What makes a good infographic?

How designers' choices lead to attractive and comprehensible infographics for their lay audience

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Abstract

Nowadays, humanity lives in a world with access to a tremendous amount of information, which is often easier to process for people by presenting it in infographics. Earlier research has shown that there is an ongoing debate about what a good infographic should look like. Some researchers in this debate stated that embellished infographics lead to better understanding of the data, whereas other studies have shown that embellishments could lead to interpretation problems. However, not much research has been conducted about what the designers' point of view is in this debate. The subject of the current study is to find out what designers believe makes a good infographic and whether this relates to their audience's opinion. This is investigated in two studies: a production study and a perception study.

For the production study 11 design students were asked to create infographics with given data. The results show that designers create both comprehensible and attractive infographics and vary in their creations from standard to non-standard and from pictorial to abstract. This indicates that designers are not proponents of either one side of the debate about infographics, but they remain divided. Furthermore, they appear to be aware of their creations.

The perception study was conducted to find out how Standardness and Pictorialness in infographics affect their comprehensibility and attractiveness. Four infographics of the first study were selected which resulted in four conditions for study 2: pictorial-standard, abstract-standard, pictorial-non-standard and abstract-non-standard. It was hypothesized that a standard infographic would be perceived as more comprehensible and more attractive than a non-standard infographic. The same was expected for pictorial compared to abstract infographics. Furthermore, it was expected that an infographic would be perceived most comprehensible and attractive if it is standard and pictorial. The study utilized a within-subjects design. The data of 105 participants were used to test the hypotheses.

The results of study 2 show that standard infographics were perceived as more comprehensible than non-standard infographics. In addition, pictorial infographics have been found to be both more comprehensible and attractive than abstract infographics. The interaction effects were not as hypothesized. It has been found that the abstract-standard infographic is most comprehensible, whereas the pictorial-non-standard infographic is seen as most attractive. The abstract-non-standard infographic was rated lowest on all variables.

Based on both the production and the perception study, it is suggested for designers to adapt their creations to their audience. More specifically, they could use abstract-standard infographics to make data comprehensible, and pictorial-non-standard infographics to visualize data in an attractive way. In all cases designers could better avoid using abstract-non-standard infographics, and spider-web infographics in particular. Several limitations and suggestions for future studies are given in the discussion section.

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1. Introduction

In the present, humanity lives in a world with access to a tremendous amount of information. To process all this information it is helpful to present information in infographics. An infographic presents information in a graphic form by using for example charts and diagrams (Hart, 2013). These visualizations help people to accurately communicate a message to their audience by blending data with design (Smiciklas, 2012) and they help people to process the data easier. Visualizations can help people because approximately half of the brain is committed to visual functions, which makes it useful for people to visualize data to ease the processing of the information (Smiciklas, 2012). The brain can process data from visualizations in one look, whereas information in textual form is processed in a linear matter which takes more effort (Smiciklas, 2012). Therefore, infographics and information visualizations are helpful tools for people when they deal with data.

Traditionally, infographics were meant to allow expert users to explore and analyse data very quickly and accurately (Quispel, 2016). Therefore, infographics have been primarily developed for science and statistics. Yet, over time the popular purposes of infographics increased, which meant that not only expert users had access to infographics anymore, but also non-experts began to use them (Quispel, 2016). However, experts could not agree on what the visualizations should look like in order to have non-experts understand them as well. Different studies have been done to find out what a good infographic should look like (e.g., Bateman et al., 2010; Quispel & Maes, 2014; Dunlap & Lowenthal, 2016). Yet, most of the results have been contradicting each other.

In the debate of what a useful infographic should look like, some researchers stated that visualized information leads to better understanding of the data than only plain displays, whereas other studies have shown that visualizations of data could lead to interpretation problems of the data. In favour of the first perspective exists the idea that visual imagery could help remember data and help to convey a specific message (Bateman et al., 2010). In their research Bateman et al. (2010) found that people remember graphics better when they are visually attractive. Over time, the topic and the details of the data in attractive visuals were remembered better than the same information that was presented in plain graphs. Graphics that were used by Bateman and colleagues (2010) can be seen in Figure 1, where it is clearly visible which graphic is aimed to be the attractive one, and which is aimed to be the plain, informative one.

The ideas of Holmes (1984) support the perspective of why attractive visualizations could help people to understand data rather than distract people from the data. According to Holmes (1984), a data graphic should engage the interest of the reader and should clarify data that is hard to understand when written. However, in favour of simple and plain visualizations, Tufte (1983) argued that visual embellishments would distract the reader and therefore could make interpretation of the data more difficult. According to the latter perspective, data should be presented graphically so that the interpretation effort is reduced and the interpretation accuracy is increased (Bateman et al., 2010). Thus, there is an ongoing debate about whether visuals should be attractive or informative, which leaves undecided what viewers would like to see in infographics. One way to take perspective in this debate would be to ask the people who produce the visualizations, namely the graphic designers. What is their view on the infographics they create?

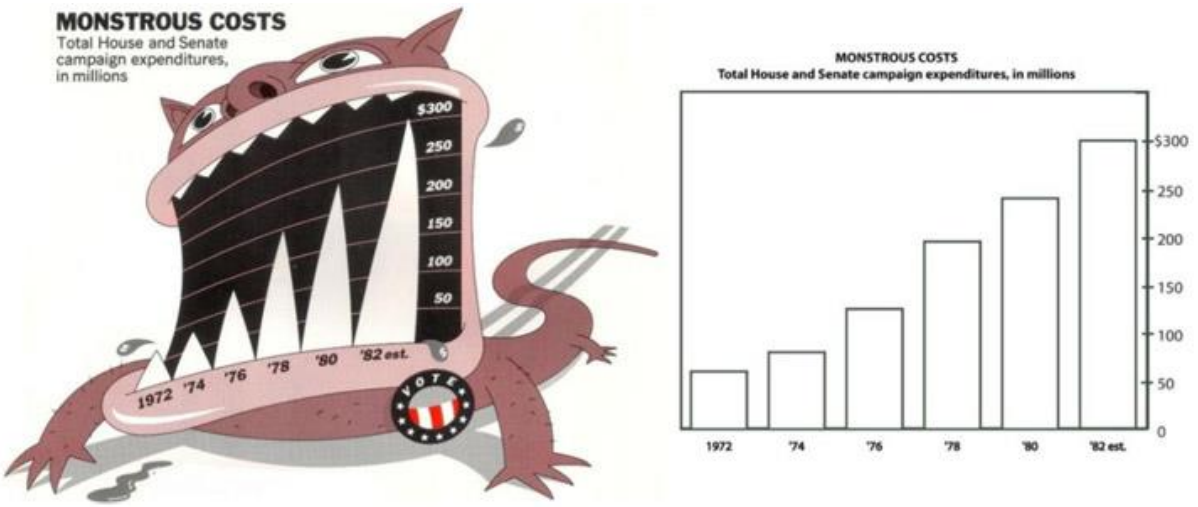

Figure 1. Two graphics representing the increasing costs of House and Senate campaigns, primarily aimed at either being attractive (left) or being informative (right) (Bateman et al., 2010)

According to the Online Oxford Dictionary, the term 'graphic design' refers to "the art or skill of combining text and pictures in advertisements, magazines, or books". Quispel, Maes and Schilperoord (2016a) state that 'graphic' refers to the techniques used to produce and distribute written works, such as books and news-papers. Yet, 'graphic design' also includes activities like the design of websites and information visualization, which are conventional for the 'digital age'. The number of graphic designers is still increasing in the present, which indicates that their job is growing in popularity (Quispel et al., 2016a). These designers will likely face the dilemma between choosing an attractive or a plain, more informative infographic.

Unfortunately, there is not much known about the way in which designers work (Quispel et al, 2016a), although some work has been done in this direction. For example, Quispel and Maes (2014) investigated how laypeople and designers rated attractiveness and clarity of visualizations. They found that designers appreciated attractiveness of visualizations better than their clarity, which suggests that attractiveness of an infographic is more important to designers than the informativeness. On the other hand, Quispel, Maes and Schilperoord (2016b) conducted surveys and interviews amongst designers which resulted in contradicting conclusions: they found that designers consider attractiveness as important, but think that clarity remains dominant. Another conclusion that can be drawn based on Quispel et al. (2016b), is that designers are aware of the way they visualize information. They appreciate the correctness of the data and are careful not to deceive their audience. These contradicting findings could be the consequence of the fact that the methods and professional practices of graphic designers are not usually documented (Quispel et al., 2016a). Therefore, the question remains: *Do graphic designers prefer attractive or informative infographics?*

The answer to this question is relevant, since it provides insight into what designers think is a good infographic. The question is an explorative question, which is answered in the first study, with the help of designers who create infographics. Based on these designs, two factors were found to be relevant: Pictorialness and Standardness. The effect of these factors on laypeople (i.e., the designers' audience) is tested in the second study of the current research, which is a perception study. Hypotheses for these effects are formulated in Study 2. By having the combination of a production study with designers, and a perception study with their audience, it is possible to compare designers' choices to what viewers think is a good infographic, in order to get to an agreement in what would be the best working infographic for both designers and their audience.

