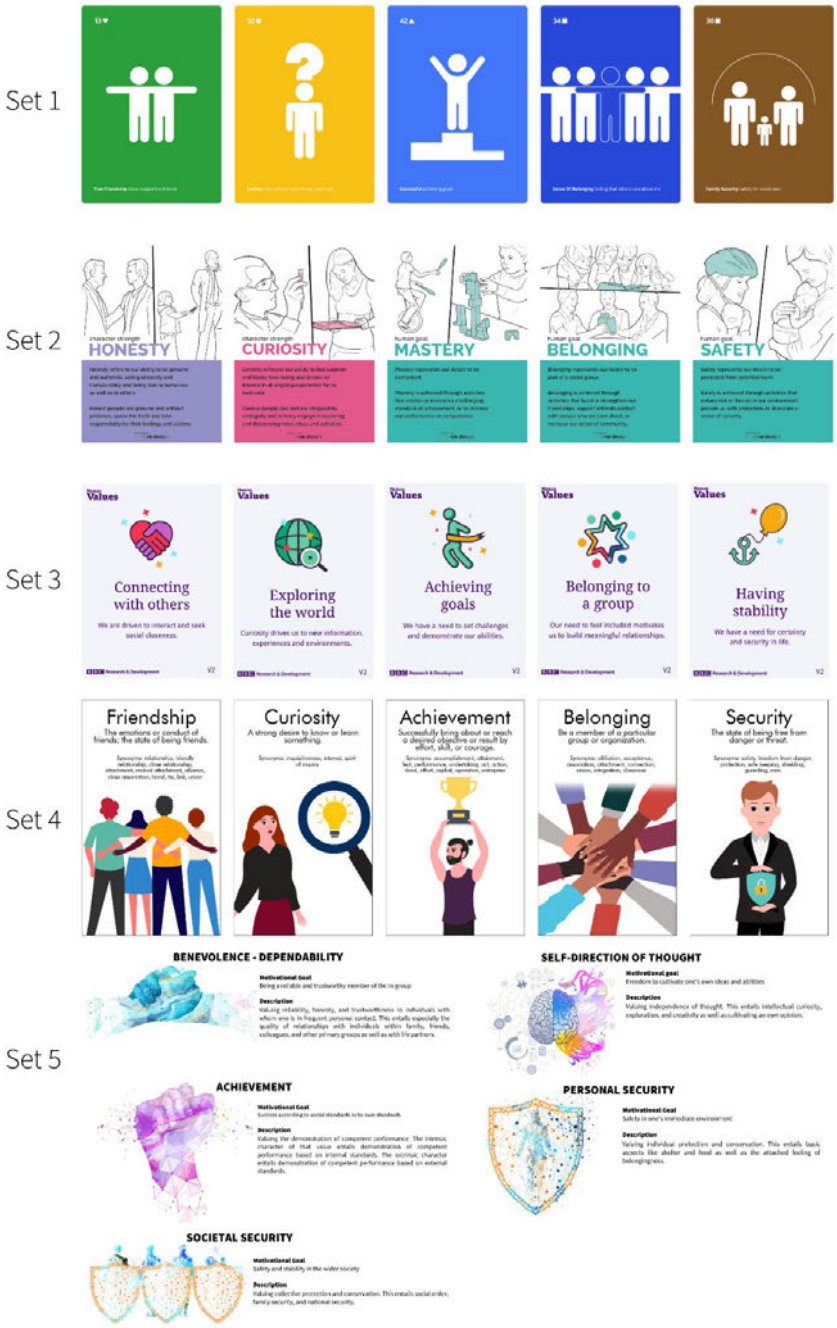


Figure 21 Value visualizations from each of the five products, including the solution, used for the set question in the survey for study 3. Set 1 = 'Values deck, by Studio Carreras' (SC), set 2 = 'Design for happiness' (DfH), set 3 = 'BBC digital wellbeing cards' (BBC), set 4 = the solution (Harms), and set 5 = 'Find your Values' (VF)

For each of the five values, and for the set separately, the participants were asked to answer six questions. After each question, they had the opportunity to explain their answer. These six questions are based on the previously used questions/statements in the study 1 and 2: 'aesthetically pleasing', 'contribute to understanding', and 'use in a discussion'. By using similar questions, it is easier to compare answers between the three studies, if this is desired. The question asked are:

1. Which of these images do you find **most** aesthetically pleasing?
2. Which of these images do you find **least** aesthetically pleasing?
3. Which of these images do you find **most** contributing to your understanding of this human value?
4. Which of these images do you find **least** contributing to your understanding of this human value?
5. Which of these images would you consider **most** to use during a discussion of this human value with someone else during the design process?
6. Which of these images would you consider **least** to use during a discussion of this human value with someone else during the design process?

The decision to use 'most' and 'least' instead of a likert-scale question or a ranking question is related to time. Both of these questions take more time to answer, as more answers need to be given. Additionally, based on personal experience of the researcher and her peers, this approach (indicating the two extremes) is also easier and faster as one more easily forms an opinion on those extremes than on the undefined middle. Since the participants will be asked to perform this task for each of the five values and for the sets, which totals to six parts in the questionnaire, it was important to reduce the time needed to fill in this survey so that enough participants could be found willing to fill in the survey.

5.3.2 Participants

The target audience for this survey is students at a university or university of applied sciences, preferably with a design aspect to their study, for the same reason as explained in the participants section of chapter 3 (3.2.2). The survey can also be filled in by participants outside of the target audience. Questions regarding the participant's student status and their study will clarify the demographics of the participant pool. The search for participants will be conducted via email and WhatsApp. As this is the same approach as the one taken in study one, this will most likely result in comparable participants. As the first study already indicated that there is no significant difference between the answers from the students and the non-students, this will also be applied in this study.

Participants that filled in the survey from study one will not be excluded from participating in this survey. This survey does not state that it contains the value visualizations created by the researcher and it mainly uses other state of the art products compared to the ones used in study one, so it is highly unlikely that any of the participants will have a bias.

To further reduce the chance of biased answers, the participants were not informed that they are evaluating four existing products and one product created for this thesis. This does no harm to the participants and the information is not needed to perform the survey.

The aim was to have about thirty participants for this survey. This number was chosen as the research conducted for sub research question one indicated that gathering this number of participants is feasible while still giving insightful results.

5.3.3 Procedure

The procedure was approved by the Ethical Committee of the Faculty of Electronic Engineering, Mathematics and Computer Science (EEMCS) at the University of Twente and can be found under reference

number ‘RP 2021-233’. After this, the survey, a Google Forms (see Appendix C.3), was spread via email and WhatsApp. Additionally, the survey was posted on a Canvas page from the University of Twente that helps researchers find participants for research.

On the first page of the survey, the participants were greeted with a welcome message and information regarding the survey and consent. This was followed by several questions regarding the participant (demographics), such as age range, gender, nationality, and student status and study information. The next page included more information regarding the questions that will be asked in the survey. These questions can be found in section 5.3.1. After this, the questions regarding the value visualizations started. The participants were asked to look at the five images presented on that page. These five images are the similar values from the four state of the art products and the solution. The first value that was shown was related to the value of friendship. The subsequent pages asked the same questions for the remaining four values: curiosity, achievement, belonging, and security. The last page related to the value visualizations asked these questions again, but this time for the complete set of value visualizations of each product. A set in this case is the five value visualizations of each product used in the survey.

The images and sets were all given a number for easy reference and to avoid bias to any of the products, as the product name would indicate which of the products was created by the researcher. These numbers remained the same for the products throughout the survey. The products and their corresponding numbers can be seen in Figure 21. The same references can also be found later in this chapter in Table 14, which shows all the references and abbreviations used in this study.

At the end of the survey, the participants were thanked for their participation and asked to submit their response.

If a participant filled in their email address for the sake of retracting consent, this email address removed 48 hours after the submission as was assured to the participant in the consent section at the start of this survey.

5.3.4 Analysis

The data gathered through the survey was sorted, transcribed, and analyzed using excel. No entries had to be deleted to insufficient consent. Several answer had to be converted such that they fit into the correct category. In de nationality section, all answers that indicate the same nationality were changed to the same name, such as “the Netherlands” and “Dutch (the Netherlands)” to “Dutch”. In the student section of the demographics, if a participant that is a PhD student/researcher did not previously fill in they are a student, then they did not get the question of at which level they currently are, such as bachelor, master or PhD. These are manually included as student. Subsequently, it was also manually entered that their study level is PhD. For the questions ‘does your study involve design?’, one participant answered “other”. This was converted to a “yes”, as their explanation indicated that their study used to involve design. As mentioned before, also the answers from the PhD students that did not fill in that they are a student were manually added to the answers. However, it is unknown whether their studies included design, so this question was manually filled in as ‘unknown’.

The data from this survey is categorical (nominal) data, as the answer provided is an image or a set name. As there is only one group of participants, there is only one sample in this single response multiple choice survey. The most common analysis applied to such data is the use of descriptive statistics, such as frequencies, percentages, bar graphs, pie charts, and so on. Inferential statistics cannot be applied to this data set. Therefore, the data and results section (5.4) will display the data using descriptive statistics such as bar graphs and frequency tables.

5.4 Data and Results

What follows in this section is the data and the results from the survey conducted that aims at answering the third sub research question, which tries to find out if the created value visualizations are preferred over the state of the art products. This is done by giving an overview of the demographics of the participant pool in section 5.4.1, followed by the data and results (section of the two main parts of the survey: the questions regarding the individual values and the questions regarding the sets. The former shows this in section 5.4.2 by displaying the overall results of all the questions for all the values, followed by a more detailed analysis per question. The latter, in section 5.4.3, is an analysis of only the questions asked with regard to the sets of the five value visualizations from each product. All the data is analyzed using descriptive statistics, such as bar graphs and frequency tables. The written explanations of the participants that support or further explain this data is given at each section where it is deemed necessary or wanted.

5.4.1 Demographics

The survey was filled in by twenty-eight participants. Table 13 gives an overview of their demographics. Most notable is that the majority of the participants are between 18 and 25 years old and Dutch. The gender distribution is slightly skewed towards female, and non-binary has the smallest representation.

As explained in section 5.3.2, regarding the participants, it is assumed for this study that there is no difference between the answers from the student and the non-students. Therefore, the answers from all participants will be included in the further analysis of the data.

Table 13 Demographics overview of the participants from study 3

Age			
18-25	26-35	36-50	51+
20	7	0	1

Gender		
Female	Male	Non-binary
16	11	1

Nationality								
Dutch	Dutch-Canadian	Indian	Luxem-bourgish	Bulgarian	German	South-African	Brazilian	Belgian
20	1	1	1	1	1	1	1	1

Students								
University					University of Applied Sciences			
18					3			
Unknown	Study involves design		Study does not involve design		Study involves design		Study does not involve design	
3	10		11		2		1	
PhD	Bachelor	Master	Bachelor	Master	Bachelor	Master	Bachelor	Master
3	5	5	5	6	2	0	1	0

5.4.2 Per value

The survey contained six parts that are related to the value visualizations. The first five of those showed the five similar values, with at each section five products in total. This section displays the outcome of those parts of the survey.

For each part, and thus each value, the participants were asked six questions. These questions are abbreviated in the data visualizations used throughout the rest of this chapter. Additionally, as explained in the procedure section (5.3.3), each of the value visualizations or sets were given a number instead of the product name to avoid bias among the participants. These numbers are also used throughout the analysis. The abbreviations and number references to the products can be found in

Table 14. Furthermore, in the analysis the values are also referenced using both a number, which is in the order they appeared in the survey, and the value name the researcher gave to that corresponding value. For example, the first value shown in the survey is related to friendship, which is named 'value 1 (friendship)' in the figures.

Table 14 Question abbreviations and product reference numbers used in study 3

Product name / full question	Reference / abbreviation
Which of these images/sets do you find MOST aesthetically pleasing?	Most aesthetically pleasing
Which of these images/sets do you find LEAST aesthetically pleasing?	Least aesthetically pleasing
Which of these images/sets do you find MOST contributing to your understanding of this human value?	Most contributing
Which of these images/sets do you find LEAST contributing to your understanding of this human value?	Least contributing
Which of these images/sets would you consider MOST to use during a discussion of this human value with someone else during the design process?	Most consider discussion
Which of these images/sets would you consider LEAST to use during a discussion of this human value with someone else during the design process?	Least consider discussion
'Values deck, by Studio Carreras' (SC)	Image/set 1
'Design for happiness' (DfH)	Image/set 2
'BBC digital wellbeing cards' (BBC)	Image/set 3
the solution created by the researcher (Harms)	Image/set 4
'Find your Values' (VF)	Image/set 5

Total

The complete overview of all the answers per value and per question are displayed in Table 21 as a frequency table in Appendix C.4). For an easier overview, Figure 22 visualizes this data but has all the values for each product (image) combined.

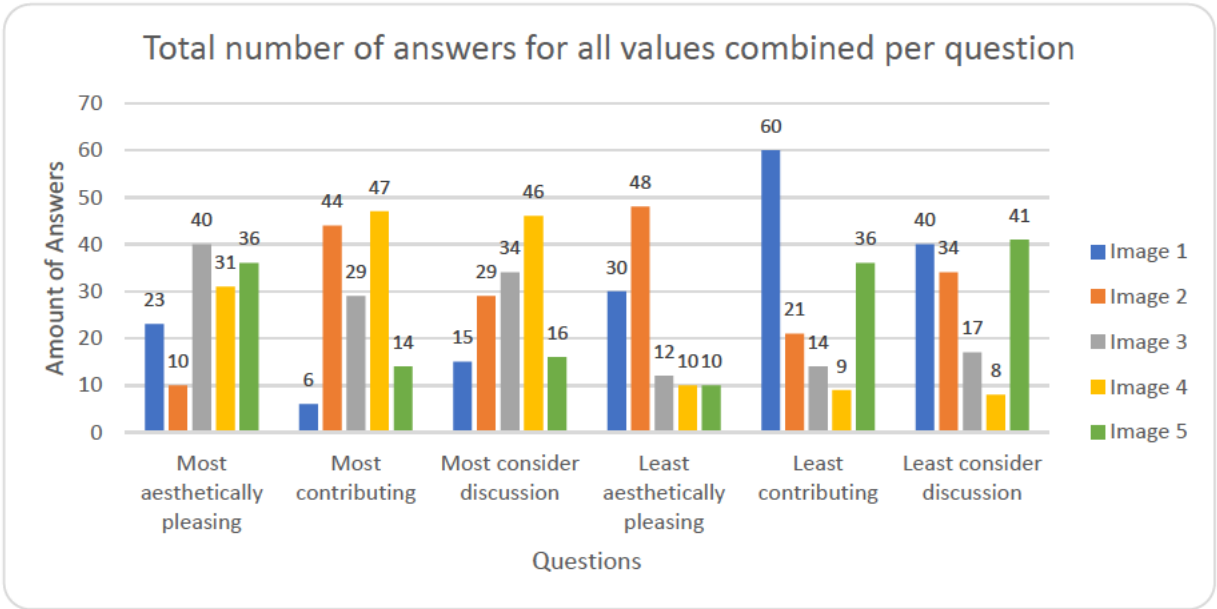


Figure 22 Total number of answers to the six questions from study 3 (values combined)

What can be seen in this figure is that the most aesthetically pleasing product is found to be image 3 (BBC), the most contributing product is image 4 (Harms), and the product that is found to be considered to be used in a discussion the most is also image 4 (Harms). The products that score highest on the 'least' questions are image 2 (DfH), image 1 (SC), and image 5 (VF) for aesthetically pleasing, contributing and consider discussion, respectively.

Another way to show the data for the five products is by combining all the 'most' questions, and all the 'least' questions. In this case, it is good if a product scores high on the 'most' questions and low on the 'least' questions. Even more important is the ration between the two: if a products scores high on the 'most' questions but also 'high' on the 'least' question, this cannot be considered a good/preferred product because either the opinion of the participants is very divided or the product scores high on one aspect (such as aesthetically pleasing) but low on another. Therefore, not only the numbers should be taken into consideration, but also the ratio. Figure 23 shows what the answers from this survey are if they are displayed this way. The answers per image are stacked, where the green part is the total for the 'most' questions, the orange for the 'least' questions, and the number at the top the total number of answers.

Figure 23 Study 3 scores per image for the most and least questions combined

Table 15 shows the same information is in Figure 23, but also displays the ratio between the 'most' and 'least' in the last two rows by showing the percentage of 'most' and 'least' answers when considering the total number of answers.