2. Theoretical Framework

2.1 Infographics

Data have become widely available nowadays, but much of this information regards raw data that might be hard to understand for the people who need to process it. This data could be better understood by visualizing it, for example in infographics (Quispel et al., 2016a). An infographic presents information in a graphic form as is shown in maps, diagrams and (statistical) charts (Hart, 2013). They are often used when tables, charts or text alone are not enough for a complete comprehension of the message (Dunlap & Lowenthal, 2016).

Presenting information in infographics helps individuals and organizations to accurately communicate a message to their audience by blending data with design (Smiciklas, 2012). Infographics help the viewer to understand the data by focussing on the message rather than the data itself. The main goal of an infographic is to present clear information in a story that is designed by communicators (Rodriguez, Nunes & Devezas, 2015), in which the presence of data is not necessarily required. By presenting information in a visual story form, either with or without text, an infographic seems to be more appealing than facts presented in words (Hart, 2013). Since the new millennium the use of infographics began to increase: it extended beyond scientific purposes, and infographics became available online. However, people have been using similar images to share information and tell stories throughout history, which indicates that the use of infographics is not new to human kind (Smiciklas, 2012).

Infographics can be used for different purposes. For example, they can be used by small businesses, non-profit organizations and large corporations to improve the communication of their information to their target audience (Smiciklas, 2012). For some non-profit organizations they can be used to raise awareness of an issue and in educational and scientific settings they can be used to introduce a research project, to mark important research findings or simply to start sharing ideas about a topic (Ferreira, 2014). In addition, they can be used to determine cause and effect relations within data and to classify relationships among data (Sicharoen & Sicharoen, 2015). Thus, infographics can have different purposes and each purpose is likely to need an appropriate infographic to deliver the message. Infographics can be mainly informative or mainly attractive. Designers need to make decisions regarding these factors to improve their infographics.

Infographics can occur in different types and forms. However, a few components are generally accepted, such as the use of Arabic numerals to represent the data and the use of an underlined and/or centered headings above the data (Sicharoen & Sicharoen, 2015). Furthermore, every infographic consists of three main elements, which are visual elements (e.g., signs, icons and colours), content elements (e.g., references, facts and statistics) and knowledge, which refers to the conclusion that can be drawn from the infographic (Sicharoen & Sicharoen, 2015). Within the visual elements, colour is an important aspect as it affects the attractiveness and understandability of an infographic (Hart, 2013). However, designers should take all the former factors into account when designing an infographic, since they could influence the attention of the viewer and the attitude the viewer will have towards the infographic (Hart, 2013).

Based on two different blogs (Ashton, 2013; Branded4good.com, 2012), infographics can be divided into several types, for example: Flow Charts, Useful Attraction, The Timeline, Data visualization, The Photo, How-to, Research Results, and “Did-You-Know”. The most important design choices that have to be made for these types regard the flow of the information (e.g., linear or multidirectional), the structure (e.g., layers or matrices), clustering (e.g., linked or overlapping), radiation (e.g., with a core or from a point), pictorialness (e.g., location and process), and type of

display (e.g., distribution or comparison) (Dunlap & Lowenthal, 2016). According to Dunlap and Lowenthal (2016), these characteristics help to convey abstract ideas and complex context that would need a lengthy narrative to be clear, if the visual representations were not present.

In section 2.2 it will be discussed why visuals are important for better understanding of the data. After that, the focus will shift to an ongoing scientific debate about what would make a better infographic, an attractive or an informative one. Finally, the view of the designers in this debate will be illustrated.

2.2 The importance of visuals

Researchers have found that visuals help people to process, memorize and recall information (Dunlap & Lowenthal, 2016; Smiciklas, 2012). Approximately half of the brain is committed to visual functions, which makes it useful for people to visualize data to help them to process this information (Smiciklas, 2012). About 30% of the brain consists of neurons that are responsible for visual activity, compared to only 8% consisting of neurons for touch and 3% for hearing. In addition, the retina of the eye alone, which is a physical extension of the brain, consists of more than 150 million cells. Since the brain has the tools to process visuals, it is easier for the brain to process infographics than text. The brain can process data from visualizations in one look, whereas information in textual form is processed in a linear matter which takes more effort (Smiciklas, 2012). Therefore, infographics and information visualizations are helpful tools for people when they deal with data.

According to Smiciklas (2012), infographics provide a possibility to add elements of innovation and oddity to the information in the brain and make the information more outstanding to the audience one wants to reach. This happens because the brain is built to operate efficiently, and therefore disregards irrelevant information. However, information that is divergent from what usually gets to the brain attracts attention and therefore will remain in the brain longer (Smiciklas, 2012).

A theory that can explain why visuals facilitate information processing is the Dual Coding Theory (DCT; Clark & Paivio, 1991). According to the DCT, there are two different manners for a person to process learned material, namely via verbal associations and visual imagery. The theory suggests that visual as well as verbal information are used to represent information and that these types of information are processed differently (Clark & Paivio, 1991). Each type of information has its own system: the verbal system, that copes with language, and the nonverbal system, that copes with processing and representing objects and events that are retrieved from world knowledge. These systems function independently but are interconnected. Verbal and visual mental representation codes are used to organize information that enters the brain and both types of codes can be used to recall the stored information. According to Clark and Paivio (1991), the chance of remembering an item increases when the item is coded via both the verbal and the visual way, rather than when the stimulus is only coded via one way.

Clark and Paivio (1991) state that the activation of the nonverbal system can help to understand how humans process information. This system can merge different information aspects into one integrated image, which can improve one's memory. Among others, concreteness has an effect on processing. This means that concrete words (e.g., "book" and "teacher") have an advantage over abstract words (e.g., "ability" and "success"). Concrete language makes a representation of an image arise (e.g., when thinking of a teacher one imagines his or her favourite teacher in high school), but this does not happen with abstract words, such as "ability". When a person can evoke imagery, he or she will be more likely to remember and understand that information. Similarly, Clark and Paivio (1991) state there are also individual differences that influence the way in which people process

nonverbal information. Some people can make a representation of an image easier than others, which also increases the chance that they will remember and understand the given information better (Clark & Paivio, 1991). An infographic also makes information more concrete, as their purpose is to present concrete information to an audience (Smiciklas, 2012). Therefore, the information that is presented in infographics is likely to be understand and remembered better than when information is not presented in an infographic.

2.3 Informative vs. attractive

In the previous section it is explained why visuals are important for humans to process information and how the brain is built to help this processing. However, these findings do not reveal what kind of infographic would succeed best in helping people to ease the processing of data. Creating an infographic has several requirements and constraints, in order to achieve a balance between aspects of utility, soundness and attractiveness (Vande Moere & Purchase, 2011).

Utility correspondents with functionality, the designer's attempt to optimize a visualization in levels of effectiveness and efficiency. It also indicates the informativeness of a design. Soundness refers to the reliability and robustness of a design, which mirrors the quality of the visualization presentation algorithm. Attractiveness indicates the appeal or beauty of a designed visualization. Proponents of attractive visualizations have found that an appealing visualization can positively influence task performance and the overall user satisfaction (Vande Moere & Purchase, 2011). This is in line with just one side of the debate, that discusses the idea that there might be one best way to make visuals work, in which two sides are strongly represented (e.g., Bateman et al., 2010; Quispel & Maes, 2014; Dunlap & Lowenthal, 2016). In short, on the one side, researchers state that visual embellishments, applied in attractive visualizations, lead to a better understanding than plain displays. Embellishments are decorative details or features that are added to, for example, graphs to make them more attractive (Bateman et al., 2010). On the other side, it has been found that visuals could distract people from the data, and therefore visualizations should remain primarily informative. In the next few paragraphs these two perspectives will be compared with examples and existing research.

2.3.1 Proponents of informative infographics

On the side of proponents of informative infographics, researchers suggest that embellishments are not essential to understanding the data and that they do not add to better interpretations. Embellishments should therefore be left out from information charts or be limited. Edward Tufte is one of the researchers that has a leading statement on this side of the debate. Tufte (1983) states that the ink that is not used to display data should be removed and he introduces the data-ink ratio. The data-ink ratio is used to calculate the amount of ink that is used to represent the data, rather than embellishments, which can be done by dividing the ink used for displaying data (data ink) by the total amount of ink used in the graphic (Tufte, 1983). His idea was that the data-ink ratio should be as high as possible. The leading view on this side of the debate is the minimalistic view, which indicates that researchers think it is important that the interpretation of the infographic is as accurate as possible with the least effort made.

Tufte's (1983) perspective argues that the data could not be interpreted as intended, when visual embellishments are used in infographics. One study that supports this argument is that of Dunlap and Lowenthal (2016). In their study they looked at a top 20 of most 'liked' infographics from a popular infographic sharing website in order to get more insight into what makes an infographic effective. They found that an effective infographic should only include relevant images, whereas less effective visuals

often use decorative visuals that possibly distract from the message. Therefore, they conclude that infographics should be efficient, precise and clear and that they should support the instructional purpose of the message. In addition, Dunlap and Lowenthal (2016) state that infographics should exclude distracting details when they are not helpful for the primary goal of the infographic: providing information.

Bateman et al. (2010) give an interesting reason for why one should argue against the use of embellishments in infographics, namely the artistic ability, creativity and effort that is needed to design an embellished infographic. Bateman et al. (2010) state that it is difficult to find a way to integrate an accompanying graphic to fit the story one is trying to convey. These tasks might be hard to do or will not be done well without a skilled designer, which could result incomprehensible infographics (Bateman et al., 2010).

Within this side of the debate there are still discussions about what is too much decoration in a graph and what might be the "right" amount. Few and Edge (2011) state that there is a line between too much embellishments in a graph and visualizations that are not data, but are enough to support the data in a useful manner. According to these authors, embellishments that (metaphorically) represent data can also be qualified as "data ink". Yet, embellishments can get incomprehensible when specific tools are overdone, such as: 3D objects and perspective, decorative fonts, different background colours, dark and unnecessary grid lines, photos, and texture patterns. These tools are all readily available in different photoshop programs, which likely makes it more appealing for designers to use these tools, while this will not always result in an effective infographic (Few & Edge, 2011).

2.3.2 Proponents of attractive infographics

On the other side of the debate, researchers suggest to add embellishments because they will help people interpreting the data. Few and Edge (2011) gave three possible ways in which infographics can improve the effects of data. Firstly, embellishments engage the interest of the reader, which makes them read the content. Secondly, they can draw the reader's attention to important items in the data. Thirdly, the message can be remembered better when embellishments are included (Few & Edge, 2011).

One research that supports the last statement made by Few and Edge (2011) is that of Bateman et al. (2010). In their research, Bateman et al. (2010) wanted to test the influence of embellished versus plain graphs on comprehension and recall. No difference was found in recall immediately after receiving the graphs. However, after two or three weeks, the recall of data of the embellished graphs was higher than that of the plain graphs. The researchers had several possible reasons for why participants could better remember embellished visualizations than plain graphs. One of these reasons was that the embellished visualizations were reasonably different form one another, whereas the plain graphs, as they were all bar graphs, had a similar appearance. The difference in the embellished visuals might have contributed to a better memory of these images (Bateman et al., 2010).

Bateman et al. (2010) also showed that embellishments did not lead to comprehension problems with interpreting the data. The researchers measured the participants' eye movements in their research and found that people spent similar amounts of time looking at the data proportions of the graphs. The style of the graph did not influence viewing behaviour. Thus, if participants spent equal amounts of time looking at the data in both conditions, then it is likely that their interpretation of the data would be equally accurate. Bateman et al. (2010) also conducted a description task, in which they asked their participants four component questions. The questions regarded the topic of the chart, the displayed values and categories, the basic trend and the message the author might be communicating

with the chart. With this task, Bateman et al. (2010) found that in general the accuracy for describing embellished charts and plain charts was the same. However, there was a difference in the description of a value message of the charts, that indicated that embellished charts were described more accurately on this point than plain charts. In addition, the images used in this experiment were tightly connected to the topic and details of the graph, which means that the overall message and the structural elements are encoded in the message (Bateman et al., 2010). This makes it easier for participants to interpret and understand the data, rather than making it more difficult for the participants.

In a similar study, Borgo et al. (2012) investigated if visual embellishments have a relation to some fundamental aspects of perception and cognition in visualization processes. Aspects of perception and cognition that were included were working memory, long-term memory, visual search and concept-grasping. Borgo et al. (2012) found that the preservation of information is improved by the use of visual embellishments. Yet, they also found that the processing time increases when embellishments are used. However, Borgo et al. (2012) conclude that visual embellishments mainly have a positive impact on the speed of memory recalling, which again indicates that infographics help people to recall memorized information, similar to Bateman et al. (2010).

In line with the ideas of Few and Edge (2011) that embellishments engage the interest of the reader, Larson-Hall (2017) gives an explanation that well-chosen graphics can make texts more accessible and attractive to readers. This especially applies to the presentation of scientific findings. Graphs catch attention when people look through articles and can help people to understand statistical data. Essentially, most people who are not interested in methodological issues, usually do not understand the statistics used in that article. Graphs can support readers to overcome the sometimes overwhelming statistical language that is used in articles. Therefore, infographics used in scientific methodologies can be helpful for people to understand and judge the statistical significance of a finding described in the article (Larson-Hall, 2017).

2.4 Designer's view

Since the arguments for the debate remainstrong on both sides, there is not one clear description for what a good infographic should look like. The question remains: should an infographic be (mainly) informative or attractive? To help answer this question it is interesting to ask the designers about infographics. What is their view on what a comprehensible infographic should look like? And, perhaps more importantly, what kind of infographic would they create?

There has not been a lot of research to investigate the way in which designers work so far (Quispel et al., 2016a), yet some work has been done in this direction. For example, Quispel and Maes (2014) investigated how laypeople and designers rated attractiveness and clarity of infographics. Their aim was to collect data about two criteria of embellishments: construction type (standard or non-standard) and mode of expression (pictorial or abstract). The first criterion should enhance the ease of use, whereas the second criterion should enhance attractiveness through expressive characteristics.

In the first part of their study, Quispel and Maes (2014) conducted a production experiment in which designers had to visualize data that was offered to them by the researchers. Most designers created a standard format (29 out of 41), with an overrepresentation of bar graphs (26 out of 29). In addition, 25 out of 41 infographics were classified as abstract (which means that the infographics are simple and do not contain any pictorial elements) and 16 as pictorial (which means that the infographics include illustrations, as for example hats as bar graphs or a balloon as pie chart). Therefore, it can be concluded that designers are likely to create a standard and abstract infographic,

if they are free to design the infographic. In the second part of their study, which was an evaluation study, Quispel and Maes (2014) found that designers appreciated attractiveness of infographics better than their clarity, which suggests that attractiveness of an infographic is more important to designers than the informativeness. However, this contradicts the results from the production experiment.

In another study, Quispel, et al. (2016b) conducted interviews with 10 professional designers and looked at designer handbooks to investigate what designers value most between clarity and attractiveness, and between objectivity and subjectivity. The researchers also wondered what makes an infographic attractive. With the statements that Quispel et al. (2016b) got from the interviews and handbooks, they designed a separate explorative survey that was taken by both designers and lay-people in design. The results that Quispel et al. (2016b) found in their interviews and surveys contradicted the findings of Quispel and Maes (2014). Quispel et al. (2016b) found that designers consider attractiveness as important, but think that clarity remains dominant. This finding means that designers would rather focus on informativeness than attractiveness. This is in line with the production study of Quispel and Maes (2014), but contradicts their evaluation study. Another conclusion that can be drawn based on Quispel et al. (2016b), is that designers are aware of the way they visualize information and prefer objectiveness over their personal opinion. Designers appreciate the correctness of the data and are careful not to deceive their viewers.

Despite the work described above by Quispel and colleagues (2014; 2016a; 2016b), it still remains unclear what designers prefer in infographics. After all, when they design they create informative infographics, but when they evaluate they prefer more attractive infographics. Therefore, this study investigates what designers create when they get a data set and are free to design what they prefer, as long as they include the correct data. In addition, this study looks at whether the designers were actually aware of attractiveness and informativeness while creating the infographic and whether they thought that these concepts are important in an infographic.

3. Study 1: Production perspective

3.1 Method

For the production study, graphic designer students from two different schools were asked to create an infographic with given data. The purpose of this study is to find out whether graphic designers prefer attractive or informative infographics.

3.1.1 Participants

In total 11 graphic design students participated to create infographics. 3 of the participants were male and 8 of them were female. The average age of the participants was 23 years, with a minimum age of 19 and a maximum age of 27. Of the participants, 5 were third year students majoring in graphic design from the AKV, St. Joost, Avans University, located in Breda. The other 6 students were first or second year Master's students from the same university, but now located in Den Bosch. The students in Breda were all Dutch students, whereas the students from Den Bosch were international students. In total, 7 of the infographics that the students designed were created on a laptop. To do this they used different programs, such as Adobe Illustrator (5), Adobe Photoshop (2) and Adobe InDesign (2). 2 of the 7 participants indicated that they used both Adobe Photoshop, as well as Adobe Illustrator. The remaining students (4) designed an infographic with pencil and paper, using a variety of materials to do so, including crayons, rulers and coloured markers.

The students in Breda used materials brought by the experimenter, namely: 16 lead pencils, 60 crayons (four Bic colouring sets), 8 erasers, 14 rulers (different sizes and shapes, i.e. straight rulers

and geo-triangles) and A4 sized paper. The participants were told that they could also use their own material if they wanted. This made it possible for some students to work with markers as well. In Den Bosch, the same materials were offered as in Breda, but the students did not use any of the materials provided by the experimenter. One student only used paper and a lead pencil or black pen to design an infographic. All other students in Den Bosch provided digital versions of their designed infographics.

3.1.2 Materials

The data the students had to use to design an infographic with, was taken from Bateman et al. (2010). The data was about the total House and Senate campaign expenditures in millions from 1972 until 1982. The title of the data that had to be included was: Monstrous costs. The source of the data was the Citizens' Research Foundation. The concrete list of data, as the students received it in their instruction, can be seen in Table 1.

Table 1. The data that was used to design the infographics as it was shown on the instruction.