Table 15 Study 3 answer overview for the most and least questions combined per image, including the ratio in percentages

	Image 1	Image 2	Image 3	Image 4	Image 5
Number of 'Most' answers	44	83	103	124	66
Number of 'Least' answers	130	103	43	27	87
Total number of answers	174	186	146	151	153
Percentage 'Most'	25,3%	44,6%	70,5%	82,1%	43,1%
Percentage 'Least	74,7%	55,4%	29,5%	17,9%	56,9%

What can be learned from this is that image 3 (BBC) and image 4 (Harms) are the only products that show a positive ratio, meaning that there are more 'most' answers than 'least'. The other three images all have a negative ratio, thus more 'least' answers than 'most' answers. When comparing image 3 and 4, we can see that image 4 scores slightly better. The ratios for the 'most' answers are 70,5% for image 3 and 82,1% for image 4. Although this might indicate that image 4 is better than image 3, without inferential statistics proving this is a significant difference, this conclusion cannot be drawn with certainty. Therefore, a more in-depth analysis per question will be done to see if this provides any additional insight.

Most aesthetically pleasing

When looking at the answers to the 'most aesthetically pleasing' question, see Figure 24, it can be seen that image 3 (BBC) scores one time the highest, image 4 (Harms) scores two times the highest, and image 5 (VF) scores two times the highest, but all of them also score low sometimes on the other values where they are not the highest scoring image. Both image 1 (SC) and image 2 (DfH) score relatively low on all values. Although image 3 (BBC) scores the most points in total, it is difficult to point out one product that is more aesthetically pleasing than the rest because the answers differ quite a bit per value.

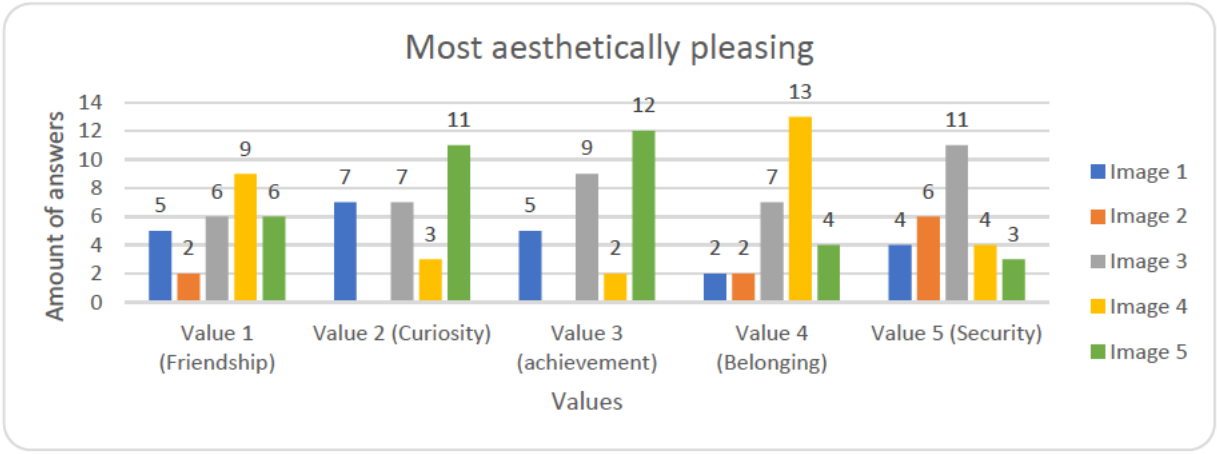


Figure 24 Study 3 answers to 'most aesthetically pleasing' question per image for each value

The participants clarify in the written explanations that they like the simple, clear, and calm visualization of image 3 (BBC) and 4 (Harms), with remarks such as "good visual hierarchy", "not much distraction", "easy to understand image with minimal text to understand the context", and "short & informative text". For image 5 (VF) most participants indicate that they like this image because of the artwork and the colors used within it.

Least aesthetically pleasing

As per Figure 25, the least aesthetically pleasing image is image 2 (DfH). Also image 5 (VF) and image 1 (SC) are both once considered to be the least aesthetically pleasing images. Both image 3 (BBC) and 4 (Harms) score relatively low on all five values. This corresponds with the answers to the 'most aesthetically pleasing' question.

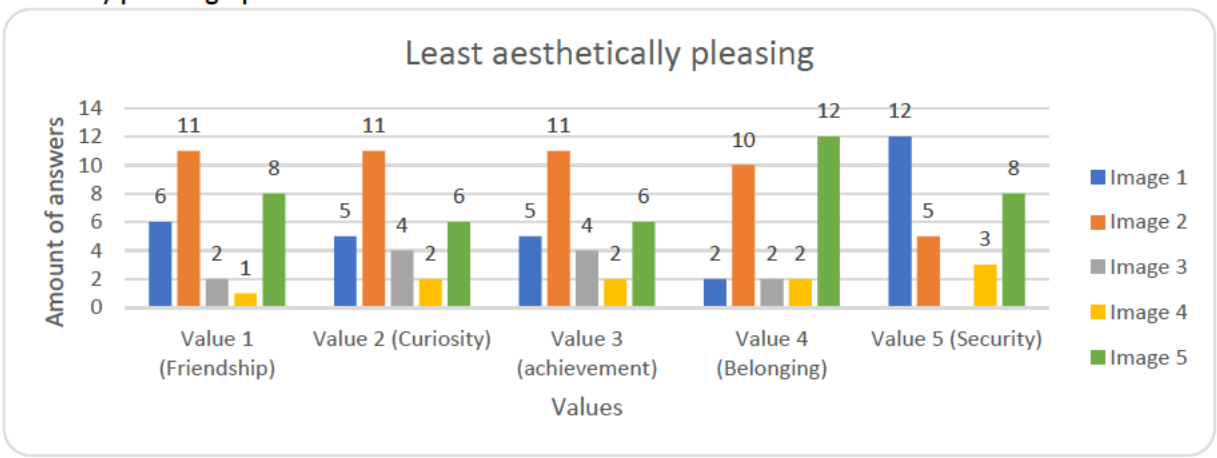


Figure 25 Study 3 answers to 'least aesthetically pleasing' question per image for each value

Participants describe image 2 (DfH) as "too much to look at", "looks rather static and reminds me of (fake) internet guides on how to do something", and "I don't feel the urge to pay much attention to this image". Regarding image 5 (VF) participants explain that "image and text feel like separate

elements" and "too busy with the splatters of color". Image 1 (SC) gets comments such as "too simple, "I've seen something similar way too often", "the color", and "it looks like the UN sustainability goals, not creative at all".

Most contributing to understanding

The images that are considered to be the most contributing to the participants' understanding are image 2 (DfH) and image 4 (Harms). Image 3 (BBC) scores the same as image 4 (Harms) for value 3. Image 3 (BBC) is the runner up to images 2 (DfH) and 4 (Harms) because it scores higher than the other two images (1 and 5) on all values. This information can be seen in Figure 26.

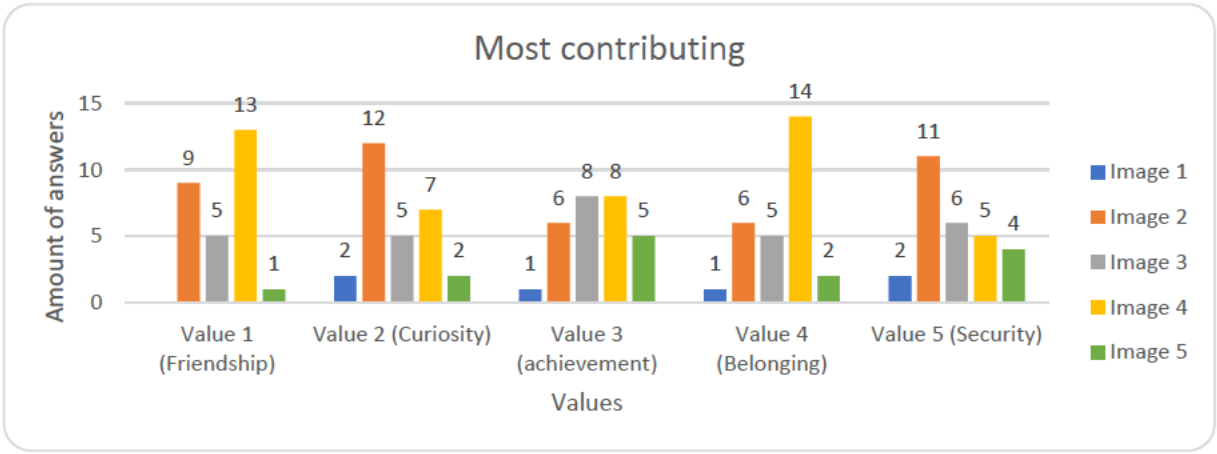


Figure 26 Study 3 answers to 'most contributing' question per image for each value

This is supported by the participants written explanations, as they clarify that they like the written information provided in image 2 (DfH) and 4 (Harms). Not only is the description of the value clear, but several participants add that they like the given context in image 2 (DfH) and the synonyms included in image 4 (Harms). Two people pointed out that they like the different skin colors used in the hands of image 4 (Harms) that show the value of belonging. One person likes image 2 (DfH) of value 5 because "it depicts different kinds of safety instead of just one".

Least contributing to understanding

The image that is the least contributing according to the participants is image 1 (SC). This image scores highest on all five values, as can be seen in Figure 27. Image 5 (VF) also scores relatively high in most of the cases.

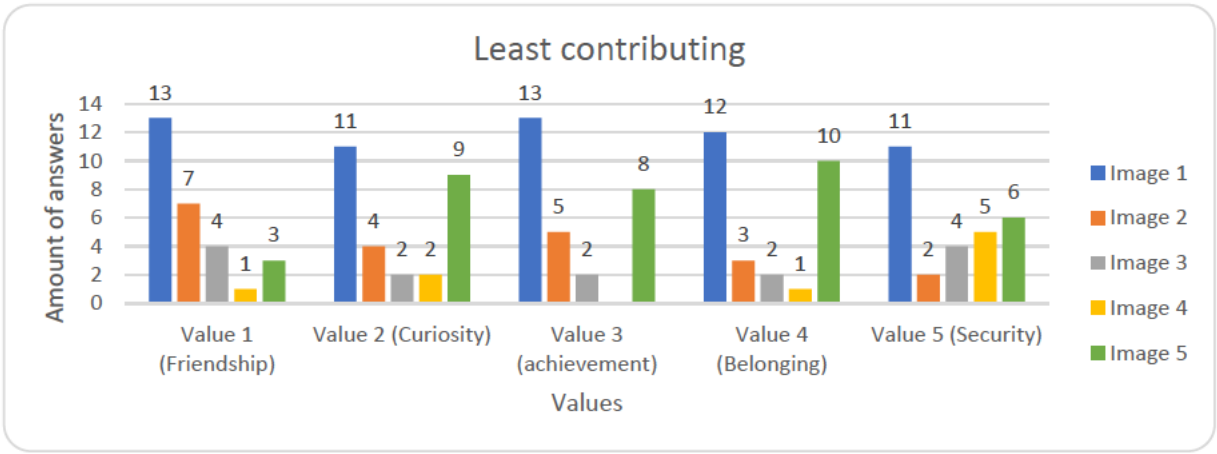


Figure 27 Study 3 answers to 'least contributing' question per image for each value

Participants support this by explaining that the written information provided for image 1 (SC) is not sufficient and that the imagery used is not contributing to this either. Some of these explanations

are: “It has absolutely no context why this message is conveyed to me, I don’t understand the point. And the people are t-posing with their arms blending into each other, it doesn’t look very human-like” for value 1, “No info about the value at all. Also I can barely see the difference between the text in bold and the regular text”, “The explanation is an alternate phrase of the value rather than an explanation of what the value means and how it is used by people”, “It tells me nothing”, “The other people are coloured white and one it blue, which makes them stand out and seem like they don’t belong” for value 4, “It reminds me of keeping someone out instead of belonging” also for value 4, and “It shows a child with two parents, which is not accurate for everyone’s situation. It’s very exclusive towards people with a different family setting” for value 5. What people indicate regarding image 5 (VF) is that the written information and the image do not always support one another and that it takes longer with this image to understand the value being expressed than with the other images.

Most consider discussion

As can be seen in Figure 28, the image that the participants would consider most to use in a discussion is image 4 (Harms), which scores highest on three out of the five values, namely value 1, 2 and 4. This is followed by images 2 (DfH) and 3 (BBC). Image 1 (SC) and image 5 (VF) score lowest on the ‘most consider discussion’ question.

The participants clarify why they like image 4 (Harms) the best by stating the following: “Easy to see image and represents value”, “The included list of synonyms can help with evoking different ideas or emotions during the design process”, “The differences in font sizes show the importance of each piece of text, which makes it pretty easy to read. That’s good design”, and “It does give context, but there’s not too much text”. This indicates that they like the simplicity of the design while it still provides sufficient information. This is supported by the hierarchy (different font sizes) used in the design. Similar arguments are given for image 3 (BBC): participants like the simplicity of the images, supported by a simple but effective image and text in different font sizes, which makes it easy to read. For image 2 (DfH) participants explain that they would consider using this image in a discussion because it provides context to the value on top of the explanation (description of the value). Many also indicate that they like the image used, as it shows different situations/examples in which the value is applied.

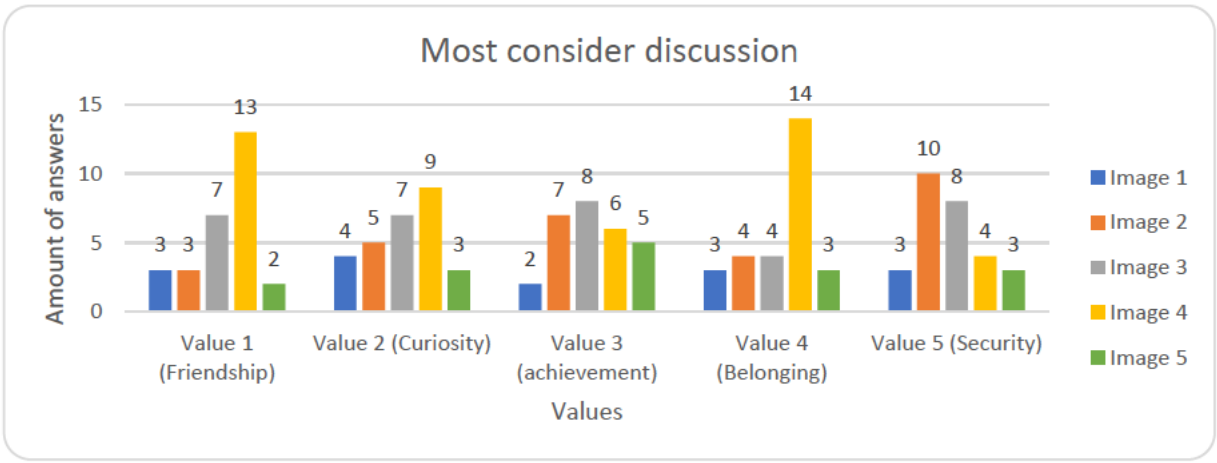


Figure 28 Study 3 answers to 'most consider discussion' question per image for each value

Least consider discussion

As expected from the previous question, the participants would consider image 1 (SC) and image 5 (VF) the least to use in a discussion, although Figure 29 also shows that image 2 (DfH) is not favored by the participants.

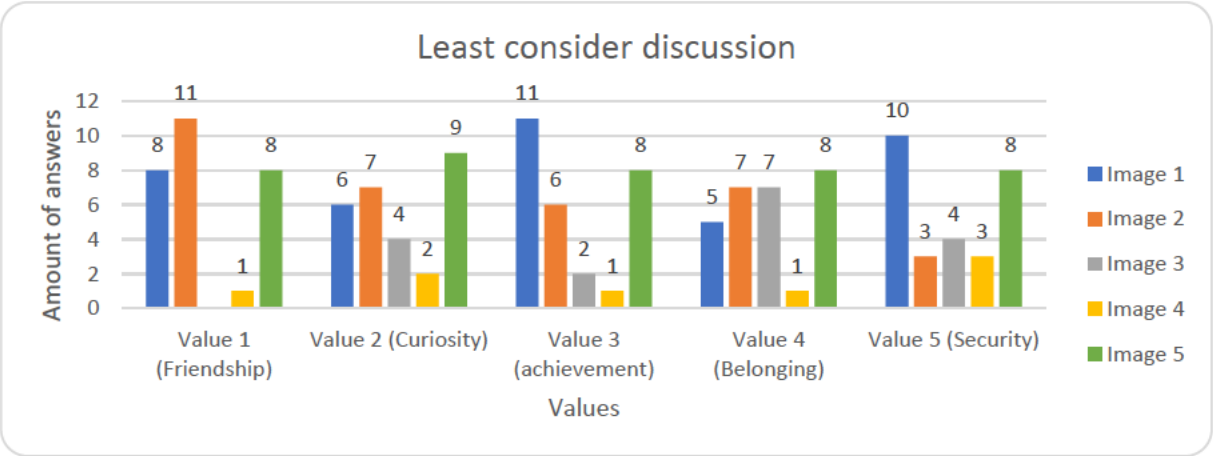


Figure 29 Study 3 answers to 'least consider discussion' question per image for each value

Explanations for why the participants do not like image 1 (SC) are mostly about this image having not enough information regarding the value, such as "simply too little information to help with the process" and "I wouldn't consider image 1 due to it being very bland. It expresses barely any value with no context". Regarding image 5 (VF) the participants explain that it is too busy, which makes it hard to distill what the value is about, with comments such as "Too much going on", "A lot of text, too generic image, does not speak to the imagination", and "It just visually looks the worst and I don't think it would easily get the point across". For image 2 (DfH), two participants point out that they do not like the faces of the people in the images, saying that "the man has a weird face" and "the faces look really weird". Another participant pointed out that there is too much text and, due to the low contrast between the letters and the background, this text is difficult to read.