Title	Monstrous costs
Subtitle	Total House and Senate campaign expenditures in millions
Source	Citizens' Research Foundation
Data	1972 – 60 million dollars
	1974 – 80 million dollars
	1976 – 130 million dollars
	1978 – 195 million dollars
	1980 – 245 million dollars
	1982 – 300 million dollars

3.1.3 Procedure

Each designer was given the same introduction to start designing their infographic. First, the designers received a general verbal explanation about the background of the experimenter and in short what the research was about. After that, the designers received a written instruction. The instruction explained that the designers needed to design an infographic that they considered to be a "good" one. It was emphasised that all data should be included. Furthermore, it was explained to them that they got a maximum of an hour to perform their task and that they could not use the internet or help each other. At the end of the instruction the participants were asked to fill in three personal questions, regarding their age, sex and study year. Since the group of designers in Breda were all Dutch participants, they received the instruction in Dutch. The students in Den Bosch received the same instruction, but translated in English. The complete instructions as they were given to participants, in English and Dutch can be found in Appendix A and B respectively.

After having read the instruction the participants who decided to design the infographics on paper were provided with their designing materials. The designers who wanted to work on a laptop were free to use all possibilities of their photoshop program(s). In Breda, the students designed their infographics with supervision of the experimenter. They were all seated in one classroom in which the supervisor was present. The students in Den Bosch received general instructions in a classroom, but were not able to work in that room on their designs. Therefore, they all worked at their own desk in a few open spaces in the school. The rooms were on the same floor and there were no doors that separated the rooms from each other. These students did not receive as much supervision as the students in Breda, but the experimenter walked around to check on the students. Students from both

schools had a maximum of one hour to work on their designs. This time limit was also used in the production study by Quispel and Maes (2014).

Finally, participants received a short survey after handing in their infographic. The survey consisted of four questions regarding their design choices for the infographic. The survey questions were about whether the participants focused on attractiveness and/or informativeness while designing the infographic, and about whether they thought attractiveness and/or informativeness are important for an infographic. All four questions could be answered on a 5-point Likert scale ranging from *strongly agree* to *strongly disagree*. The complete surveys, one in English and one in Dutch, can be found in Appendix C and D respectively.

3.2 Results

3.2.1 Survey results linked to designs

First, the results of the survey are discussed, on the importance of attractiveness and informativeness in infographics. The results of the survey are compared to some of the infographics that the designers handed in. The most outstanding results are discussed below. All of the infographics that were designed in the production study can be found in Appendices E-P.

The first infographic that is compared to the survey is number 4 (see Appendix H). In the survey, the designer indicated that he or she *strongly agreed* that attractiveness and comprehensibility are important to an infographic, whereas the person indicated that he or she only *agreed* on focussing on attractiveness and comprehensibility while designing the infographic. When looking at the design, it can be seen that it is a pretty clear bar graph, even though it looks like a reversed bar graph. The infographic looks like a building with columns coming down from the roof, which gives it an attractive appearance. Yet, when looking closer at the infographic it can be seen that the year is indicated in the column and the amount of money spent in that year is indicated below it. In normal bar graphs this is usually not the case, as normally the bar itself indicates the amount (Quispel & Maes, 2014; Zacks & Tversky, 1999). Therefore, this infographic might not be as comprehensible as it seems, but its design corresponds with the answers the designer gave on the survey.

The second infographic that is compared to the results of the survey, is number 5 (see Appendix I). This designer indicated that he or she *neither agreed, nor disagreed* on focussing on the attractiveness while making the infographic. He or she *agreed* on the finding the attractiveness of an infographic important. On the other hand, this person *strongly agreed* on both questions focussing on the comprehensibility of the infographic, as well as thinking it is important for infographics. This can also be found when looking at the final infographic, namely a pretty plain bar graph with clear numbers. There was no focus on attractiveness of this infographic and thus a plain, but comprehensible bar graph was the result.

The next infographic that is worth discussing, is number 7 (see Appendix K). The designer *disagreed* on focussing on the attractiveness of the image while designing it. He or she *neither agreed, nor disagreed* on thinking the attractiveness of an infographic is important. However, the person *agreed* on focussing on comprehensibility while designing and *strongly agreed* on thinking the comprehensibility is important. The infographic does not seem very appealing, as it does not make use of any colours. The image is designed in black and white (and grey), which is in agreement with the statements of the designer. However, its comprehensibility does not seem that high. The infographic is not standard bar graph and length of the bars does not correspond with the amount that is indicated. Moreover, the bars indicate the amount of money it has increased in that particular year. The latter

does not seem as a standard thing to do with bar graphs and could therefore make the graph rather confusing than comprehensible.

The last infographic that should be mentioned here, is number 9 (see Appendix L). The designer of this infographic seemed to prefer attractiveness over comprehensibility as he or she *agreed* on focussing on attractiveness while designing the infographic, and *strongly agreed* on thinking that attractiveness is important. On the other hand, he or she *neither agreed, nor disagreed* on both comprehensibility questions. These preferences are reflected in the design of the infographic. It seems a very appealing idea to use coins as bars, to indicate the increase in money over the years. The graph also has clear numbers indicating the year at the bottom and the amount at the top. Yet, the bars itself do not seem that comprehensible. Three of the six bars include silver coins, whereas the others only consist of gold coins. It remains unclear why there are silver coins on top of some of the gold coins. In the first bar that uses a silver coin, the coin should be 10 to reach to total number of dollars spent, whereas using the number 10 does not seem to add up in all three cases.

In sum, most designers created infographics in line with what they think is important. This could be either attractiveness, comprehensibility, or both. Their infographics were often in agreement with their opinions about the importance of attractiveness and comprehensibility. Thus, designers do not have a preference for either attractiveness or comprehensibility, but they seem to be aware of their creations.

3.2.2 Infographic analyses and discussion

After receiving all infographics by all designers, the infographics were analysed and compared. A couple of interesting observations were made, which are discussed here. Firstly, most of the infographics were bar graphs (9 out of 11, see Appendix E-M). This does not come as a surprise, since Quispel and Maes (2014) indicated that a bar graph is one of the two standard graph forms (the second one being pie charts). Being standard means that these kinds of bars are the most efficient for representing specific kinds of data, such as election results. In addition, bar charts allow viewers to quickly and easily compare the values of each category in the graph by comparing the size of the bars (Quispel & Maes, 2014). Results from another study, by Zacks and Tversky (1999), indicated that bar graphs are used to show discrete comparisons between data points, as bars are distinct entities. Bars help readers to view the data as point estimates (Zacks & Tversky, 1999). This is applicable to the data that is used in this study, since it was data that regarded different points in time. A trend graph would not be applicable to this data, because these lines are often used to connect entities (Zacks & Tversky, 1999). Thus, it seems like a logical step of the designers to use bar graphs for this experiment, since the data of this study matches the goals of a bar chart and bar charts are easily understood by viewers.

Secondly, the design of infographics can be pictorial (with meaningful embellishments) or abstract (without embellishments). For the pictorial designs, several designers created infographics with visuals that match the theme of the data “Monstrous costs: Total House and Senate campaign expenditures in millions”, such as money (2 out of 11, see Appendix F and L), “the monster of America” (1 out of 11, see Appendix G) and houses or the Senate (2 out of 11, see Appendix H and J). The visualizations were used in different ways, for example money coins or houses to indicate the bars of the graph, or just as embellishment of the data, like “the monster of America”. The visualizations that were added, have a relevance to the topic of the infographic. Relevance is useful for people when having a conversation or when communicating via infographics. Dunlap and Lowenthal (2016) concluded in their study that an infographic is effective when it only includes relevant images. A theory that explains the importance of relevance is, appropriately named, the Relevance Theory by Sperber

and Wilson (1986). This theory explains that new information that is received by an individual is processed in a context of already available beliefs and assumptions. Combining new information with context can yield cognitive effects that could not have been acquired from the new information alone. This indicates that the new information is relevant in the context. The cognitive effects that make new information relevant can consist of new beliefs implied by the information depending on the context, or contradicted by the new information that is depending on the context (Sperber, Cara & Girotto, 1995). Sperber and Wilson (1986) argue that the consideration of relevance guides the human cognition in a way that people tend to pay attention to the most relevant and available information at the time and at any time. Humans will put the information in a context of assumptions that will maximize its relevance.

The Relevance Theory may also explain how thematic relevance gives people a more positive attitude towards the information they are receiving, as was found in a study by Wise, Bolls, Kim, Venkataraman and Meyer (2008). In their study, Wise et al. (2008) found that the relationship between attitude towards a game and attitude toward a brand is more positive when the game and the brand have a high thematic connection. Thus, translating this to visualizations in infographics, viewers are likely to have a more positive attitude towards the infographic when they receive a design with thematical relevance to the data, than when there is no thematical relevance. Therefore, it seems wise of the designers to have created infographics with thematical relevance, because it helps the viewer get a positive attitude towards the infographic and also helps to pay attention to the information that is most relevant to them.

Thirdly, there was a variety in the use of colours. Five designers used colours in their design, but in very different ways. One designer created a bar graph and coloured the bars in two different shades of green. One designer created “the monster of America” and used the colours red and blue for the American flag and green for the grass it was standing on. Another designer used yellow/gold and grey/silver to colour the coins that were used to indicate money. One designer used the colours brown, red and yellow for the bars and name tags and the colour green for bags of money. One designer partly coloured the bars of the bar graph orange and blue alternately. Finally, one designer coloured the lines of the spiderweb graph he or she created. The other designers did not use a lot of colour (2 out of 11, see Appendix H and N) or left the design completely black and white (3 out of 11, see Appendix J, K and M). Thus, it seems like most designers did not focus on the use of colour in their design, although it has been stated that colour is an important aspect within visualizations, because it affects the attractiveness and understandability (Hart, 2013).