By looking at the questions separately, and especially the written explanations from the participants that go with the answers to these questions, it can more clearly be seen why some images are preferred and why some are not. For example, image 3 (BBC) and 4 (Harms) are like for their simplicity while still providing sufficient information regarding the value. They both make use of different font sizes for different types of information, which is pointed out to be helpful. Image 1 (SC) is mainly found to be too simple, as it does not contain enough written information and the image is not creative enough and seen before. For image 2 (DfH) the participants explained that they liked the added context provided both in the written information and the two-part imagery used. However, several participants also pointed out that all together this image is too much to easily process and some found the faces in the imagery to be weird. Image 5 (VF) was considered overall too busy, with too much text that does not always support the imagery. Several participants do like the artwork in the imagery.

5.4.3 Sets

The participants also answered the same six questions regarding the sets, which are the five images of the five values from each product combined. The questions regarding the sets were included as it might give a different impression than standalone images. Throughout this analysis, the same abbreviations are used as in the previous section (5.4.2 Per value), which can be found in Table 14.

The answers to these questions can be found in Figure 30. What can be seen in this figure is that set 3 (BBC) is by far the most aesthetically pleasing set and set 4 (Harms) is both the most contributing set and the most considered to be used in a discussion, although the differences between the sets in these latter two aspects are smaller. Set 2 (DfH) is clearly the least aesthetically pleasing set and set 1 (SC) the least contributing to the participants' understanding of the values presented. Set 5 (VF) is least considered to be used in a discussion.

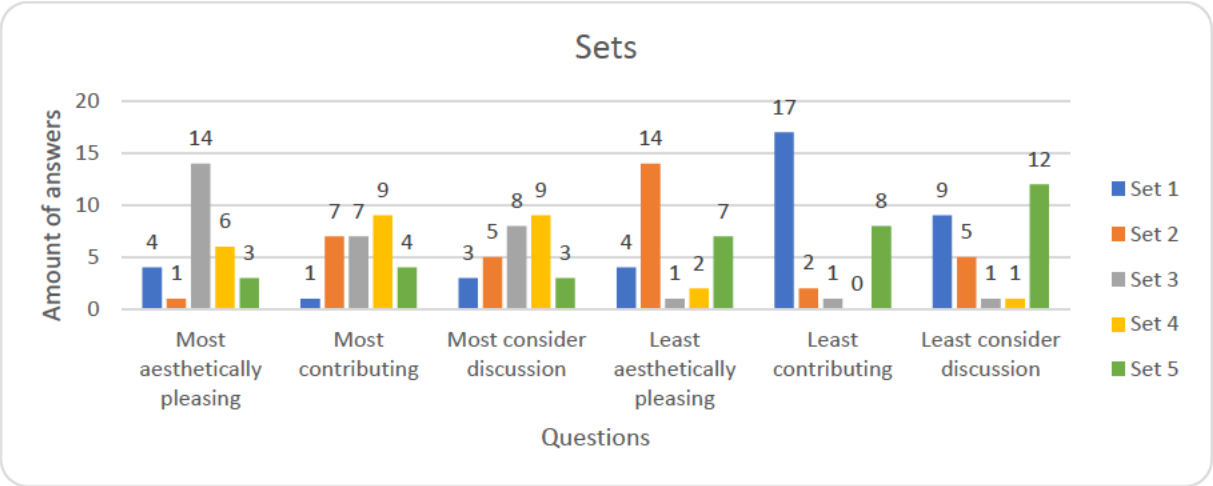


Figure 30 Study 3 answers to the six questions for the sets, where the sets are the five images of the five values from each product

The participants explain that they find set 3 (BBC) the most aesthetically pleasing because this set feels "the most coherent" and because it is "simple, pleasing colours, easy to understand", whereas set 2 (DfH) is the least aesthetically pleasing because overall the images are too busy due to the large amount of text, too much to see in the imagery, and the faces of the people look weird and even "non-human". Set 4 (Harms) is the most contributing set because there is enough text to explain the value, but not too much. The overall images, and the value each of them represents, are easy to understand in one glance. Set 1 (SC) does not contribute to the participants' understanding of the values as these images are too simple, with too little textual information and imagery that does not represent the value very well. Additionally, several participants indicate that the images in this set lack a context for the value. Lastly, set 4 (Harms) is most considered to be used in a discussion because of its simplicity while at the same time presenting enough information: "Once again, enough text for the context and easy to see pictures. Easily usable". The opposite is true for set 5 (VF), which is considered the least for a discussion because it is "way too much text" and there is "too much going on".

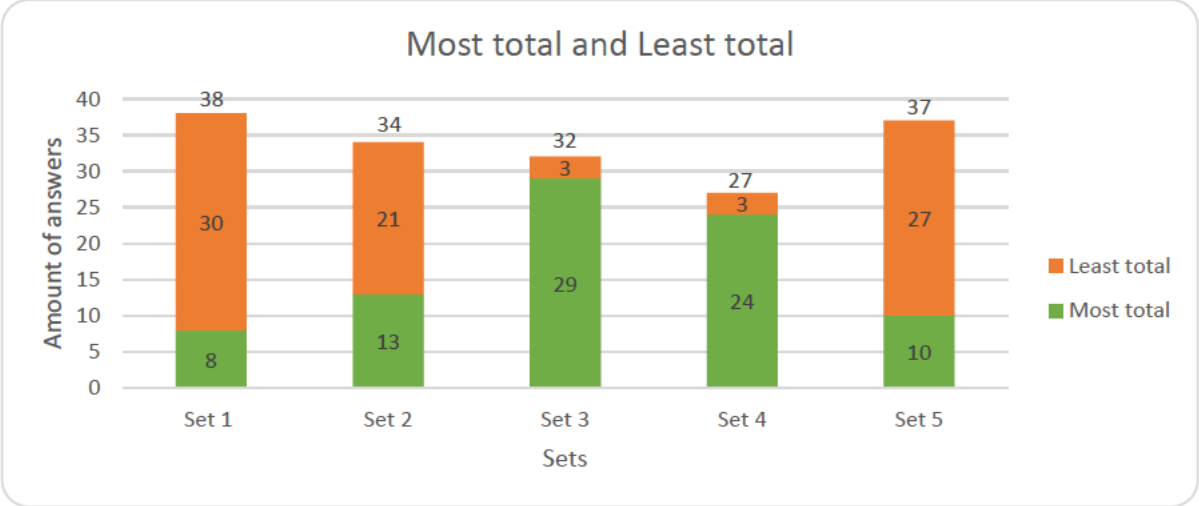


Figure 31 Study 3 scores per set for the most and least questions combined

This information is also supported when all the answers to the 'most' and all 'least' questions are combined. This information can be found in Figure 31 and in Table 16, which also includes the ratios between the in the last two rows. What can be learned from this is that set 3 (BBC) and set 4 (Harms), just like image 3 (BBC) and image 4 (Harms), are the only two with a positive ratio, meaning that they have more 'most' answers than 'least' answers. What is different between these two when

compared to the individual value questions is that now set 3 (BBC) scores slightly better than set 4 (Harms). They both only have three 'least' answers in total, but set 3 (BBC) has more 'most' answers than set 4 (Harms), making their ratios 90,6% and 88,9% respectively. Yet, this difference is very small: they differ less than two percentage points.

Table 16 Study 3 answer overview for the most and least questions combined per set, including the ratio in percentages

	Set 1	**Set 2**	**Set 3**	**Set 4**	**Set 5**
Number of 'Most' answers	8	13	29	24	10
Number of 'Least' answers	30	21	3	3	27
Total number of answers	38	34	32	27	37
Percentage 'Most'	21,1%	38,2%	90,6%	88,9%	27%
Percentage 'Least	78,9%	61,8%	9,4%	11,1%	73%

5.5 Conclusion and Discussion

What follows is the conclusion and discussion of the data and results as described above. The conclusion will summarize the chapter and answer sub research question 3. Both of these will be discussed as to point out any details that should be taken into consideration with regards to the study or its outcome. Finally, the discussion will also include a future works part which describes what can be done in the future to either improve or extend this research.

5.5.1 Conclusion

This study was focused on answering the third sub research question: 'Are the created visualizations preferred over the state of the art products?'. For this, the illustrations created in the previous chapter were combined with the accompanying written information. The composition of all these elements and the font for the written information were determined. A survey was sent out which asked several questions regarding four state of the art products and the solution to determine whether the solution is preferred over the state over the art products. In total, twenty-eight participants filled in the survey.

The answer to the questions per value were analyzed separately from the answer to the set questions, but both show a similar outcome. The most aesthetically pleasing image/set was found to be BBC and the least aesthetically pleasing image/set was DfH. The solution (Harms) was regarded as the most contributing to the participants' understanding of the human value, while SC was considered the least contributing. The solution (Harms) was also deemed to be considered to be used the most in a discussion of that human value, whereas VF was indicated as the product that the participants would consider the least to use.

For both the values and the sets, the totals of the three 'least' and the three 'most' questions were combined and the ratio between these two were calculated. For the individual value questions, the solution (Harms) was found to be the best scoring product as this has the highest positive ratio (82,1%). The only other product that has a positive ratio is BBC (70,5%). With the set, again these two products are the only products with a positive ratio. However, this time BBC scored better than Harms, with the ratios being 90,6% and 88,9%, respectively. Although BBC scores better, the difference between the products is much smaller (less than 2 percentage points) than the difference between the two from the individual values questions (11,6 percentage points).

All of this indicates that the two best scoring products from this survey are BBC and Harms. Without inferential statistics, which cannot be applied to this type of data, it cannot be determined whether one or the other is significantly better. Therefore, it can only be concluded, and thus answering the sub research question, that the solution (created visualization) is not better than all of the (tested) state of the art products, but that it does score on the high end.

All of the requirements, as set and explained at the start of this chapter, are met: the illustrations from detail level three and the accompanying written information from the previous study are included in the designs of the solution, the design includes the four elements as determined by study one, and only the front of the card was made and tested.

5.5.2 Discussion

There are several points and actions in this chapter that need to be pointed out and discussed.

Limitations of the creation process

The first point of discussion is the composition of the elements, which has not been tested. Due to time constraints, it was not possible to test this. This means that the chosen composition might not be the best.

The font used in the solution was tested, but only a small selection of fonts was assessed, and the test was performed (informally) among a limited number of peers. These peers are probably like-minded and thus do not fully represent the complete population of the solution, which would be anyone around the world.

The solution consists of four elements 'name of the value', 'description of the value', 'visualization of the value' and 'other written context', where the other written context takes shape as synonyms. Although study 1 indicated that it might not be really necessary to include all four elements, as the value name and description were most important but the other two did not always contribute to the understanding of the value, it was decided to include all the elements in chapter 4. The visualization of the value was definitely included as that is the topic of this thesis, but the decision to add the other written context was made because the hope was that, if this is done right, it would contribute to the understanding of the value. The survey for this study did not include specific questions regarding the elements, but several participants commented that they like the additional information provided with the other written context. This was not only indicated for the solution, but also for DfH. This indicates that it was a good decision to include this.

Limitations of the method

The survey included only four out of the twelve identified state of the art products, which means that the solution is not tested against all of the state of the art products. Therefore, any conclusions drawn for this chapter only applies to the four tested products, and thus not all of the state of the art products.

Additionally, the questions that were asked in the survey produced nominal data. This only allowed for descriptive statistics and not inferential statistics. Although it is common for explorative studies to gather such data, it makes it difficult to draw definitive conclusions. It might have been better to change the questions in such a way that inferential statistics can be applied. However, such questions, for example likert-scale questions or ranking questions, generally take longer to answer. This would also mean that the survey would need to be shortened to decrease the time that it takes to fill in the survey to ensure that enough participants can be found willing to fill in the survey.

With the current setup of this survey, it took participants about 10 minutes to fill it in if one only answered the mandatory questions. If a participant decided to explain their answers (not mandatory), the needed time to complete the survey could increase to approximately half an hour. People might have become fatigued over time and the answers towards the end of the survey could have gotten less attention than the first, which could have negatively impacted the survey and its outcome. This could have been avoided if the survey was shorter. One example of how the survey could be made shorter is to not ask the individual value questions for all five values, but only on three out of the five.

The sets would still need to include all five as this gives the participants a better sense of what a complete set of all values (approximately between 40 and 50 cards) would look like.

The last part of the survey where the participants were asked to review the sets only included five value visualizations from each of the products, which is not their full set of cards. This means that the participants did not get the full view of what each product looks like. The answers to this part of the survey might have been different if they had seen all the cards of each product.

The order in which the values were shown, both the order of the individual value question parts as well as the (same) order of those values in the sets, have influenced the answers of the participants. For the individual value questions, the participants had to first get used to the questions for the first value but might have experienced some fatigue towards the last value. For the questions regarding the sets, the images of each card from each product were shown in the same order as they were shown during the individual value questions. One participant remarked here that they did not like the DfH set because the last three cards all are the same color. If the order of the values had been different, their answers, and maybe of other participants as well, could have been different.

Lastly, the target population for this survey was the same as the target population for the first study. This was kept the same to ensure that the same type of participants partook throughout the thesis. Although study 1 already indicated that students and non-students answer similarly, which would indicate that it would be okay to search participants outside of the student related places such as the University of Twente (where many of the participants were scouted), it would also introduce a new and untested variable. This is because study 1 only proved that the student and non-students within the search area of the researcher (the University of Twente, and several of her WhatsApp groups and other connections) answer similarly. It did not prove that this would also be the case outside of the search scope. Therefore, the search for participants was kept the same to ensure that this similarity in answering, and thus that all entries can be used in the analysis, is also true for this pool of participants.

Discussion of the results

The demographics section of this study showed that the participants were not always evenly distributed on all aspects. The biggest difference lies in the nationality diversity, because the majority (20 out of 28) of the participants is Dutch. Each individual person of course has their own opinions, but these are partially affected by their cultural influences such as their nationality. If a more diverse pool of participants with regards to nationality would have been tested, the outcome might have been different. Another aspect which was not evenly distributed was the gender of the participants: there were a few more females than males that filled in the survey, and only one person that identifies as non-binary.

Many points of discussion regarding the questions are already mentioned above in the method, however there are also some points of discussion that arise from the data itself. For instance, not all participants gave explanations to their answers, which means that the given written explanations throughout this chapter are only from this select group and thus do not fully represent all participants. Also, some participants indicated in their written answer that they would have picked another (additional) answer if they could pick two answers, because they found two images to be equally good/bad with regards to that question. This was not changed or added data of the questions.

The conclusion drawn with respect to the sub research question is not a definitive answer, as the solution was not clearly preferred over all state of the art products, but it was only preferred over most. It scored very similar to one other product, namely BBC, and without inferential statistics it could not be determined whether one or the other was preferred. Also, as mentioned in the limitations of the method, the survey only tested the solution against four of the state of the art products. Therefore,

it must be kept in mind that the conclusion only applies to these products and not all state of the art products.

Future work

There are several actions that can be taken in the future that would improve or expand the research as done in study 3.

First of all, many of the decision taken during the creation process are not (fully) tested, which should be done in the future. This includes the composition of the elements on the card as well as more extensive testing regarding the font that should be used for the written information. Additionally, as there is currently no information known concerning color association and human values and there was no time during this thesis to research this, colors were not used in the complete design outside of the colors used in the illustration. However, color could possibly contribute to the understanding of the value. It could be used to group individual values that belong to the same value group, it could be used to make the cards look more interesting, and it could possibly help with conveying the meaning of the value. Therefore, color association with human values should be researched in the future and applied where necessary or wished for in the solution.