People can associate colours with feelings, both positive and negative ones (Naz & Epps, 2004). As can be concluded from the study by Naz and Epps (2004), the colours green, yellow and blue-green evoke positive feelings, whereas green-yellow evokes negative feelings. A colour that did not evoke positive or negative feelings was purple, in a variety of shades. In addition, studies have shown that the use of the right colours can positively influence the attractiveness and comprehensibility of an infographic. The attractiveness is influenced by colours as some colours are more preferred than others, which means that these colours are seen as more attractive (Palmer & Schloss, 2010). Comprehension is influenced by colours, since the use of the right colours increases reading comprehension as well as reading speed (Iovino, Fletcher, Breitmeyer & Foorman, 1998). It could be expected that designers are aware of the influence of colours since they are often used in infographics. However, in this study the designers did not show behaviour that indicated their awareness of these influences, as designers used colours associated with money (green) or the American flag (red/blue). The colours do not seem to be based on colours that other studies found to have positive effects on

attractiveness and comprehensibility, since for example the colour brown was used, which has found to be a less appreciated colour (Palmer & Schloss, 2010).

4. Study 2: Perception experiment

As explained in section 3.2.2, the production study showed that designers use specific ways to design their infographics. For example, they mainly used a standard format rather than a non-standard format. Furthermore, some thematic visuals were also used, which indicates that designers create both pictorial and abstract infographics. For the second study there will be a focus on perception, answering the question how laypeople in the graphic design field perceive the infographics that the designers created. In the next section Standardness and Pictorialness will be explained further. After that, the description of Study 2 will be given.

4.1 Standardness and Pictorialness

Graphics help to communicate information and to process information. Most of the data presented in graphs consists of categorical and quantitative data, which is usually visualized in bar and pie charts (Quispel & Maes, 2014). Since these two kinds of graphs are most common, they can be indicated as standard graph forms. Especially bar graphs are considered to be standard constructions, as they are most efficient for presenting specific kinds of data (Quispel & Maes, 2014), such as financial results (in this case House and Senate expenditures). Other types of graphs are therefore considered as non-standard. The extent to which a graph is considered to be standard or non-standard will be referred to as Standardness.

Most standard graphs published in printed mass media are abstract, which means that they do not contain any pictorial elements (Zacks, Levy, Tversky & Schiano, 2002). Yet, as described in the theoretical background, there are designers who add visual embellishments to their infographics, as research showed that viewers seem to appreciate them (Bateman et al., 2010). Designers have the possibility for both options when they create infographics, they can choose to leave the infographic abstract or they can make it pictorial. Pictorial, in this sense, means that a visualization includes graphic objects that illustrate recognizable physical objects or scenes (Quispel & Maes, 2014).

Hegarty (2011) discusses the idea that visual displays can be divided into different types based on the relation between the representation and the nature of the object or entity that is represented (the referent) and the complexity of the information represented. This division leads to three types of visual displays: iconic, relational and hybrid. Iconic displays are representations of objects that are visual spatial entities. The space that is visualized in iconic displays represent space in the world and the properties, such as shape and colour (Hegarty, 2011). Yet, referents that are not visible in real-world viewing can also be presented in iconic displays, such as cross sections of organs. Hegarty's (2011) iconic display is comparable to pictorial infographics described by Quispel and Maes (2014), as they both illustrate recognizable objects.

Relational displays represent entities that are not necessarily visible and do not have spatial extent. In these displays, variables (such as colour, shape and location) represent dimensions of the display, but they can be any category or quantity (Hegarty, 2011). This means that colour could represent heat and a location could represent importance rather than the actual place. Next to that, some displays are a hybrid of both iconic and relational displays. They exist from a direct aligning between space in the representation and space in the referent, but nonvisual properties (such as colour and shading) are represented by visual variables. Hegarty's (2011) relational and hybrid displays can be compared with abstract infographics as described by Quispel and Maes (2014), since they do

not solely represent real world objects or scenes. The extent to which a graph is considered to be pictorial or abstract is referred to as Pictorialness in the current study.

Both Standardness and Pictorialness were investigated by Quispel and Maes (2014) in a study in which they predicted that designers would prefer standard over non-standard infographics and pictorial over abstract infographics. Quispel and Maes (2014) found that indeed most designers, who accurately represented the data, used a standard format. However, in the production study they found that designers created an equal amount of abstract and pictorial designs. In addition, Quispel and Maes (2014) conducted a perception study, in which both laypeople and designers were asked to carry out four evaluation tasks and one performance task with the infographics that were designed in the production study. The evaluation tasks consisted of one question regarding attractiveness and one question regarding clarity. The evaluation also included an overall mark per infographic, ranging from 0 to 10 and a selection task. The participants were also presented with an information retrieval task, for which they had to answer a content question about the infographic.

In their research, Quispel and Maes (2014) found that the attractiveness of non-standard and pictorial infographics was rated higher by professionals than standard and abstract infographics. Laypeople preferred standard and abstract infographics. The pattern for clarity ratings was different, as both groups preferred standard and abstract infographics. Laypeople also gave higher ratings for the standard and abstract infographics in their overall rating. For designers there was no significant difference between Pictorialness and Standardness. Designers preferred non-standard infographics, whereas laypeople preferred standard ones. However, they also found that both laypeople and designers rated a standard and pictorial design among the most appreciated infographics.

Both Pictorialness and Standardness were investigated separately by Quispel and Maes (2014), yet, the study has some limitations. Most importantly, it would be interesting to investigate what happens if the two factors are combined. Since infographics should visualize information that should be both comprehensible and attractive for a broad audience of mostly laypeople, it would be interesting to investigate whether the designs are actually perceived as being comprehensible and/or attractive. This leads to the following research question for Study 2:

How do Standardness and Pictorialness in infographics affect their comprehensibility and attractiveness?

This question is answered in a perception study, in which laypeople are presented with four of the infographics that the designers created in the first study. The focus of this study is on laypeople, because they are the audience for which infographics are designed. The infographics of this study are selected based on the factors discussed before, which results in four conditions, namely: pictorial-standard, abstract-standard, pictorial-non-standard and abstract-non-standard. Based on previous literature the following hypotheses are formulated:

H1a: A standard infographic is perceived as more comprehensible than a non-standard infographic.

H1b: A standard infographic is perceived as more attractive than a non-standard infographic.

H2a: A pictorial infographic is perceived as more comprehensible than an abstract infographic.

H2b: A pictorial infographic is perceived as more attractive than an abstract infographic.

H3a: An infographic is perceived as most comprehensible if it is standard and pictorial.
H3b: An infographic is perceived as most attractive if it is standard and pictorial.

4.2 Method

In this perception study, laypeople were asked to answer three evaluation questions per infographic, and one overall rating question. The purpose of this study was to find out how Standardness and Pictorialness in infographics affect their comprehensibility and attractiveness.

4.2.1 Design

The study utilized a within-subjects design in which each participant viewed four infographics. The independent variables were Pictorialness (pictorial, abstract) and Standardness (standard, non-standard), leading to four conditions: pictorial-standard, abstract-standard, pictorial-non-standard and abstract-non-standard. The dependent variables were attractiveness and comprehension.

4.2.2 Participants

In total 156 participants took part in an online Qualtrics survey. However, only the data of 105 participants were analyzed in this study, as they completely finished the survey. 25 of the participants were male and 80 of them were female. The average age of the participants was 30,1 years, with a minimum age of 15 and a maximum age of 63. The distribution of educational level of the participants was: primary education (1), secondary education (16), higher vocational education (MBO) (30), higher professional education (HBO) (21) and university (WO) (37). One participant was colour blind.

4.2.3 Materials

In this study, four infographics were used representing four conditions: pictorial-standard, abstract-standard, pictorial-non-standard and abstract-non-standard (Figure 2-5, respectively). Three of the infographics were made by the designers in Study 1 (Figure 2, 3 and 5). The infographic in Figure 3 did not originally include the source of the data and the infographic in Figure 5 missed the title, subtitle and source of the data. These were added to the infographics later by the experimenter, to make all infographics contain the exact same information. The infographic in Figure 4 was designed by the experimenter, based on two design from study 1, since the design students did not provide a sufficient infographic to fit in the non-standard-pictorial category. Thus, this type of infographic was not made-up, it was inspired by what the students already created. The non-standard format was based on the infographic that can be found in Appendix I (5b). The pictorials were based on the infographic that can be found in Appendix F, which also used bags filled with money. Both original designs were drawn on paper, thus the design in Figure 4 was an improvement since it combined the two ideas and is a digitalized version.

The infographics in Figure 2 and 3 are standard infographics, since they both are bar charts. The infographic in Figure 2 is considered pictorial as it uses coins to indicate the bars, rather than plain bars as in Figure 3. The infographics in Figure 4 and 5 are considered non-standard, as they are not bar charts (or pie charts). Figure 4 is a pictorial infographic, because bags with money (and a dollar symbol) are used to indicate the increase in the amount of money that is spent on House and Senate campaigns.

The infographic in Figure 3 and 5 do not contain any pictorial elements, and are therefore considered to be abstract infographics.