Secondly, during the creation process it was discovered that illustrations with objects at the top or coming out of the top of the illustration, such as the hands in the value visualization of belonging, pose an additional implementation problem. For study 3 this was solved by applying a white/transparent gradient to the top of that illustration to make the transition from the background to the illustration smoother. In the future, either the same technique should be applied such that all illustrations with this characteristic are implemented on the cards in the same way, or the illustrations of the values should be designed in such a way that no objects are at or coming through the top of the illustration.

Thirdly, the size of the cards for the solution was chosen to ensure that all the information and the illustration fit on the card. However, this size is not a standard card size. If the solution stays a digital tool, then this will not pose a big problem, but if a physical card set will be made in the future, it would be good to look into the size of the cards. The reason for this is two-part: first because the size of the cards partially determines the font size of the text and the text should remain legible to the user, and secondly to ensure that the physical cards can be produced as cost- and material effectively as possible.

Lastly, the solution should be tested more extensively and accurately. This can be done by: 1) comparing the solution to more than four of the state of the art products, preferably all state of the art products; 2) to design a survey or another type of test in such a way that more definitive conclusions can be drawn, by for example asking questions that give numerical or quantitative data to which inferential statistics can be applied; 3) test among a more representative sample of the population, especially regarding the nationality, as the participants from this test were mainly Dutch, and the full population, not only students, should be tested; 4) either all participants should explain their answers to ensure that these do not give a skewed view or a disclaimer should be given, as done in this study, that these might give a skewed view if not all participants gave these insights. This should not only be done in the early stages of the design of the solution, where only a small number of visualizations are created, but certainly also at the end stage of the design to ensure that the complete set of value visualizations has the desired effect.

6: Conclusion

To answer the main research question, each of the sub research questions and their outcomes are summarized. This if followed by the answer to the main research question.

6.1 Answer to sub research question 1

Sub research question 1:
Which elements of the visualization of values from the state of the art of the preliminary research contribute to the understanding of values?

In chapter 3, four products from the state of the art products were identified that each had different characteristics (see Table 2) that could analyzed in the study to examine which elements should be included in the solution. The products each made use of a different imagery style (icon, digital illustration, photograph, combination) and had various numbers of elements. The elements a product could contain are: name of the value, description of the value, visualization of the value, and other written context.

A digital survey was sent out, which was filled in by thirty-two participants. The results of study 1 in chapter 3 indicate that at least the name of the value and the description of the value should be included in the solution, but that the other two elements, visualization of the value and other written context, also contribute to the understanding of a value if they are done right. The participants indicated that more elements do contribute to their understanding of the value, but that it can also lead to too much information. Accordingly, it is essential that there is a good balance between the elements, such that they provide enough information regarding the value while not being overwhelming. The type of imagery used for the visualization also has to adhere to this balance: an icon was found to be too simple, while the combination imagery and sometimes the digital illustration were found to be too busy. A middle ground between an icon and a detailed digital illustration or photograph, which can be considered as the two extremes with regards to the level of detail in an image, has to be found.

6.2 Answer to sub research question 2

Sub research question 2:
What imagery should be used in the visualization of human values to improve the understanding of that value and such that people would use them in a discussion of that value during a design process?

The first study indicated that the image should neither be too simple nor too busy and overwhelming. Therefore a balance has to be found between the two extremes of an icon and a detailed digital illustration or photograph. What the perfect balance is between those two, was determined in the study for sub research question 2 in chapter 4. For this, three levels of details that were to be illustrated were defined (see Table 10) and illustrations were created according to these levels. Five values were illustrated, because an overlap of five similar values could be found among four state of the art products, which are needed for the next study.

The created illustrations were tested among eight design experts. The survey used in study 2 (chapter 5) shows the five values separately (the three illustrations of a value according to the three levels of detail, for each of the five values) and the complete set of the five values at the three levels of detail. The results show that there is a preference for the middle level of detail, which is level 3 (set

2). This level contains: five to ten flat but saturated colors that should be of a medium tonal range; there should be no textures, patterns, shadows, or background; the lines used can be both curved and straight but should not be too detailed; and the people in the illustrations should have facial details. It should be noted that this is only the preferred style from this one instance that the illustrations were created and tested. Several participants explained that there are multiple points of improvement for the illustrations which would make them better. However, these were not executed for the thesis but are part of the future works.

6.3 Answer to sub research question 3

Sub research question 3:
Are the created visualizations preferred over the state of the art products?

For the third study in chapter 5, the illustrations from the third level of detail, as determined best by study 2, were combined with their accompanying written information to create a card-like product. The composition of these elements was kept simple, and the font used for the written information was informally tested among several peers. This quick test indicated that a sans-serif font would be the best fit, more specifically the font 'Futura'.

A digital survey with the created product (the solution) and four state of the art products was created and sent out. It asked questions about the images of the five individual values as well as the set of five values. Twenty-eight participants filled in this survey. The results reveal that the solution scores well and scores similar to one of the other products, namely the BBC Digital Wellbeing cards. The other three products score considerably lower. With the similar scores between the two products, it is hard to determine which one was better and thus to conclude whether the created visualizations are preferred over the state of the art products. However, it does indicate that the solution performs well. Nonetheless, it should be noted that this study tested the solution among only four state of the art products, and not all identified state of the art products.

6.4 Answer to main research question

Main research question:
"What is the best way to visualize human values such that they can help in a discussion between a designer and a stakeholder in a design process to get a better grip on the concept and thus improve the discovery and the discussion of the stakeholder's values?"

The three studies conducted for the master thesis are of an explorative nature. This means that there are not hard numbers, such as inferential statistics, to support the results. Nonetheless, the results from study 3 indicate that the created visualizations score very well. Consequently, it can be assumed that the approach taken in this thesis works satisfactory to visualize human values. Whether these visualizations help in a discussion between a designer and a stakeholder in a design process to get a better grip on the concept and thus improve the discovery and the discussion of the stakeholder's values is yet unknown. This is because the created product could not be tested in such a situation.

This means that the visualizations of human values should include the four identified elements from study 1, which are: name of the value, description of the value, visualization (imagery) of the value, and other written context, such as synonyms. The imagery should adhere to level three of detail as defined during study 2 in Table 10. The written information should neither be too short nor too long,

as too short will not improve the understanding of the human value, and too much written information can overwhelm and distract the user. The imagery and the written information should support one another. This is to say: the imagery should reflect the written information and provide additional context, such as example situations, but also the written information can provide such examples or additional context to reinforce the imagery. The composition of the elements on the card should be kept simple, as this will make it easier for users to distill the relevant information from the card. This can be enhanced by applying a visual hierarchy to the written information, by using, for example, different font sizes. In this instance, a larger font size is used for more important information, such as the name of the value, and a smaller font size for the less crucial information, such as the synonyms or other types of other written context. Lastly, there needs to be a balance between the written text and the imagery. This can include, but is not limited to, a balance in size between the elements or a harmony in color, such that neither the text nor the imagery outweighs the other.

7: Discussion

This chapter will first discuss the conclusion regarding the main research question and the requirements for the solution in sections 7.1 and 7.2, respectively. The discussion related to the sub research questions can be found in their respective chapters. Following the discussion is the future work regarding this thesis. This can be found in section 7.3. Again, this is only regarding the main research question and the research conducted overall. How the sub research questions can be improved or expanded in the future are pointed out in their corresponding sections.

7.1 Discussion of conclusion

As indicated in the conclusion in section 6.4, the thesis is an exploratory research, which gives a better understanding of the problem and possible (indications to) solutions, but it does not provide conclusive results. So, although the third study indicates that the approach used works well to visualize human values and that the solution scores well when compared to several state of the art products, there are no (inferential) statistics to support this.

Additionally, the solution was only tested among a limited number of state of the art products by means of a survey, but was not tested in a real life-like situation to see whether it helps in a discussion between a designer and a stakeholder. Therefore, it is only an assumption that the solution would help because the survey indicates that participants prefer the solution over the majority of the state of the art products that were tested.

Some of the descriptions given for what the visualizations of human values should include remain vague. For example, the description of "the written information should neither be too short nor too long" does not give definite boundaries for the amount of written text. The same can be argued for "there needs to be a balance between the written text and the imagery".

Furthermore, the method described and used to create the visualizations will not always produce the same result. Throughout the method, many choices are made that depend on the designer's judgement. Also, some information is taken from the internet, which can change over time. This means that if, for example, one year from now someone would follow this method, they might find different information, such as the reference photographs, and based on their choices from their personal judgement different visualizations will be made.

Nonetheless, this research contributes to the understanding of how human value visualizations can be created. It has identified a method and accompanying requirements for visualizing human values.

7.2 Requirements

In section 2.3.1 several requirements for the solution were set. Most were met throughout the thesis research and this is indicated in the appropriate chapters. Appendix D.1 gives an overview of these requirements and how they were met. Any additional requirements specifically for a sub research questions were added and discussed in the corresponding chapters.

One requirement that was not fully met is regarding the intention of the solution, as stated in the main research question. The solution was created with the intention that it can be used in a discussion to help the elicitation of stakeholders' values. As explained in the discussion of the conclusion (7.1), it is not certain whether the solution reached this goal, as the interaction was not examined in this thesis.

In the current format of the solution, which is a digital card-like format, the design allows for accounting for value change, because any necessary changes can easily be made and the updated

version or new additions can easily be distributed among the users. However, if in the future a different format is used, such as a physical card deck, it is unclear if the product can account for value change.

7.3 Future work

Throughout this report, several future work points have already been indicated. For instance, section 2.3.2 describes the future works that result from the literature research. Each of the three study chapters also include the future works related to that study. These can be found in sections 3.4.2, 4.5.2, and 5.5.2. A short summary of those can also be found in Appendix D.2. The most important and recurring actions that should be taken in the future are explained below.

First, as mentioned in section 2.2 regarding the state of the art, color coding is used to some extend in the state of the art products. However, it is unknown which values people association with which colors. To the researcher's knowledge, there is currently no known official record about this. Therefore, the color association regarding human values should be researched. If this exists and it is known which colors are associated with which colors, this can be included in the design of visualizations to further improve them.

Secondly, this thesis only created five value visualizations for research purposes. To make this a complete product, a complete set of visualization should be created where all human values are visualized. During the creation and subsequent research that is needed to validate them, one should account for several aspects. First of all, it is important that the cards are proofed for colorblindness. Secondly, the correct symbolism for each value should found and used. Also, the most generally accepted and valid value description and other written context, for instance synonyms, should be included in this. Lastly, the composition of elements, font used for the written information, value illustrations, and card size should be further researched, tested, and included in this design such that the most optimal cards are created.

Moreover, the format of the cards, or even a complete tool, should be decided upon. For this thesis it was chosen to create digital card-like visualizations so that they can easily be tested. However, it is important to explore all possible options and chose the best one. For instance, a physical card deck can be created. However, with a physically printed deck it will be difficult to change the visualizations as the values change over time. On the other hand, many people prefer a physical product of a digital product to avoid more screen time and to improve easier interaction. A digital card set would allow for easier and faster changes to the visualizations and for more accessibility around the world, like during a pandemic, but at the same time also limits the availability because one would need a digital interface such as a smartphone or laptop. A combination of both, where neither is reliant on the other grants the benefits of both sides but costs more money and time in the creation and upkeep. There are many more advantages and disadvantages to these formats, and there might even be better formats. This all needs to be further investigated and the best choice must be made.

Furthermore, as this was an explorative research, more testing will have to be done in the future to validate the results from this thesis. This includes but is not limited to: 1) an iterative process of testing and (re)designing the visualizations to optimize them, 2) quantitative research, 3) in-person testing of the product to see if they have the desired effect, 4) all tests should be done with participants that fully represent the population, 5) ensure that all these tests are done well such that they do not produce skewed results or insights, or written explanations from only a select group of the complete participant pool, or biased answers.

If desired, a complete tool instead of only a card deck can be created. This tool should aim at guiding and helping the designer through the complete design process. This can, for example, include stakeholder identification, help with stakeholder value conflicts and value trade-offs, assist with translating the human values into design requirements, and so on.

Moreover, a decision must be made that was not specifically mentioned in the future works throughout the report, but it was mentioned in the discussions of some of the studies: value list choice. The value names used in the solution are partially based on the values of H. Schwartz (1992) but the names are not validated. For any future work it should be decided whether a (validated) values list should be used for this. As explained in the literature research, there are reasons in favor and against using a value list. The main benefit is that it provides an overview and structure for creating the visualizations, but the drawback is that this list will never be complete or always up to date as values change over time. If it is chosen that a value list should be used, it should be researched which list will be used for this (one of the existing ones or a self-made list) and how the visualizations will account for the value change that happens over time in this list.

To conclude, in general, the research conducted for this thesis and its outcome can serve as steppingstone for any topics related to the visualization of human values. It provides insights regarding the elements that should be included in such visualizations and presents a method that guides the creation and inclusion of these elements. In the future, the designs of the five created visualizations, especially the illustrations, will have to be improved to better reflect the values they display, and the remaining human values need to be visualized. More extensive evaluations of the design are needed to ensure that it works as intended. Finally, a complete tool to guide a user through the design process of a product or service with a focus on human values would greatly contribute to the incorporation or human values in design.

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Appendix A: Sub Research Question 1

A.1 Sub Research Question 1 Survey

Survey Master Thesis Irma Harms - Visualizing Values

Hello and welcome to this survey!

You are invited to participate in a web-based online survey where you will be asked to look at several visualizations of human values and to answer several questions regarding those visualizations. Below, you can find more information on the survey and on the need for providing informed consent.

It is recommended that you do this survey on a laptop, pc, tablet or any other device that has a relatively large screen. This is because the images that are to be shown to you can be viewed best on a large screen.

* Required

Information about the survey

The survey that will follow serves to answer a sub research question for the master thesis research of Irma Harms. The master thesis is about visualizing human values, for example creativity and friendship, such that they can help in a discussion between a designer and a stakeholder about the values of the stakeholder. Such visualizations can include elements like the name of the value, the value description, and imagery. Designers and their stakeholders can use these visualizations to better understand the value that they are discussing. This helps a designer understand what is important to a stakeholder and can use this information to improve their design. Human values can be described as "what a person or group of people consider important in life".

This specific survey aims to find out which type of visualization is most preferred when visualizing such values and which elements contribute to this. First, we ask you to reply to several personal questions. None of this information allows the provided answers to be traced back to you. Consequently, you will be shown several visualizations of values and questions regarding these images will be asked. This includes closed questions such as Likert-scale questions and some open questions where you can explain you answer. Some examples of the closed questions are “this image is aesthetically pleasing” where you fill in a 7 point Likert-scale and “which elements that are contained in the image contribute to your understanding of the value?”.

It is expected that it will take 10 to 20 minutes to fill in this survey and there are no risks involved in filling in this survey.

1. Do you understand the purpose and the tasks of this survey? *
   Mark only one oval.

   - ◯ Yes
   - ◯ No

Information about the research and consent

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time while filling in the survey. If you decide not to participate in this study or if you withdraw from participating at any time, you will not face any consequences and your data will not be saved or stored.

Your responses will be confidential, meaning that none of the information that you provide can lead back to you personally.

Below you can fill in your e-mail address (optional). This will then be linked to your survey response for 48 hours with the sole purpose of you being able to withdraw your answers after you have submitted your survey. If you wish to withdraw your answers, you can send an email - using the email address that you filled in - [redacted] with a request for withdrawal. This must be done within 48 hours of submitting the survey response. After this timeframe, your e-mail address will be deleted from your survey response and therefore will not be linked to your answers anymore. At that point your answers cannot be deleted anymore. If you do not fill in your email address, no personal information will be linked to your response and your answers cannot be withdrawn.

The data will be stored in a password protected google drive folder and it will be deleted once the study is finished. The results of this study will be used for scholarly purposes only.

If you have any questions about the research study, you can contact any of the following people:

- Researcher: Irma Harms [redacted]
- Supervisor of thesis: M. B. van Riemsdijk [redacted]
- Supervisor of thesis: G.D.S. Ludden [redacted]

If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the Ethics Committee, Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS), University of Twente, at [redacted].

2. Please, check the checkboxes that apply to you: *

Mark only one oval per row.

	Yes	No
I have read and understood the study information provided above, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	◯	◯
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	◯	◯
I understand that data I provide will be used for the master thesis of Irma Harms with only an educational purpose.	◯	◯
I understand that personal information collected about me that can identify me, such as my email address, will not be shared beyond the study team.	◯	◯
I agree that my information can be quoted in research outputs.	◯	◯
I am at least 18 years of age.	◯	◯

3. If you would like to be able to withdraw consent and your answers (within 48 hours of filling in and submitting this survey), please provide your email address below.