Figure 2. A pictorial-standard infographic

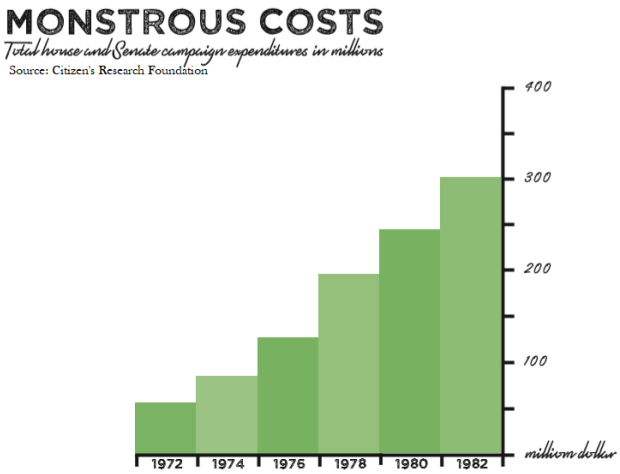

Figure 3. An abstract-standard infographic

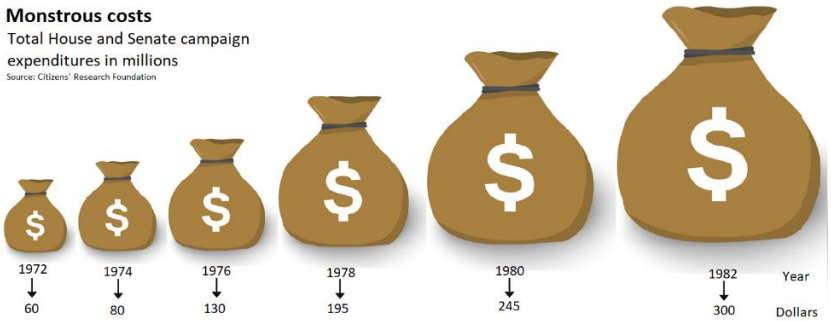

Figure 4. A pictorial-non-standard infographic

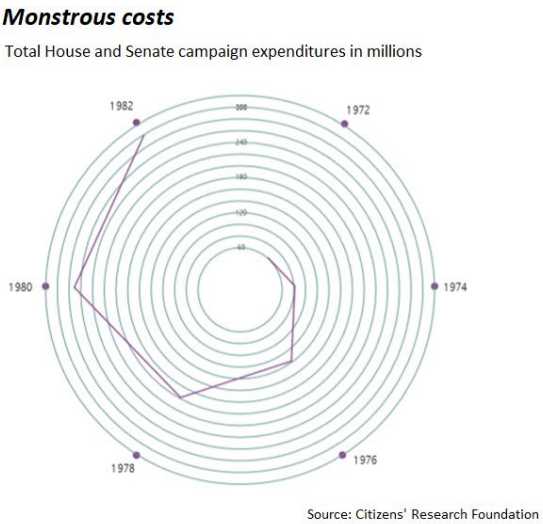

Figure 5. An abstract-non-standard infographic

4.2.4 Instrumentation

Per infographic the participants answered a few questions regarding the attractiveness, comprehensibility and overall rating of the infographic. The questions concerning comprehensibility and attractiveness were taken from Maes, Ummelen and Hoeken (1997) and can be found in Table 2 and 3, respectively. The original scales, as they were used in the survey (in Dutch) can be found in Appendices Q and R. The question regarding the overall rating was based on the study by Quispel and Maes (2014), and measured the overall grade participants would give to the specific infographic on a 1 to 10 scale (*Extremely bad* to *Extremely good*).

Table 2. Dimensions of comprehensibility

This infographic is ..		
Difficult	0 0 0 0 0 0 0	Easy
Vague	0 0 0 0 0 0 0	Explicit
Clear	0 0 0 0 0 0 0	Unclear
Built up logically	0 0 0 0 0 0 0	Built up illogically
Concise	0 0 0 0 0 0 0	Circuitous

Table 3. Dimensions of attractiveness

This infographic is ..		
Interesting	0 0 0 0 0 0 0	Not interesting
Distant	0 0 0 0 0 0 0	Appealing
Fascinating	0 0 0 0 0 0 0	Boring
Monotone	0 0 0 0 0 0 0	Alternately
Attractive	0 0 0 0 0 0 0	Unattractive

As can be seen in Table 2 and 3, both comprehensibility and attractiveness were measured by five dimension scales. The scores of the five dimensions were combined to construct one variable for comprehensibility (the reliability of the scale was high: $\alpha = .81$). The same was done to create one variable for attractiveness (the reliability of the scale was high: $\alpha = .85$).

After seeing the four infographics and answering the questions belonging to the infographics, participants answered a final question concerning which infographic they liked best. This question was also based on Quispel and Maes (2014). For this question, participants got to see all four infographics again (smaller versions) and had to indicate a number from 1 to 4 for which they thought was the best infographic. The complete survey as it was used for this study (in Dutch) can be found in Appendix S.

4.2.5 Procedure

The participants were recruited via Facebook and WhatsApp to take part in the online Qualtrics survey. This survey started with an introduction. The introduction firstly thanked the participant for helping with the survey and briefly explained what the study was about. After that, the participants were informed what would happen with their data and privacy and that the survey will take about five minutes. They were told that they would receive some questions about themselves, some questions about four infographics, and one final question. In addition, the participants were warned that the images they got to see were quite big, so it was preferred to conduct the survey on a laptop. The participants were informed that if they continued to the survey they would give permission to the experimenter use their data. They were provided with an e-mail to contact the experimenter for

possible questions or remarks. Finally, the participants were thanked one more time, before the survey started.

After the introduction, four demographic questions followed. The demographics included gender, age, level of education and colour-blindness. Gender was measured with a two-point semantic differential (*male/female*), which is common practice. Age was measured with an open numeric question, for which is was specified that participants had to fill in a number (rather than letters). Next, level of education was measured with a five-point semantic differential with answer options corresponding to the Dutch education system. Finally, colour-blindness was measured with a two-point semantic differential (*yes/no).*

Following the demographics, participants saw infographics with three questions each. They saw the questions simultaneously with the infographic, but only one infographic and one set of questions at a time. Participants saw all four possible infographics, yet the order was randomised. There was no time limit for the participants to view the infographics and questions. Below each infographic five 7-point Likert scale questions regarding comprehensibility and five for attractiveness were asked. Subsequently, there was a final question for which participants had to rate the infographic on a scale from 1 to 10 (*extremely* bad to extremely *good)*.

After seeing the four infographics separately, the participants saw smaller versions of all four infographics listed on one page and had the judge which infographic they thought was the best one. For the final question the order of the infographics was the same for each participant (non-standard-pictorial, standard-pictorial, non-standard-abstract, standard-abstract, respectively). Finally, participants were noted that they reached the end of the survey and were thanked for their participation. On average, participants took 5 minutes to finish the survey.

4.3 Results

The effects for the independent variables (Standardness and Pictorialness) on the dependent variables (perceived comprehensibility and attractiveness) and the mean overall rating of the infographics are discussed below. Before analyzing the results, several items that measured perceived comprehensibility and attractiveness had to be recoded. All items were recoded in such a way that the positive item was mentioned last and thus would get the highest score on the 7-point Likert scale.

4.3.1 Comprehensibility

A Repeated Measures ANOVA was conducted to test the effects of Pictorialness and Standardness on perceived comprehensibility. The results showed that there was a main effect of Pictorialness, F (1, 104) = 64.54, $p < .001$. Pictorial infographics (M = 5.13, SD = .10) resulted in higher comprehensibility of the infographics than abstract infographics (M = 4.13, SD = .09). In addition, a main effect was found for Standardness, F (1, 104) = 99.73, $p < .00$. Standard infographics (M = 5.19, SD = .10) resulted in higher comprehensibility than non-standard infographics (M = 4.07, SD = .08).

Finally, there was an interaction effect between Pictorialness and Standardness, F (1, 104) = 140.04, $p < .001$, as can be seen in Figure 6. The figure shows that for a pictorial infographic it did hardly matter whether it was standard (M = 4.89, SD = 1.35) or non-standard (M = 5.38, SD = 1.27); the perceived comprehensibility of that infographic was relatively high in both cases. In addition, the comprehensibility of an abstract and standard infographic was also relatively high (M = 5.49, SD = 1.42). However, when an infographic was abstract and non-standard, the comprehensibility ratings decreased significantly (M = 2.76, SD = 1.33), which means that Standardness is an important factor in the comprehensibility of infographics.

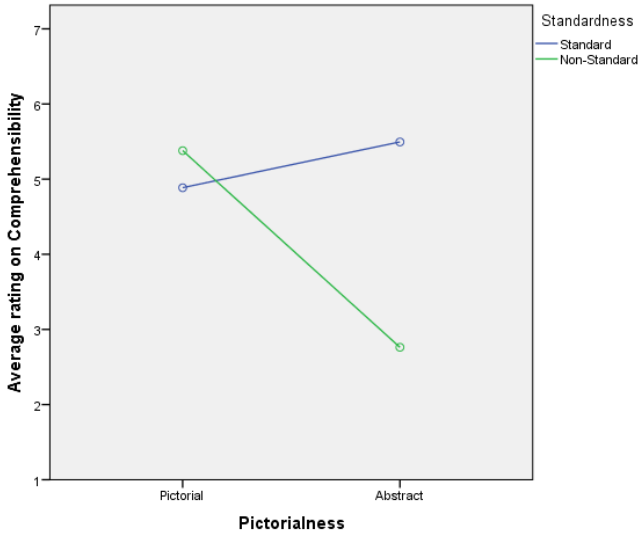

Figure 6. Average rating on Comprehensibility

4.3.2 Attractiveness

A similar Repeated Measures ANOVA was conducted to test the effects of Pictorialness and Standardness on perceived attractiveness. The results showed that there was a main effect of Pictorialness, F (1, 104) = 61.33, p < .001. Pictorial infographics (M = 4.50, SD = .09) were seen as more attractive than abstract infographics (M = 3.56, SD = .11). No significant effect was found of Standardness, F (1, 104) = 1.83, p = .179, which indicates that there was hardly any difference between a standard (M = 4.10, SD = .94) and a non-standard infographic (M = 3.95, SD = .96) in terms of attractiveness.

Furthermore, there was an interaction effect between Pictorialness and Standardness, F (1, 104) = 10.52, p = .002, as can be seen in Figure 7. This interaction indicates that for the perceived attractiveness of an infographic, it did not really matter whether it was standard (M = 4.39, SD = 1.31) or non-standard (M = 4.61, SD = 1.13), as long as it is pictorial. For abstract infographics the difference in Standardness appeared to be more visible, as an abstract and standard infographic (M = 3.82, SD = 1.34) scored higher on attractiveness than an abstract and non-standard infographic (M = 3.30, SD = 1.36).

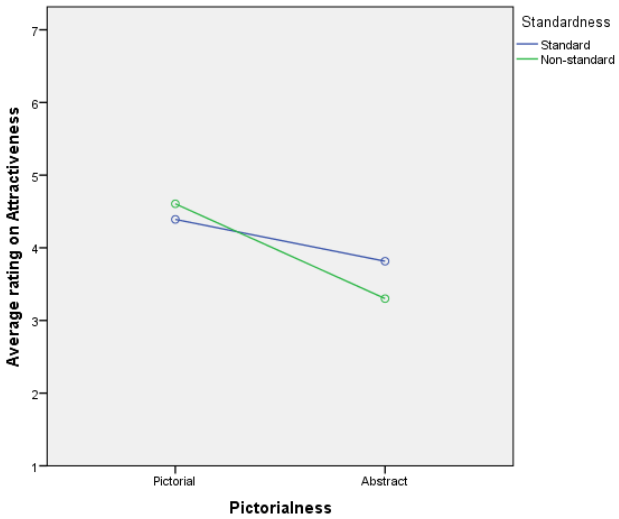

Figure 7. Average rating on Attractiveness

4.3.3 Overall mean rating

To test the effects of Pictorialness and Standardness on the mean overall rating of the infographics, a third Repeated Measures ANOVA was conducted. The results showed that there was a main effect of Pictorialness, F (1, 104) = 72.65, p < .001. Pictorial infographics (M = 6.64, SD = .12) received a higher overall rating than abstract infographics (M = 5.50, SD = .13). In addition, there was a main effect of Standardness, F (1, 104) = 34.34, p < .001. Standard infographics (M = 6.42, SD = .11) were rated higher than non-standard infographics (M = 5.72, SD = .14).

Finally, there was an interaction effect between Pictorialness and Standardness, F (1, 104) = 64.69, p < .001. The results indicated that for a pictorial infographic it did not matter whether an infographic is standard (M = 6.47, SD = 1.50) or non-standard (M = 6.82, SD = 1.43); the overall rating of that infographic is in both cases almost equal. In addition, the overall rating of an abstract and standard infographic was also relatively high (M = 6.37, SD = 1.43). The abstract-non-standard infographic received the lowest overall grade (M = 4.62, SD = 1.90), thus the mean overall grade decreased significantly when an infographic is abstract and non-standard. This indicates that Standardness is an important factor in the overall rating of infographics.

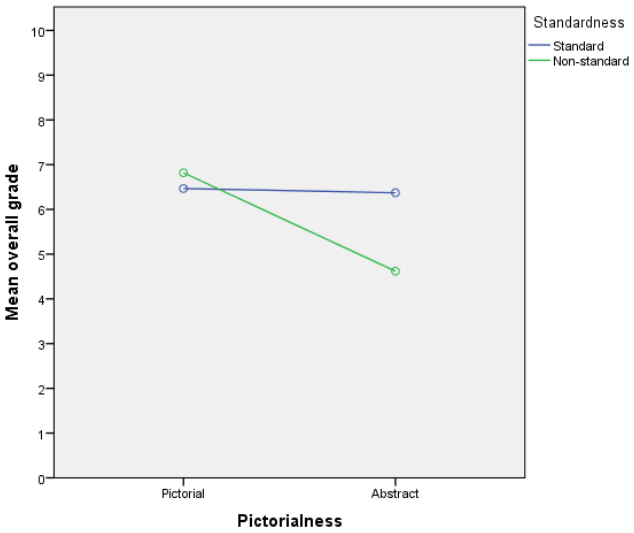

Figure 8. Average overall grading of the infographics

4.3 Conclusion Study 2

In this second study the effects of Standardness and Pictorialness on the perceived comprehensibility and attractiveness of infographics was investigated. Based on previous literature it was hypothesized that a standard infographic would be perceived as more comprehensible (H1a) and more attractive (H1b) than a non-standard infographic. In addition, it was expected that a pictorial infographic would be perceived as more comprehensible (H2a) and more attractive (H2b) than an abstract infographic. Finally, interaction effects were hypothesized, in particular that an infographic would be perceived as most comprehensible (H3a) and most attractive (H3b) if it is both standard and pictorial.

The results provided support for three out of six hypotheses. Standard infographics were perceived as more comprehensible than non-standard infographics, which confirms H1a. However, there was no significant difference between standard and non-standard infographics regarding perceived attractiveness, which means that H1b has to be rejected. Furthermore, pictorial infographics have been found to be both more comprehensible and more attractive than abstract infographics,

which means that H2a and H2b can be confirmed. Finally, two interaction effects were found. However, these were not as hypothesized. The pictorial-standard infographic did not appear to be most comprehensible (H3a) and most attractive (H3b). Rather it has been found that the abstract-standard infographic is most comprehensible, whereas the pictorial-non-standard infographic is seen as most attractive and received the highest overall grade. The abstract-non-standard infographic was rated lowest on all three variables. The results of study 2 will be discussed in further detail in the General Discussion of this study, also in combination with the findings of the production study of this research (study 1).

5. General discussion

The main function of an infographic is to accurately transfer information that is comprehensible, but also to transfer it in an attractive manner. An scientific debate is going on regarding the comprehensibility and attractiveness of infographics. The main question in this debate is about what is most important for an infographic to accurately blend data with design and to help people process the data easier (Smiciklas, 2012). On one side of the debate, researchers state that embellished infographics lead to better understanding of the data (e.g., Bateman et al., 2010), whereas on the other side, studies have shown that embellishments could lead to interpretation problems of the data (e.g., Holmes, 1984). Researchers have found support for both sides in the debate, but the designer's perspective on the debate was still not entirely clear. In a perception study, Quispel et al. (2016b) found that designers consider attractiveness as an important factor, but clarity remains crucial to them. However, in an evaluation study, designers appeared to prefer more attractive infographics over informative infographics (Quispel & Maes, 2014). Thus, these studies contradict each other.

The production study of the current research (study 1) was conducted to find an answer to the question that was still not answered by Quispel and Maes (2014) and Quispel et al. (2016b): do designers prefer attractive or informative infographics? To do this, designers received data to create an infographic with, which was taken from Bateman et al. (2010). There were no examples provided, so the designers were free to create what they thought would be a good infographic. The results show that designers created both informative and attractive infographics. Their creations varied from standard to non-standard infographics and from pictorial to abstract infographics. In most cases, the designers created infographics in line with what they think is important in an infographic. This is in line with Quispel et al. (2016b), who stated that designers are aware of the way they visualize information. However, the designers did not seem to pay attention to their colour use, even though it has been found that colours also influence the way in which infographics are perceived (Naz & Epps, 2004; Palmer & Schloss, 2010). So, designers created infographics that resemble both Pictorialness as well as Standardness and did not seem to focus more on either attractiveness or comprehensibility. Their creations were in line with what they thought was important, yet this was different for each designer. Thus, from the first study it can be concluded that designers follow both sides of the discussion, and are not specifically proponents of either one of the sides. It is clear that designers are aware of the way in which they visualize data, however, they do not have a preference for attractiveness or comprehensibility.

Quispel and Maes (2014) also conducted an evaluation study to compare the opinions of both laypeople and designers with what the designers claimed to find important in infographics. Following this study, it seemed interesting to have a second study in the current research to follow up on the production study. In this evaluation study, laypeople could evaluate the infographics made by the designers. In their study, Quispel and Maes (2014) studied Pictorialness and Standardness. For the

evaluation study of the current research, four final conditions of the survey ended up in the survey, which were: pictorial-standard, abstract-standard, pictorial-non-standard and abstract-non-standard. It was expected that pictorial and standard infographics would be perceived as most comprehensible and attractive. This was expected to be the case for both factors separately, as well as when the factors interact with each other. Quispel and Maes (2014) found similar results in their study: laypeople and designers both rated a standard and pictorial infographic among the most appreciated infographics for comprehensibility and attractiveness. For the interaction effect it was expected that a pictorial-standard infographic would be perceived as most comprehensible and most attractive.