_____

Demographic information

4. Age range *

Mark only one oval.

◯ Younger than 18 years old
◯ 18-25 years old
◯ 26-35 years old
◯ 36-50 years old
◯ 51+ years old

5. Gender *

Mark only one oval.

◯ Male
◯ Female
◯ Prefer not to say
◯ Other: _____

6. Nationality *

_____

7. Are you a student at a university or a university of applied sciences (HBO in Dutch)? *

Mark only one oval.

◯ Yes, I am a student at a university. *Skip to question 8*
◯ Yes, I am a student at a university of applied sciences (HBO in Dutch) *Skip to question 8*
◯ No *Skip to question 10*
◯ I don't know *Skip to question 8*

Demographic information

8. Does your study involve design, such as the programs of Industrial Design Engineering, Graphic Design, and so on? Please fill in "other" if you don't know and provide the name of your study. *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

9. What is the level of study that you are currently in? *

Mark only one oval.

- ◯ Bachelor
- ◯ Master
- ◯ PhD/PDEng
- ◯ Other: _____

Value Visualization: Introduction

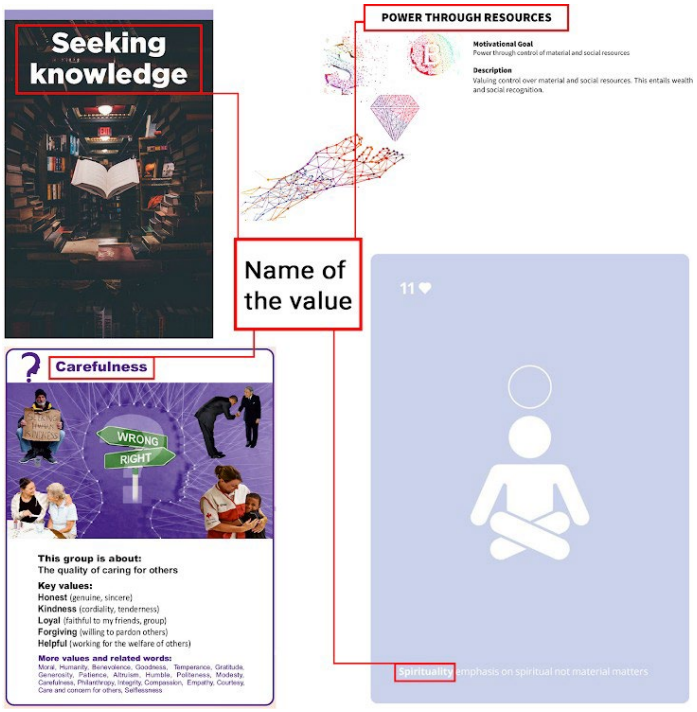
You will answer some questions regarding existing products that visualize human values. You will see four products in total.

For each of the products, you will first see the image about which the questions will be asked.

After this, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory.

Then you will be asked some questions about the elements in the image and which of these contribute to your understanding of the value. A small explanation below will illustrate what these elements are. The four images show you the elements of "name of the value", "description of the value", "other written context", and "visualization of the value". Red boxes indicate where these elements can be found in the products. As you might see, not all products contain all the elements. If an element does not apply to the image you are answering questions about, then you can ignore that element in the question.

Example image for the element "name of the value"



Example image for the element "description of the value"

Example image for the element "other written context"

Example image for the element "visualization of the value"

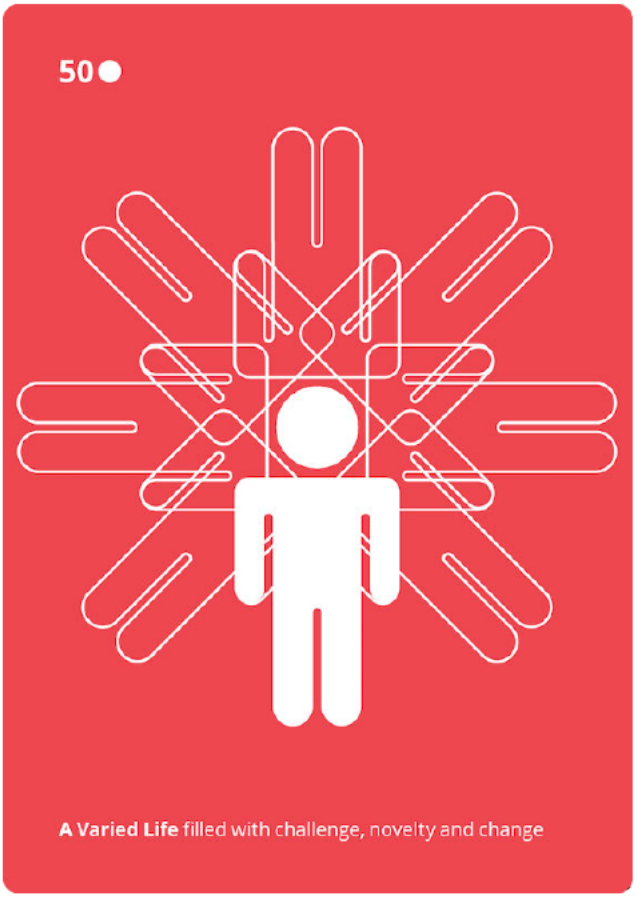
10. Of these three, which is your favorite colour? *
Mark only one oval.

- ◯ Yellow *Skip to question 11*
- ◯ Red *Skip to question 131*
- ◯ Green *Skip to question 71*

Product 1

Below you see the the image of product 1. This image portrays the value of "a varied life". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 1



11. What is the number in the top left corner of the image? *
Mark only one oval.

- 50
- 80
- 20

12. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

13. Please, explain your answer.

14. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

15. Please, explain your answer.

_____

16. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

17. Please, explain your answer.

_____

18. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

19. Please, explain your answer.

_____

20. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

21. Please, explain your answer.

_____

22. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

23. Please, explain your answer.

_____

24. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

25. Please, explain your answer.

_____

Product 2

Below you see the the image of product 2. This image portrays the value group of "pleasure". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 2

26. How many key values are mentioned in this product? *

Mark only one oval.

- 3
- 5
- 7

27. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

28. Please, explain your answer.

29. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

30. Please, explain your answer.

_____

31. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

32. Please, explain your answer.

_____

33. Which elements do you see in the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

34. Please, explain your answer.

_____

35. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

36. Please, explain your answer.

_____

37. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

38. Please, explain your answer.

_____

39. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

40. Please, explain your answer.

_____

Product 3

Below you see the the image of product 3. This image portrays the value of "seeking adventure". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non- obligatory. After this, you will answer several questions regarding the elements in this image.

Product 3

41. What type of verhicle do you mainly see in the image? *

Mark only one oval.

- Cars
- Planes
- Trains

42. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

43. Please, explain your answer.

44. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

45. Please, explain your answer.

_____

46. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

47. Please, explain your answer.

_____

48. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

49. Please, explain your answer.

_____

50. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

51. Please, explain your answer.

_____

52. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

53. Please, explain your answer.

_____

54. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

55. Please, explain your answer.

_____

Product 4

Below you see the the image of product 4. This image portrays the value group of "stimulation". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory.
After this, you will answer several questions regarding the elements in this image.

Product 4

56. What is the first text below the value group name? *
Mark only one oval.

- Moving man
- Material gain
- Motivational goal

57. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

58. Please, explain your answer.

59. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

60. Please, explain your answer.

61. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

62. Please, explain your answer.

_____

63. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

64. Please, explain your answer.

_____

65. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

66. Please, explain your answer.

_____

67. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

68. Please, explain your answer.

_____

69. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

70. Please, explain your answer.

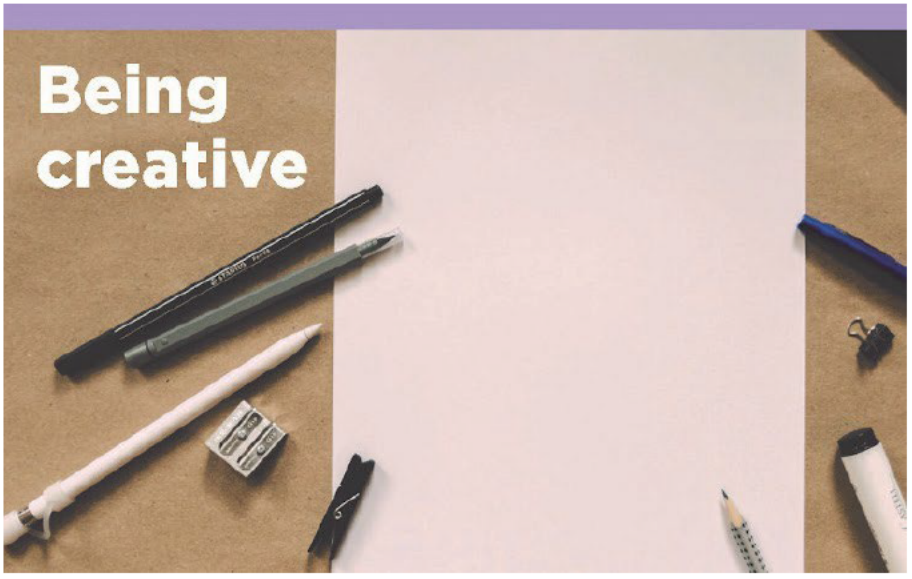
_____

Skip to section 17 (The end)

Product 1

Below you see the the image of product 1. This image portrays the value of "being creative". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non- obligatory. After this, you will answer several questions regarding the elements in this image.

Product 1



71. What do you see in the image? *

Mark only one oval.

- ◯ Paper and writing utensils
- ◯ Paint and brushes
- ◯ Yarn and knitting needles

72. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

73. Please, explain your answer.

_____

74. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

75. Please, explain your answer.

_____

76. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

77. Please, explain your answer.

_____

78. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

79. Please, explain your answer.

_____

80. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

81. Please, explain your answer.

_____

82. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

83. Please, explain your answer.

_____

84. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

85. Please, explain your answer.

_____

Product 2

Below you see the the image of product 2. This image portrays the value group of "self-direction of thought". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non- obligatory. After this, you will answer several questions regarding the elements in this image.

Product 2

86. What is the first text below the value group name? *

Mark only one oval.

- Moving man
- Material gain
- Motivational goal

87. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

88. Please, explain your answer.

89. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

90. Please, explain your answer.

91. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

92. Please, explain your answer.

93. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

94. Please, explain your answer.

95. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

96. Please, explain your answer.

97. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

98. Please, explain your answer.

_____

99. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

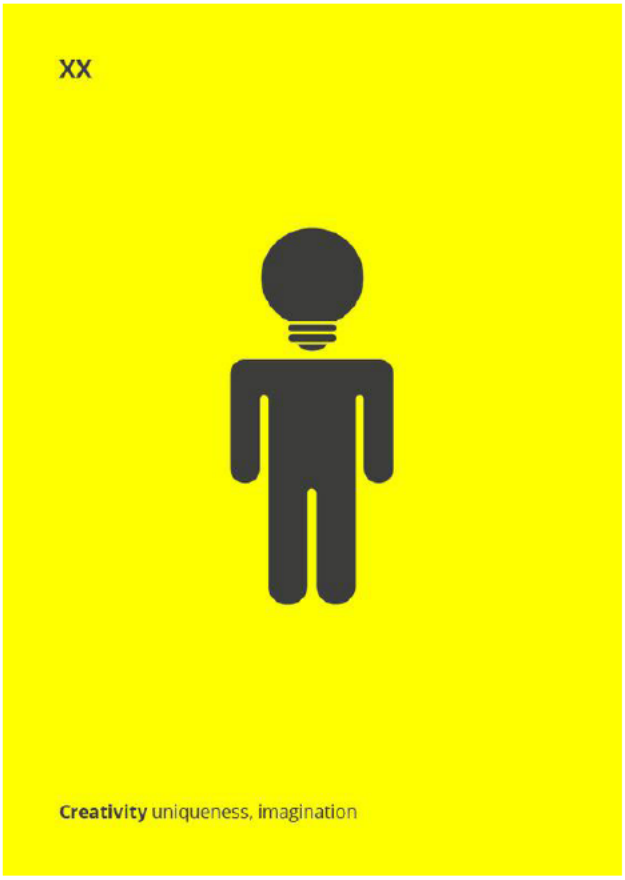
100. Please, explain your answer.

_____

Product 3

Below you see the the image of product 3. This image portrays the value of "creativity". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 3



101. What is written in the top left corner of the image? *

Mark only one oval.

- XZ
- XX
- YY

102. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

103. Please, explain your answer.

104. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

105. Please, explain your answer.

_____

106. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

107. Please, explain your answer.

_____

108. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

109. Please, explain your answer.

_____

110. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

111. Please, explain your answer.

_____

112. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

113. Please, explain your answer.

_____

114. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

115. Please, explain your answer.

_____

Product 4

Below you see the the image of product 4. This image portrays the value group of "personal development". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 4

116. How many key values are mentioned in the image? *

Mark only one oval.

- 9
- 3
- 5

117. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

118. Please, explain your answer.

119. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

120. Please, explain your answer.

_____

121. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

122. Please, explain your answer.

_____

123. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

124. Please, explain your answer.

_____

125. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

126. Please, explain your answer.

_____

127. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

128. Please, explain your answer.

_____

129. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

130. Please, explain your answer.

_____

Skip to section 17 (The end)

Product 1

Below you see the the image of product 1. This image portrays the value group of "benevolence - dependability". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 1

BENEVOLENCE - DEPENDABILITY

Motivational Goal
Being a reliable and trustworthy member of the in-group

Description
Valuing reliability, honesty, and trustworthiness to individuals with whom one is in frequent personal contact. This entails especially the quality of relationships with individuals within family, friends, colleagues, and other primary groups as well as with life partners.

131. What is the first text below the value group name? *

Mark only one oval.

- Moving man
- Material gain
- Motivational goal

132. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

133. Please, explain your answer.

134. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

135. Please, explain your answer.

136. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

137. Please, explain your answer.

_____

138. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

139. Please, explain your answer.

_____

140. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

141. Please, explain your answer.

_____

142. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

143. Please, explain your answer.

_____

144. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

145. Please, explain your answer.

_____

Product 2

Below you see the the image of product 2. This image portrays the value of "building friendships". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non- obligatory. After this, you will answer several questions regarding the elements in this image.

Product 2

146. How many people do you see in the image? *

Mark only one oval.

- 2
- 4
- 6

147. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

148. Please, explain your answer.

149. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

150. Please, explain your answer.

151. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

152. Please, explain your answer.

_____

153. Which elements do you see in the image? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

154. Please, explain your answer.

_____

155. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- ☐ Use of color (coding)
- ☐ Name of the value
- ☐ Description of the value
- ☐ Other written context
- ☐ Visualization of the value
- ☐ None of the above
- ☐ Other: _____

156. Please, explain your answer.

_____

157. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

158. Please, explain your answer.

_____

159. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

160. Please, explain your answer.

_____

Product 3

Below you see the the image of product 3. This image portrays the value group of "respect for others". Value groups are higher-order groups which contain several values of the same category. First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non-obligatory. After this, you will answer several questions regarding the elements in this image.

Product 3

161. How many key values are mentioned in this product? *

Mark only one oval.

- 3
- 5
- 7

162. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

163. Please, explain your answer.

164. This image helps me understand the meaning of the value. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

165. Please, explain your answer.

166. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

167. Please, explain your answer.

168. Which elements do you see in the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other:

169. Please, explain your answer.

170. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other:

171. Please, explain your answer.

172. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

173. Please, explain your answer.

_____

174. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

175. Please, explain your answer.

_____

Product 4

Below you see the the image of product 4. This image portrays the value of "true friendship". First, you will be asked to fill in several 7-point Likert Scale questions. The Likert Scale questions are mandatory to be filled in, whereas the follow-up questions where you can explain why you chose this answer are non- obligatory. After this, you will answer several questions regarding the elements in this image.

Product 4

176. What is the number in the top left corner of the image? *

Mark only one oval.

- 13
- 18
- 33

177. This image is aesthetically pleasing. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

178. Please, explain your answer.

179. This image helps me understand the meaning of the value. *

Mark only one oval.

1 2 3 4 5 6 7

Not at all								Very much

180. Please, explain your answer.

181. I would use this image as support when discussing this value with someone. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not at all								Very much

182. Please, explain your answer.

183. Which elements do you see in the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other:

184. Please, explain your answer.

185. Which elements that are contained in the image contribute to your understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other:

186. Please, explain your answer.

187. Which elements are missing that could contribute to a better understanding of the value? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

188. Please, explain your answer.

_____

189. Which elements do not contribute to your understanding of the value and could thus be omitted from the image? *

Check all that apply.

- [ ] Use of color (coding)
- [ ] Name of the value
- [ ] Description of the value
- [ ] Other written context
- [ ] Visualization of the value
- [ ] None of the above
- [ ] Other: _____

190. Please, explain your answer.

_____

Skip to section 17 (The end)

Section 17

The end

Thank you for your participation!
Please submit your answers.

References:
Hayes, L. & Ciarrochi J. (2020). Values cards. www.louisehayes.com.au

https://studiocarreras.com/values

https://findyourvalues.com/

https://huvaluetool.com/

A.2 Students versus non-students

To check whether the answers from the students and the non-students differ, both the Likert scale data and the checkbox data from the elements questions were analyzed. For both type of questions, the answers were split up in three groups, so that they can be compared to one another: all answers, only student answer, only non-student answers. The answer from the students and the non-students were adjusted each time to match the 'total' amount of entries. For example, if in total 15 participants answered a question, of which 10 were students and 5 were non students, the outcome from the 10 students was multiplied by 1,5 (10*1,5=15) and the outcome from the 5 non-students was multiplied by 3 (5*3=15). This 'adjusting' is necessary to be able to compare the results fairly. Since the amount of entries, especially per version, is very low, it can be difficult to prove the soundness of this method.

With the three groups, three sets can be created that can be compared: all − student, all – non-student, student – non-student. A two-sample t-test assuming unequal variances can then be done to see if the means of the answers from the three groups differ. The null hypothesis in this test is that the two groups that are being compared are equal. Thus, if the null hypothesis is rejected, it means that there is evidence of a difference between the two. If the null hypothesis is not rejected, there is no evidence of a difference. This latter outcome is what is desired in this case, as it would be beneficial that there is no difference between the students and the non-students. There are two approaches to test this, either by comparing the p-value against the alpha, or by comparing the t-statistic against the t-critical value. The chosen method is using the t-statistic. For this, the null hypothesis is not rejected if the t-statistic falls in between the two ends of the two-tailed t critical value: t-stat > - t-critical or t-stat < t-critical. This area is also known as the 'non rejection region'. For example, if the t-statistic has a value of 0,1 and the t critical two-tail value is 2,3, then the null hypothesis is not rejected because 0,1 falls between -2,3 and 2,3, and thus there is no evidence that there is a difference between the two measured groups.

For the Likert scale questions, this was tested on two points for the three groups (students, non-students, and all). It was tested per version (3 versions) and per product (4 products), so in total 21 tests were conducted. The numbers that were used are the summed points given on the Likert scale per participant, and then adjusted to match the amount of entries. All except for one had the outcome that the t-statics falls within the non rejection region and therefore the null hypothesis was not rejected, meaning that there is no evidence that these groups differ and could thus be considered the same or at least similar. The one pair where the t-statistic did not fall within the non rejection region was for the product DNAv and the two groups were the non-students versus the students. The analysis for this can be found in Table 16. As can be seen, the t-statistic does not fall in the non rejection region, and thus the null hypothesis could not be rejected, indicating that there is a difference between those two groups. This could be due to the small sample size of the non-students, which was only two entries, compared to nine student entries. As all the other tests on the Likert scale questions, but also the other pairs within the DNAv product do not produce this outcome, it was decided that we can assume that there is not difference in answering the Likert scale questions between the student and non-student participants.

For the elements questions, this was tested on two points: the four products separately and on the full set, where all the products are combined. So, in total 15 tests were performed. The elements per question, which are binary coded, were summed and then adjusted for the total amount of entries. All had the outcome that the t-statics falls within the non rejection region and therefore the null hypothesis was rejected, meaning that there is no evidence that these groups differ and could thus be considered the same or at least similar.

In conclusion, 36 two-sample t-test assuming unequal variances tests were conducted. Of this, 35 indicated that the null hypothesis could not be rejected, indicating that there is no difference between the groups. Only one test indicated that this could not be the case, however that test had a small sample size, which might have influenced this. As this was the only test with this outcome, it was decided to conclude that there is no difference between the students and non-students with regards to the answers that they have given to the questions and thus that all entries can be used in subsequent data analyses.

Table 17 Two-sample t-test assuming unequal variances on Likert scale questions for DNAv product, student versus non-student pair

Non-student vs Student

t-Test: Two-Sample Assuming Unequal Variances

	non	*student*
Mean	56,44444444	44,82924483
Variance	92,59027778	86,30384134
Observations	9	9
Hypothesized Mean Difference	0	
df	16	
t Stat	2,605252975	
P(T<=t) one-tail	0,00956775	
t Critical one-tail	1,745883676	
P(T<=t) two-tail	0,019135501	
t Critical two-tail	2,119905299	

A.3 Demographics overview of each of the survey versions

Table 18 Demographics overview of the participants from study 1 that filled in version 1 (yellow - varied life)

Age			
18-25	26-35	36-50	51+
8	1	-	-
Gender			
Female	Male	Prefer not to say	
6	3	-	
Nationality				
Dutch	German	Indian	Irish	Bangladeshi
7	2	-	-	-
Students				
University			University of Applied Sciences	
6			1	
Study involves design		Study does not involve design		Study does not involve design
2		4		1
Bachelor	Master	Bachelor	Master	Bachelor
1	1	1	3	1

Table 19 Demographics overview of the participants from study 1 that filled in version 2 (green - creativity)

Age			
18-25	26-35	36-50	51+
11	2	-	-
Gender			
Female	Male	Prefer not to say	
7	5	1	
Nationality				
Dutch	German	Indian	Irish	Bangladeshi
9	1	1	1	1
Students				
University			University of Applied Sciences	
11			-	
Study involves design		Study does not involve design		Study does not involve design
5		6		-
Bachelor	Master	Bachelor	Master	Bachelor
2	3	3	3	-

Table 20 Demographics overview of the participants from study 1 that filled in version 3 (red - friendship)

Age			
18-25	26-35	36-50	51+
6	2	1	1
Gender			
Female	Male	Prefer not to say	
5	5	-	
Nationality				
Dutch	German	Indian	Irish	Bangladeshi
9	-	1	-	-
Students				
University			University of Applied Sciences	
4			2	
Study involves design		Study does not involve design		Study does not involve design
3		1		2
Bachelor	Master	Bachelor	Master	Bachelor
2	1	1	-	2

Appendix B: Sub Research Question 2

B.1 References to vector images used in the created illustrations

Object	**Which value illustration used in**	**Reference**
Lightbulb	Curiosity	https://www.vecteezy.com/vector-art/2915286-light-bulb-vector-bulb-light-icon-bulb-light-vector
Magnifying glass	Curiosity	https://www.vecteezy.com/vector-art/1437874-set-of-magnifying-glass-icons
Lock	Security	https://www.vecteezy.com/vector-art/3282047-shield-security-with-padlock-object-vector-illustration
Man (holding the shield)	Security	https://www.vecteezy.com/vector-art/5050204-set-of-vector-illustration-isolated-international-business-team-characters-working
Hands of man	Security	https://www.vecteezy.com/vector-art/3700451-business-hand-receiving
Cup	Achievement	https://www.vecteezy.com/vector-art/1977229-winner-golden-trophy-set-vector-illustration
Mountains	Achievement	https://www.vecteezy.com/vector-art/2099713-mountain-beautiful-landscape-background-vector-design-illustration
Hands in a circle	Belonging	https://www.vecteezy.com/vector-art/1760649-diversity-of-hands-skin-in-circle-design
Four people	Friendship	https://www.vecteezy.com/vector-art/1419996-international-human-rights-day-poster-with-connected-people
People	Curiosity, Achievement	https://www.vecteezy.com/vector-art/661503-lifestyle-people-character-illustration-set
Faces	Curiosity, Achievement, Security	https://www.vecteezy.com/vector-art/2975817-face-expressions-of-a-cute-woman

B.2 Sub Research Question 2 Survey

Survey Master Thesis Irma Harms - Visualizing Values

Hello and welcome to this survey!

You are invited to participate in a web-based online survey where you will be asked to look at several visualizations of human values and to answer several questions regarding those visualizations. Below, you can find more information on the survey and on the need for providing informed consent.

It is recommended that you do this survey on a laptop, pc, tablet or any other device that has a relatively large screen. This is because the images that are to be shown to you can be viewed best on a large screen.

* Required

Information about the survey

The survey that will follow serves to answer a sub research question for the master thesis research of Irma Harms. The master thesis is about visualizing human values, for example creativity and friendship, such that they can help in a discussion between a designer and a stakeholder about the values of the stakeholder. Designers and their stakeholders can use these visualizations to better understand the value that they are discussing. This helps a designer understand what is important to a stakeholder and can use this information to improve their design. Human values can be described as "what a person or group of people consider important in life".

This specific survey aims to find out which visualization style is most preferred. First, we ask you to reply to several personal questions about your expertise. None of this information allows the provided answers to be traced back to you. Consecutively, you will be shown several visualizations of values and questions regarding these images will be asked. This includes closed questions such as indicating the preferred image and some open questions where you can explain you answer. At the end of the consent section, you will be asked for your consent to give the researcher permission to quote your written answers. This consent is completely optional, meaning that your consent (a 'yes') is not required for you to be able to participate in this survey. If you do consent to this, your answer will remain anonymous and thus cannot be traced back to you.

It is expected that it will take 2 to 10 minutes to fill in this survey and there are no risks involved in filling in this survey.

1. Do you understand the purpose and the tasks of this survey? *
   Mark only one oval.

   - ◯ Yes
   - ◯ No

Information about the research and consent

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time while filling in the survey. If you decide not to participate in this study or if you withdraw from participating at any time, you will not face any consequences and your data will not be saved or stored.

Your responses will be confidential, meaning that none of the information that you provide can lead back to you personally.

Below you can fill in your e-mail address (optional). This will then be linked to your survey response for 48 hours with the sole purpose of you being able to withdraw your answers after you have submitted your survey. If you wish to withdraw your answers, you can send an email - using the email address that you filled in - to [redacted] with a request for withdrawal. This must be done within 48 hours of submitting the survey response. After this timeframe, your e-mail address will be deleted from your survey response and therefore will not be linked to your answers anymore. At that point your answers cannot be deleted anymore. If you do not fill in your email address, no personal information will be linked to your response and your answers cannot be withdrawn.

The data will be stored in a password protected google drive folder and it will be deleted once the study is finished. The results of this study will be used for scholarly purposes only.

If you have any questions about the research study, you can contact any of the following people:

- Researcher: Irma Harms [redacted]
- Supervisor of thesis: M. B. van Riemsdijk [redacted]
- Supervisor of thesis: G.D.S. Ludden [redacted]

If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the Ethics Committee, Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS), University of Twente, at [redacted].

2. Please, check the checkboxes that apply to you: *

Mark only one oval per row.

	Yes	No
I have read and understood the study information provided above, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	◯	◯
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	◯	◯
I understand that data I provide will be used for the master thesis of Irma Harms with only an educational purpose.	◯	◯
I understand that personal information collected about me that can identify me, such as my email address, will not be shared beyond the study team.	◯	◯
I agree that my information can be quoted in research outputs.	◯	◯
I am at least 18 years of age.	◯	◯

3. Optional consent (a 'yest' is not required for you to be able to participate in this survey)

Mark only one oval per row.

	Yes	No
I agree that my provided information such as the explanation of answers, can be quoted in research outputs.	◯	◯

4. If you would like to be able to withdraw consent and your answers (within 48 hours of filling in and submitting this survey), please provide your email address below.

_____

Information about your expertise

5. Do you have any pre-existing knowledge of this master thesis, such as having heard about it or talked to the researcher about this topic? *

Mark only one oval.

◯ No, I don't have any pre-exisitng knowledge of this master thesis
◯ Yes, I do have pre-existing knowledge of this master thesis
◯ I don't know.

6. If applicable, please describe below your pre-existing knowledge of this master thesis. *

_____

7. In which way are you a design expert?? *

Check all that apply

- ☐ Master (design) student at the University of Twente
- ☐ Master (design) student somewhere else
- ☐ PhD (design) student at the University of Twente
- ☐ PhD (design) student somewhere else
- ☐ Design teacher/professor at the University of Twente
- ☐ Design teacher/professor somewhere else
- ☐ Working design professional
- ☐ Other

8. Please, describe your design expertise. *

_____

Value Visualization: Introduction

Introduction

Like mentioned at the start of this survey, this survey aims to find out which digital illustration style is most preferred. The styles of these digital illustrations differ on the level of how 'abstract' (detailed) they are, ranging from icon-like to photorealism. Both ends of this range are excluded, so none of the visualizations are icons or photos, but they range between these two ends.

You will see created visualizations for five human values, along with accompanying information such as the value name, a description of that value and synonyms. Human values can be described as "what a person or group of people consider important in life". Each value has three different visualizations, ranging from icon-like to photo-like. First, you will be asked per value to indicate which of the three visualizations you prefer based on a given statement. Optionally, you can also explain your answer. Secondly, all sets (by style) will be shown and you will asked to state your preferences based on statements. Again, optionally, you can also explain your answer.

Part 1 out of 6

Value 1: Friendship

Value name: Friendship

Description: The emotions or conduct of friends; the state of being friends.

Synonyms: relationship, friendly relationship, close relationship, attachment, mutual attachment, alliance, association, close association, bond, tie, link, union

Three visualizations of the value "friendship".

Image 1

Image 2

Image 3

9. Which of these images do you find most aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

10. Please, explain your answer (optional).

11. Which of these images do you find most contributing to your understanding of this human value? *
Mark only one oval.

- Image 1

Image 2

Image 3

12. Please, explain your answer (optional).

13. Which of these images would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

Image 1

Image 2

Image 3

14. Please, explain your answer (optional).

15. If you have any other remarks or feedback on the illustrations above, you can write this below.

Part 2 out of 6

Value 2: Curiosity

Value name: Curiosity

Description: A strong desire to know or learn something.

Synonyms: inquisitiveness, interest, spirit of inquiry

Three visualizations of the value "curiosity".

Image 1

Image 2

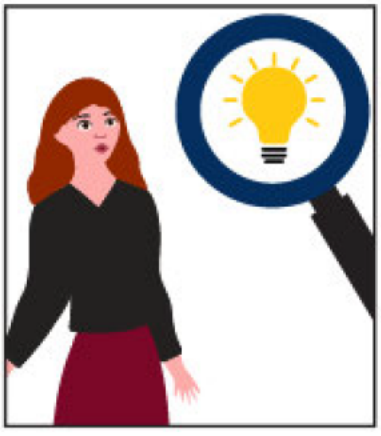


Image 3

16. Which of these images do you find most aesthetically pleasing? *
Mark only one oval.

Image 1

Image 2

Image 3

17. Please, explain your answer (optional).

18. Which of these images do you find most contributing to your understanding of this human value? *
Mark only one oval.

Image 1

Image 2

Image 3

19. Please, explain your answer (optional).

20. Which of these images would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

Image 1

Image 2

Image 3

21. Please, explain your answer (optional).

22. If you have any other remarks or feedback on the illustrations above, you can write this below.

Part 3 out of 6

Value 3: Achievement

Value name: Achievement

Description: Successfully bring about or reach a desired objective or result by effort, skill, or courage.

Synonyms: accomplishment, attainment, feat, performance, undertaking, act, action, deed, effort, exploit, manoeuvre, operation, enterprise

Three visualizations of the value "achievement".

Image 1

Image 2

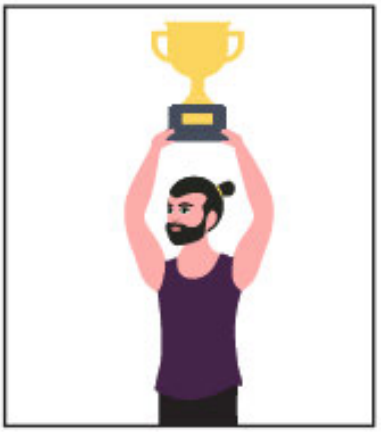
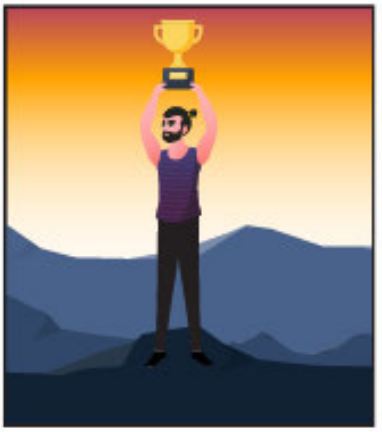


Image 3



23. Which of these images do you find most aesthetically pleasing? *
Mark only one oval.

- ◯ Image 1
- ◯ Image 2
- ◯ Image 3

24. Please, explain your answer (optional).

25. Which of these images do you find most contributing to your understanding of this human value? *
Mark only one oval.

- ◯ Image 1
- ◯ Image 2
- ◯ Image 3

26. Please, explain your answer (optional).

27. Which of these images would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- ◯ Image 1
- ◯ Image 2
- ◯ Image 3

28. Please, explain your answer (optional).

29. If you have any other remarks or feedback on the illustrations above, you can write this below.

Part 4 out of 6

Value 4: Belonging

Value name: Belonging

Description: Be a member of a particular group or organization.

Synonyms: affiliation, acceptance, association, attachment, connection, union, integration, closeness

Three visualizations of the value "belonging".

Image 1

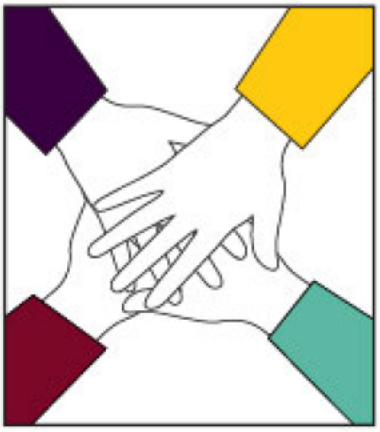


Image 2

Image 3

30. Which of these images do you find most aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

31. Please, explain your answer (optional).

32. Which of these images do you find most contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

33. Please, explain your answer (optional).

34. Which of these images would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1

- Image 2
- Image 3

35. Please, explain your answer (optional).

36. If you have any other remarks or feedback on the illustrations above, you can write this below.

Part 5 out of 6

Value 5: Security

Value name: Security

Description: The state of being free from danger or threat.

Synonyms: safety, freedom from danger, protection, safe keeping, shielding, guarding, care

Three visualizations of the value "security".

Image 1

Image 2

Image 3

37. Which of these images do you find most aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

38. Please, explain your answer (optional).

39. Which of these images do you find most contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2

Image 3

40. Please, explain your answer (optional).

41. Which of these images would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

Image 1

Image 2

Image 3

42. Please, explain your answer (optional).

43. If you have any other remarks or feedback on the illustrations above, you can write this below.

Part 6 out of 6

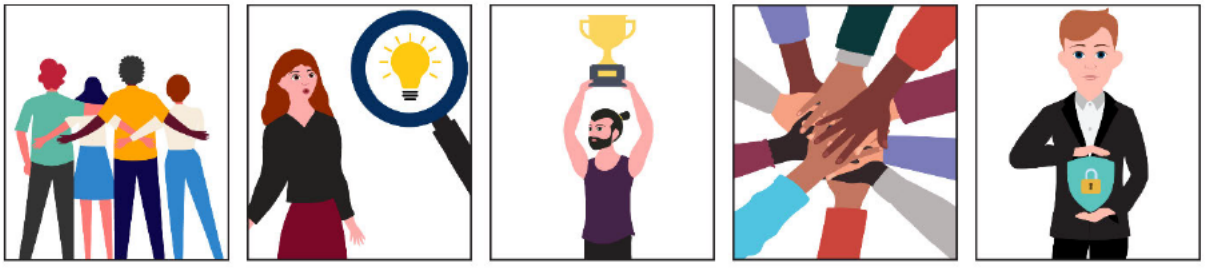
All sets

Below you see all 5 values grouped (horizontally) per visualization style, called a 'set'.

Please state your preference based on the given statement.

Set 1

Set 2



Set 3

44. Which of these sets do you find most aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

45. Please, explain your answer (optional).

46. Which of these sets do you find most contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

47. Please, explain your answer (optional).

48. Which of these sets would you consider most to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3

49. Please, explain your answer (optional).

50. If you have any other remarks or feedback on the illustrations above, you can write this below.

The end

Thank you for your participation!
Please submit your answers.

Appendix C: Sub Research Question 3

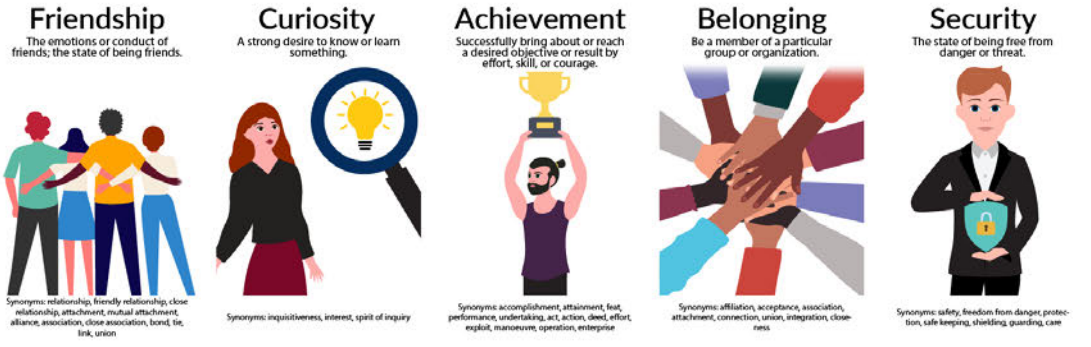
C.1 Different composition options for the solution

V1: simple hierarchy for all elements, no zoom in visualization

V2: Synonyms different place, no zoom in visualization

V3: synonyms different place, zoom in visualization

V4: synonyms at the bottom, no zoom in visualization



V5: simple hierarchy like V1, no zoom in visualization, colors for background

Figure 32 Different composition options of the elements for the solution

The first version shows the most basic option, where the visualization is placed at the bottom of the card and the written information at the top. The font size decreases as the level of importance of the element decreases, of which the order is: value name, value description, synonyms. This is labeled in the image as ‘simple hierarchy’. In the second version, the synonyms are placed in the empty white spaces of the illustrations, if they are present, to see if this could fill the image a bit more. For version three, the zoom of the illustration was increased to try to reduce the white spaces even more. In version four the zoom was restored to the original amount, but the synonyms are now placed at the bottom, aiming to decrease the (written) information at the top of the card. In version 5, color was added to the background to see if this could make the cards more interesting and fun to look at. These five versions are only a handful of all the different compositions that were tried; all possible combinations regarding synonym placement (top, bottom, somewhere else), zoom (yes or no), background color (white, or colored), were created to see the impact of all the different options

C.2 Image of created illustrations with six different font options

Figure 33 Fonts tested for the written information for the solution. 1 = Myriad Pro, 2 = Lato, 3 = Calibri, 4 = Futura, 5 = Times New Roman, 6 = Garamond.

C.3 Sub Research Question 3 Survey

Survey Master Thesis Irma Harms - Visualizing Values

Hello and welcome to this survey!

You are invited to participate in a web-based online survey where you will be asked to look at several visualizations of human values and to answer several questions regarding those visualizations. On the next page you can find more information on the survey and on the need for providing informed consent.

It is recommended that you do this survey on a laptop, pc, tablet or any other device that has a relatively large screen. This is because the images that are to be shown to you can be viewed best on a large screen.

* Required

Information about the survey

The survey that will follow serves to answer a sub research question for the master thesis research of Irma Harms. The master thesis is about visualizing human values, for example creativity and friendship, such that they can help in a discussion between a designer and a stakeholder about the values of the stakeholder. Such visualizations can include elements like the name of the value, the value description, and imagery. Designers and their stakeholders can use these visualizations to better understand the value that they are discussing. This helps a designer understand what is important to a stakeholder and can use this information to improve their design. Human values can be described as "what a person or group of people consider important in life".

This specific survey aims to find out which visualization (product) is most preferred. First, we ask you to reply to several personal questions. None of this information allows the provided answers to be traced back to you. Consequently, you will be shown several visualizations of values and questions regarding these images will be asked. This includes closed questions such as indicating the preferred image and some open questions where you can explain you answer. At the end of the consent section, you will be asked for your consent to give the researcher permission to quote your written answers. This consent is completely optional, meaning that your consent (a 'yes') is not required for you to be able to participate in this survey. If you do consent to this, your answer will remain anonymous and thus cannot be traced back to you.

It is expected that it will take 5 to 10 minutes to fill in this survey and there are no risks involved in filling in this survey.

1. Do you understand the purpose and the tasks of this survey? *
   Mark only one oval.

   - ◯ Yes
   - ◯ No

Information about the research and consent

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time while filling in the survey. If you decide not to participate in this study or if you withdraw from participating at any time, you will not face any consequences and your data will not be saved or stored.

Your responses will be confidential, meaning that none of the information that you provide can lead back to you personally.

Below you can fill in your e-mail address (optional). This will then be linked to your survey response for 48 hours with the sole purpose of you being able to withdraw your answers after you have submitted your survey. If you wish to withdraw your answers, you can send an email - using the email address that you filled in - to [redacted] with a request for withdrawal. This must be done within 48 hours of submitting the survey response. After this timeframe, your e-mail address will be deleted from your survey response and therefore will not be linked to your answers anymore. At that point your answers cannot be deleted anymore. If you do not fill in your email address, no personal information will be linked to your response and your answers cannot be withdrawn.

The data will be stored in a password protected google drive folder and it will be deleted once the study is finished. The results of this study will be used for scholarly purposes only.

If you have any questions about the research study, you can contact any of the following people:

- Researcher: Irma Harms [redacted]
- Supervisor of thesis: M. B. van Riemsdijk [redacted]
- Supervisor of thesis: G.D.S. Ludden [redacted]

If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the Ethics Committee, Faculty of Electrical Engineering, Mathematics

and Computer Science (EEMCS), University of Twente, at [redacted].

2. Please, check the checkboxes that apply to you: *

Mark only one oval per row.

	Yes	No
I have read and understood the study information provided above, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	◯	◯
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	◯	◯
I understand that data I provide will be used for the master thesis of Irma Harms with only an educational purpose.	◯	◯
I understand that personal information collected about me that can identify me, such as my email address, will not be shared beyond the study team.	◯	◯
I agree that my information can be quoted in research outputs.	◯	◯
I am at least 18 years of age.	◯	◯

3. Optional consent (a 'yest' is not required for you to be able to participate in this survey)

Mark only one oval per row.

	Yes	No
I agree that my provided information such as the explanation of answers, can be quoted in research outputs.	◯	◯

4. If you would like to be able to withdraw consent and your answers (within 48 hours of filling in and submitting this survey), please provide your email address below.

_____

Demographic information

5. Age range *

Mark only one oval.

◯ Younger than 18 years old
◯ 18-25 years old
◯ 26-35 years old
◯ 36-50 years old
◯ 51+ years old

6. Gender *

Mark only one oval.

◯ Male
◯ Female
◯ Prefer not to say
◯ Other: _____

7. Nationality *

_____

8. Are you a student at a university or a university of applied sciences (HBO in Dutch)? *
Mark only one oval.

- ◯ Yes, I am a student at a university. *Skip to question 9*
- ◯ Yes, I am a student at a university of applied sciences (HBO in Dutch) *Skip to question 9*
- ◯ No *Skip to question 10*
- ◯ I don't know *Skip to question 9*

Demographic information

9. Does your study involve design, such as the programs of Industrial Design Engineering, Graphic Design, and so on? Please fill in "other" if you don't know and provide the name of your study. *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

10. What is the level of study that you are currently in? *
Mark only one oval.

- ◯ Bachelor
- ◯ Master
- ◯ PhD/PDEng
- ◯ Other: _____

Value Visualization: Introduction

You will answer some questions regarding products that visualize human values. You will see five products (brands) in total, each visualizing five human values. As already mentioned in the introduction: human values can be described as "what a person or group of people consider important in life"

First you will answer questions per human value. You will do this for five human values, with one value per page. On each page you will see five images, which each are a visualization from a different product (brand). You will be asked to answer several statements regarding these images. Although these images portray roughly a similar value, the written and visual information differs per product. Please, imagine that these products portray the same value. The questions ask you to indicate which image you find most fitting to a given statement. This relates to the product as a whole, not the specific information given on the image. For example, when asked "which of these images do you find MOST contributing to your understanding of this human value?", you are asked to look at each image as a whole and answer this question. The given (written) information on the cards can contribute (in this example) to your understanding, but please don't determine your answer based on a different value name or description of that value. Consider the image as a whole. After each statement, you can (optionally) explain your answer.

At the end you will see all the visualizations of the products for all the values. Each product with their five visualizations is grouped and are called 'sets'. Here you will again be asked to answer several statements regarding these sets.

For both the separate human value questions as well as the questions about the product sets, the statements that you are to answer are always the same and in the same order, which is the following:

- Which of these images/sets do you find MOST aesthetically pleasing?
- Which of these images/sets do you find LEAST aesthetically pleasing?
- Which of these images/sets do you find MOST contributing to your understanding of this human value?
- Which of these images/sets do you find LEAST contributing to your understanding of this human value?
- Which of these images/sets would you consider MOST to use during a discussion of this human value with someone else during the design process?
- Which of these images/sets would you consider LEAST to use during a discussion of this human value with someone else during the design process?

Image 1

Image 2

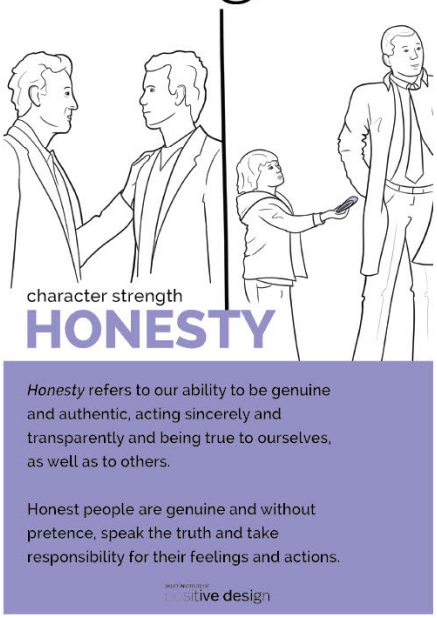


Image 3

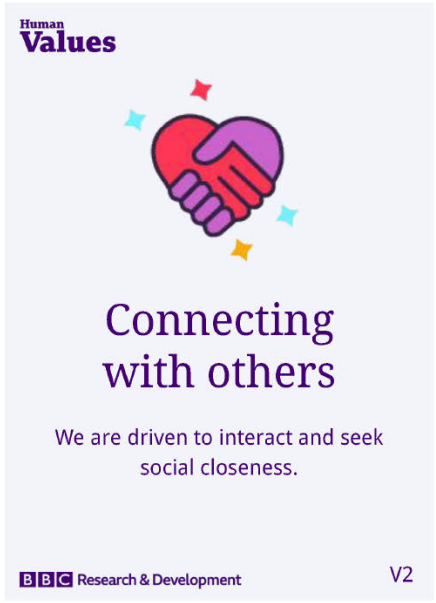


Image 4

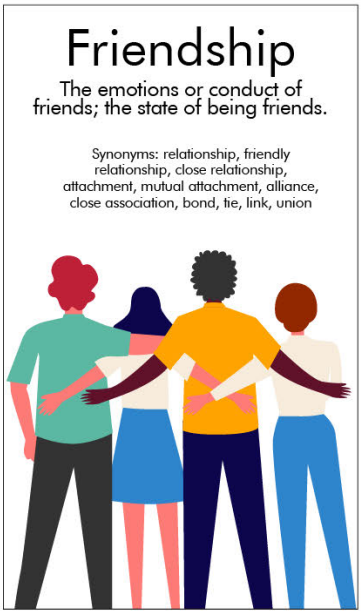


Image 5

11. Which of these images do you find MOST aesthetically pleasing? *
Mark only one oval.

Image 1

- Image 2
- Image 3
- Image 4
- Image 5

12. Please, explain your answer (optional).

13. Which of these images do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

14. Please, explain your answer (optional).

15. Which of these images do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

16. Please, explain your answer (optional).

17. Which of these images do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

18. Please, explain your answer (optional).

19. Which of these images would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

20. Please, explain your answer (optional).

21. Which of these images would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

22. Please, explain your answer (optional).

Part 2 out of 6 | Value 2

Image 1

Image 2

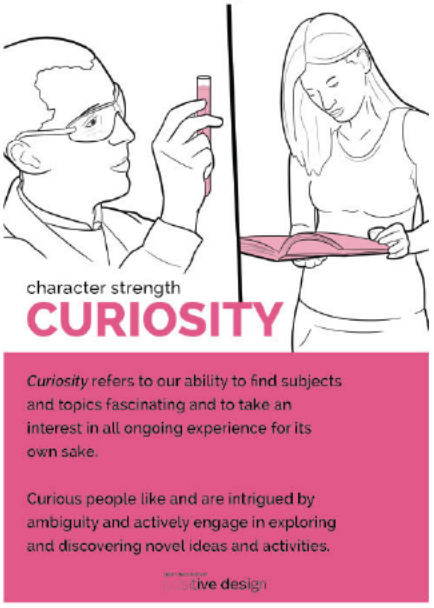


Image 3

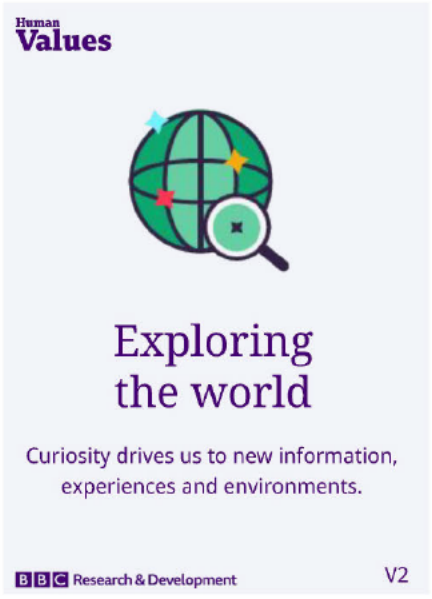


Image 4

Image 5

23. Which of these images do you find MOST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

24. Please, explain your answer (optional).

25. Which of these images do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

26. Please, explain your answer (optional).

27. Which of these images do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

28. Please, explain your answer (optional).

29. Which of these images do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

30. Please, explain your answer (optional).

31. Which of these images would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

32. Please, explain your answer (optional).

33. Which of these images would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

34. Please, explain your answer (optional).

Part 3 out of 6 | Value 3

Image 1

Image 2

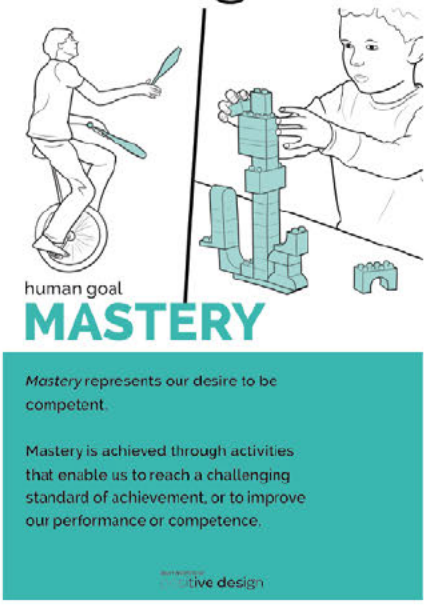


Image 3

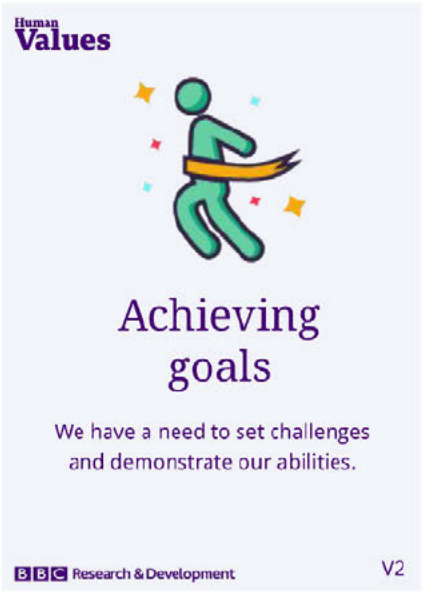


Image 4

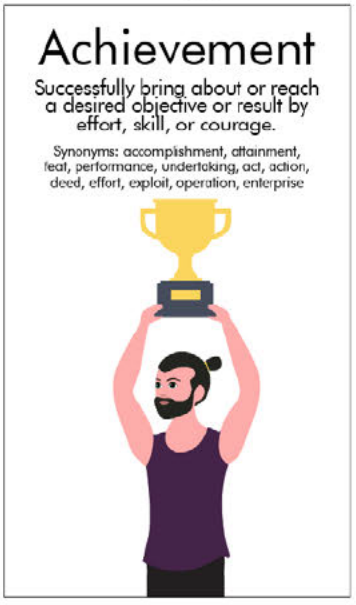


Image 5

ACHIEVEMENT

Motivational Goal
Success according to social standards or to own standards

Description
Valuing the demonstration of competent performance. The intrinsic character of that value entails demonstration of competent performance based on internal standards. The extrinsic character entails demonstration of competent performance based on external standards.

35. Which of these images do you find MOST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

36. Please, explain your answer (optional).

37. Which of these images do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

38. Please, explain your answer (optional).

39. Which of these images do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

40. Please, explain your answer (optional).

41. Which of these images do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

42. Please, explain your answer (optional).

43. Which of these images would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

44. Please, explain your answer (optional).

45. Which of these images would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

46. Please, explain your answer (optional).

Part 4 out of 6 | Value 4

Image 1

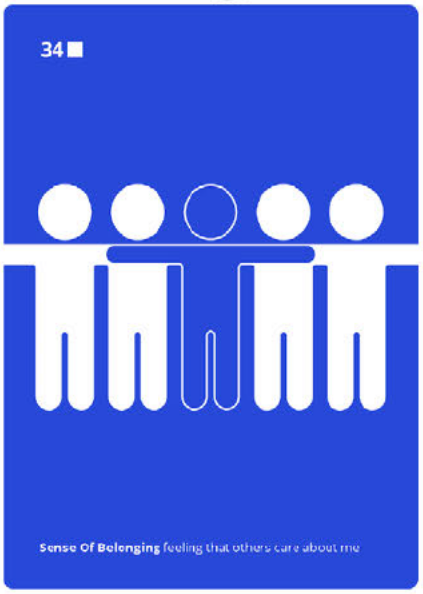


Image 2

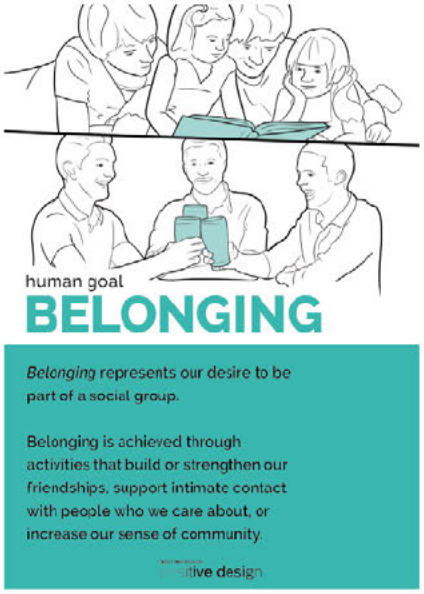


Image 3

Image 4

Image 5

47. Which of these images do you find MOST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

48. Please, explain your answer (optional).

49. Which of these images do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

50. Please, explain your answer (optional).

51. Which of these images do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

52. Please, explain your answer (optional).

53. Which of these images do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

54. Please, explain your answer (optional).

55. Which of these images would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

56. Please, explain your answer (optional).

57. Which of these images would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

58. Please, explain your answer (optional).

Image 1

Image 2

Image 3

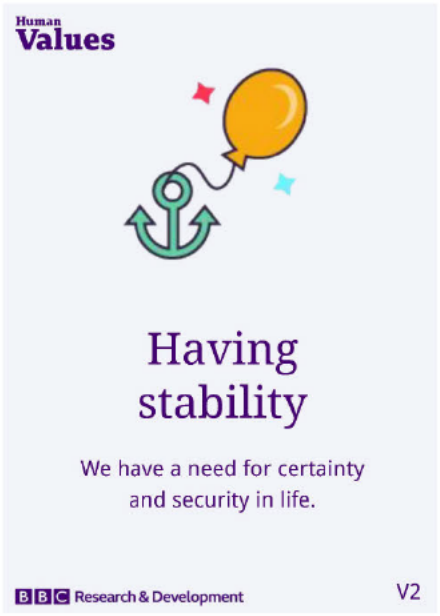


Image 4

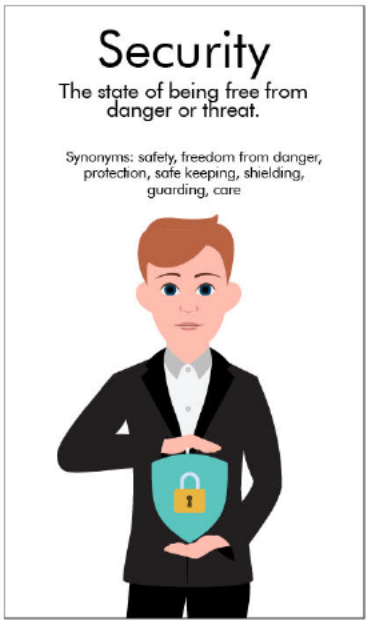


Image 5

59. Which of these images do you find MOST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

60. Please, explain your answer (optional).

61. Which of these images do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

62. Please, explain your answer (optional).

63. Which of these images do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

64. Please, explain your answer (optional).

65. Which of these images do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

66. Please, explain your answer (optional).

67. Which of these images would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

68. Please, explain your answer (optional).

69. Which of these images would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Image 1
- Image 2
- Image 3
- Image 4
- Image 5

70. Please, explain your answer (optional).

Part 6 out of 6 | Sets

Set 1

Set 2

Set 3

Set 4

Set 5

71. Which of these sets do you find MOST aesthetically pleasing? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

72. Please, explain your answer (optional).

---

73. Which of these sets do you find LEAST aesthetically pleasing? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

74. Please, explain your answer (optional).

---

75. Which of these sets do you find MOST contributing to your understanding of this human value? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

76. Please, explain your answer (optional).

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77. Which of these sets do you find LEAST contributing to your understanding of this human value? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

78. Please, explain your answer (optional).

79. Which of these sets would you consider MOST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

80. Please, explain your answer (optional).

81. Which of these sets would you consider LEAST to use during a discussion of this human value with someone else during the design process? *
Mark only one oval.

- Set 1
- Set 2
- Set 3
- Set 4
- Set 5

82. Please, explain your answer (optional).

The end

Thank you for your participation!
Please submit your answers.

C.4 Frequency table with all answers from survey 3

Table 21 Frequency table of all the answers from Study 3

		Value 1 (Friendship)	Value 2 (Curiosity)	Value 3 (achievement)	Value 4 (Belonging)	Value 5 (Security)	Sets
Most aesthetically pleasing	Image 1	5	7	5	2	4	4
	Image 2	2	0	0	2	6	1
	Image 3	6	7	9	7	11	14
	Image 4	9	3	2	13	4	6
	Image 5	6	11	12	4	3	3
Least aesthetically pleasing	Image 1	6	5	5	2	12	4
	Image 2	11	11	11	10	5	14
	Image 3	2	4	4	2	0	1
	Image 4	1	2	2	2	3	2
	Image 5	8	6	6	12	8	7
Most contributing	Image 1	0	2	1	1	2	1
	Image 2	9	12	6	6	11	7
	Image 3	5	5	8	5	6	7
	Image 4	13	7	8	14	5	9
	Image 5	1	2	5	2	4	4
Least contributing	Image 1	13	11	13	12	11	17
	Image 2	7	4	5	3	2	2
	Image 3	4	2	2	2	4	1
	Image 4	1	2	0	1	5	0
	Image 5	3	9	8	10	6	8
Most consider discussion	Image 1	3	4	2	3	3	3
	Image 2	3	5	7	4	10	5
	Image 3	7	7	8	4	8	8
	Image 4	13	9	6	14	4	9
	Image 5	2	3	5	3	3	3
Least consider discussion	Image 1	8	6	11	5	10	9
	Image 2	11	7	6	7	3	5
	Image 3	0	4	2	7	4	1
	Image 4	1	2	1	1	3	1
	Image 5	8	9	8	8	8	12

Appendix D: Thesis Discussion

D.1 Requirements

Below, the list of requirements for the solution as specified in section 2.3.1 can be seen. Only the underlined key words are given to keep the list short. Each of those points has a small description of how this requirement was met.

- Definition:
  - The definition of each value is included in the solution. The definition is based on the Lexico dictionary, which currently does not exist anymore. This dictionary is now part of dictionary.com, which is an online dictionary based on the unabridged version of the Random House dictionary.
- Value elicitation:
  - The solution was created with this goal in mind. Whether it works well for this purpose is to be determined in the future through testing.
- Values:
  - Individual values:
    - The solution portrays individual values as opposed to value groups.
  - Value list:
    - The values visualized for the solution are inspired by the value list as created by Schwartz.
  - Value information:
    - The written information (the description of the value and the synonyms) are from the Lexico dictionary.
- Visualizations:
  - Information:
    - Study 1 researched the elements present in the state of the art products and identified which of these should be present in the solution: at least the name and description of the value and preferably a visualization of the value and other written context as well.
    - Study 2 and 3 use the outcome of study 1 to incorporate the correct elements in the solution.
  - Type:
    - The outcome from study 1 indicated that the type of imagery used in the visualization should be somewhere between an icon and a detailed digital illustration or photograph.
    - Study 2 created and tested three levels of detail between these two extremes. The outcome of the test that that the third level of detail (called set 2) is the best out of the three.
    - Study 3 incorporated the illustrations from level 3 (set 2) in the solution.
  - Visualization testing:
    - The visualization (imagery) was tested separate from the full solution in study 2. The complete solution was tested in study 3.
- Format:
  - The format of the solution is a digital card-like product
- Accounting for value change:
  - Currently there is no decision on final format of the solution if it were to become a full tool or product, so it is unsure whether this requirement will be met in the future.
  - For this study, the solution was formatted and tested as a digital card-like product, which means that in this format the solution can account for value change by changing or extending the values.
  - This point is further discussed in section 7.3 Future work be further discussed in the future works section that follows

D.2 Summary of future work from each study

Below, a short overview of the future work points from each study is given.

Literature research (section 2.3.2**):**

- Definition of human values included in the complete tool
- Format:
    - At least a complete set of cards is to be created
    - Maybe a digital version or digital tool
- If a complete tool is created in the future, it would be good if it can guide in the complete design process. This means that the tool should also include:
    - Help with stakeholder identification
    - Help with stakeholder value conflicts and value trade-offs
    - Translation of the human value into design requirements
    - Additional features or activities that help support the interaction between the designer and the stakeholders
    - Help designer and stakeholder reflect on the process and the values
- Future testing:
    - Test if the tool helps the stakeholder with placing the human values in context
    - Test the solution not only with simple and easy to understand products/services, but also with complex ones

Study 1 (section 3.4.2**):**

- Ten state of the art products were identified, but there might be more that can be considered in future research that is like this research
- Test more state of the art products
- Ensure that the tests are proofed on colorblindness of participants
- A more even distribution of demographic characteristics in all research should be guaranteed, especially if a research consists of multiple groups or versions
- Test on the full population and not only on students
- Not all participants explained their answers, as this was optional. It would be good if future research asks for the explanations from all participants. If this is not possible, then it important to take into account, like done with these studies, that the explanations might give a skewed view.
- Research color association with human values
- Quantitative research should be conducted with the accompanying statistical analysis

Study 2 (section 4.5.2**):**

- Find a way to unsure that similar values between products are indeed similar
- Further explore value definitions (and synonyms) for the written information
- Have different versions of the test or make the order of the parts (sections of the test) random to avoid skewed results
- Research also which illustration is ‘least’ liked, or make ranking or Likert-scale questions to gather more data to draw conclusions from
- Test on the full population and not only on design experts related to the University of Twente
- Not all participants explained their answers, as this was optional. It would be good if future research asks for the explanations from all participants. If this is not possible, then it important to take into account, like done with these studies, that the explanations might give a skewed view.
- Exclude participants with prior knowledge of the research or the illustrations, or fully ensure that they are not biased
- Test which symbolism should be used for each value
- Test different details included and different compositions of each value visualization. This also means that the composition should not be based on a reference photograph

- Quantitative research should be conducted with the accompanying statistical analysis
- Test with a wider range of created illustrations, preferably the full set if this is created
- Test whether the created illustrations are all of the same quality such that they would perform similar across all values
- Ensure that the visualizations are proofed on colorblindness of participants

Study 3 (section 5.5.2**):**

- The illustrations should not have objects at or coming from the top, or it should be ensured that all are handled the same when inserting it in the card, such as a transparent/white gradient
- Test composition of the elements on the cards
- Test font choice more extensively
- Test color association with human values so this could be included in a design
- Find the best card size, including accompanying font size to ensure that all text is legible
- Compare the created visualizations against more state of the art products
- Create and test more versions of visualizations
- Test on the full population and not only on students
- Not all participants explained their answers, as this was optional. It would be good if future research asks for the explanations from all participants. If this is not possible, then it important to take into account, like done with these studies, that the explanations might give a skewed view.