The current evaluation study found, in line with Quispel and Maes (2014), that pictorial infographics lead to better comprehensibility and attractiveness. The standard infographics only lead to better comprehensibility. However, the pictorial-standard infographic did not lead to the highest comprehensibility and attractiveness. Instead, the abstract-standard infographic is perceived as most comprehensible, whereas the pictorial-non-standard infographic is seen as most attractive and received the highest overall grade. The lowest score was, in all cases, given to the abstract-non-standard pictorial.

Thus, viewers seem to prefer abstract-standard and pictorial-non-standard infographics over the other types, even though both are preferred for different reasons. On the contrary, designers mostly created standard infographics, which could indicate that designers prefer this form of design and thus focus more on comprehensibility than attractiveness. Hence, it seems to be the case that designers and their viewers are not unanimous about what infographic would be the best infographic to present information. Perhaps it would be wise for designers to discuss their creating process with their audience or to do discuss their creations before publishing them. As abstract-standard infographics are rated to be most comprehensible and pictorial-non-standard to be most attractive, it could be possible that different purposes need different types of infographics to convey their information in the most effective way possible. For example, comprehensible infographics should be used to make data clear as in scholarly environments, whereas attractive infographics should be used to make the data or a complete article stand out.

5.1 Effects of Pictorialness and Standardness

The results mostly follow the expectations for the second study, although it differs from them on several aspects. First of all, there was no significant difference between standard and non-standard infographics regarding attractiveness. This difference was expected since standard infographics are usually most efficient for representing specific kinds of data, such as the data used for this experiment (Quispel & Maes, 2014; Zacks & Tversky, 1999). Thus, not finding results in line with these former studies seemed unexpected. However, Quispel and Maes (2014) also found in their evaluation study that designers and laypeople gave different ratings to attractiveness and comprehensibility of infographics: designers rated non-standard and pictorial infographics higher on attractiveness, while laypeople preferred standard and abstract infographics. For comprehensibility, Quispel and Maes (2014) found that both designers and laypeople preferred the same types of infographics, namely standard and abstract. Even though the current study did not find the highest scores for standard and abstract infographics, an interaction effect was found for both comprehensibility and attractiveness. This indicates that the effects of Standardness cannot be interpreted without also addressing the factor Pictorialness, whereas earlier studies did not investigate the interaction effects of Pictorialness and Standardness.

Furthermore, the abstract-standard infographic, rather than the pictorial-standard infographic, appeared to be the most comprehensible one. The pictorial-standard infographic was expected to be the most comprehensible one, because Quispel and Maes (2014) found that both laypeople and designers rated a pictorial and standard infographic among the most appreciated infographics. However, in the case of the current research, the expectation does not appear to be true. This could possibly be due the design of the specific pictorial-standard infographic. This design seemed to be a very appealing infographic which uses coins as bars to indicate the increase in money over the years. However, three of the six drawn bars exist of only golden coins, whereas three others also include silver coins. Yet, it remains unclear why the silver coins are added. When counting the coins, the first bar that uses a silver coin should have a value of 10 to reach to total number of dollars spent. Then again, using the number 10 does not seem to add up in all three cases. Since participants could view the infographics for unlimited time, it is possible that they also saw the silver coins and started to count the golden and silver coins to get to the number indicated below the bar. This could cause confusion, since it is not the correct interpretation. Therefore, the design of this pictorial-standard infographic might have caused it to be less comprehensible than the abstract-standard infographic.

Finally, the pictorial-standard infographic was expected to be seen as most attractive, yet the pictorial-non-standard infographic received the highest rating on attractiveness and overall grade. The highest attractiveness for the pictorial-standard infographic was initially expected because bar graphs are especially applicable to data that regards different points in time (Quispel & Maes, 2014; Zacks & Tversky, 1999), which makes them suitable for the data used in this study. However, the standard infographics did not appear to be perceived as most attractive. One possible explanation for this is that the pictorial and non-standard infographic in this study might have been interpreted as a bar graph. The infographic shows bags with money that represent the amount of money that is spent in a specific year, thus they increase as the amount of money increases. The data that was used in this study was only increasing, which could possibly influence the way the infographic looks. For example, when the amount of money spent on Senate and House campaigns alternately increased and decreased over the years, the infographic would look entirely different. The infographic would possibly have looked more like a random collection of money bags, rather than an increasing line. Thus, the way in which the pictorial and non-standard infographics were designed for this experiment could have influenced their attractiveness differently than expected.

5.2 Limitations and directions for future research

Both study 1 and 2 ended up having some limitations, which are discussed in the next few paragraphs. Firstly, for study 1, in this research the designers who created the infographics were all students, varying from first year's to third year's students. They were still learning to be a designer, which could have influenced the results of this study. It could be possible that experts in the design field create completely different designs than students, as they have more experience with creating infographics and perhaps publishing them. More experienced designers are more likely to take earlier feedback, which they have received in their career and apply it to new designs. For future research it might therefore be interesting to conduct a similar research as the current one, but with experienced designers. For example, a minimum experience of ten years could be required to take part in the research. The designs could then end up very differently from the current research. Experienced designers could take more colours into account, as is assumed that they know the influences of colour on attractiveness and comprehensibility. Furthermore, they could wonder what the goal of an infographic is, in order to create an infographic that matches its purpose.

Another limitation of the first study could be that the designers had a think and design process of maximum one hour. If the designers had had more time to revise the infographics, they could possibly have changed their creations, or designed them in a different way. However, the maximum of one hour was based on Quispel and Maes (2014), who gave their designers also one hour to create the infographics. Therefore, for reasons of comparability, this was a reasonable time limit to follow. Yet, in future research the time limit could be tested, for example by asking the designers after the process what they thought about the time limit. In this way, researchers can get feedback on whether an hour is enough to design an infographic or whether designers need more or even less time for their creations. It could also be possible to ask the designers beforehand what would be the best time span for them to create an infographic. This could be done by polling several designers, preferably the designers that are also taking part in the final research. Then the average time indicated by the designers could be the amount of time the designers receive to create their infographics.

For the second study of this research (the perception study) there are also some limitations worth discussing. Firstly, only one infographic for each condition was used. In this case, there was no other possibility, because the designers did not deliver more designs to match the conditions other than the four that were used. Yet, the designers were not asked to create appropriate infographics for the conditions, they were selected after the analysis. Nonetheless, having only one design for each condition could have influenced the validity of this study, as the pictorial and non-standard infographic might have been seen as a bar graph, and thus a standard infographic rather than a non-standard infographic. Yet, this also applies to the other infographics, as there are more possible designs for each type. For example, the spider-web graph is one possibility to design an abstract-non-standard infographic, however, Quispel and Maes (2014) found other types of non-standard infographics, such as polar charts and area charts. Thus, having only one infographic for each condition, could have influenced its results. If the study had contained more variations of each condition, this could have possibly led to different outcomes of the study. However, again, it must be noted that for this research the designers were completely free to design what they thought was a good infographic, there were no expectations in the beginning of the production study.

Future studies should strive for more versions per condition to get a better validity for the study. This could also lead to different results, as different infographics might be rated differently. For example, in their study, Quispel and Maes (2014) asked designers create a total of 41 infographics of which 20 infographics were selected to use in the evaluation study. Since it can be the case that not all designs can be used to test the effects of Pictorialness and Standardness, it might be wise for future research to try to collect almost (or even ample) the double amount of what is ideally used in the study.

Furthermore, both of the current studies only used one topic in the infographics. This topic was based on Bateman et al. (2010), who used this data as main example to show the difference between embellished and plain infographics. They also showed that the presence of embellishments had an effect. In their study, Bateman et al. (2010) also used other data and different infographics. However, the experiment in the current study would take too long if it contained more than one topic. Yet, the results could look different when more topics were used per condition. Thus, it might be interesting for future research to look at the effects of Pictorialness and Standardness with different topics. For example, Bateman et al (2010) used ten different topics per condition, although it should be noted that they only had two conditions. Therefore, an indication could be to have five topics per condition, since there would be four conditions in similar research as the current one.

In addition, another limitation of this study is that colours were not specifically taken into account, while earlier studies have found that colour is an important aspect of infographics, as it affects

the attractiveness and understandability (Hart, 2013). Furthermore, Iovino et al. (1998) have found that the use of the right colours increase reading comprehension. In this study two different shades of the colour green were used to design the abstract-standard infographic. Earlier research has found that green can evoke positive feelings (Naz & Epps, 2004). Based on earlier studies it is possible that green could be considered a right colour for abstract-standard infographics and that it therefore resulted in the most comprehensible image. Yet, in this research there was no specific focus on colours and neither the designers, nor the viewers were told to take them into account. Still, colours can have all kinds of effects on attractiveness and comprehensibility (Iovino et al., 1998; Naz & Epps, 2004) and therefore it would be interesting for future studies to look at the combinations of Pictorialness and colour and Standardness and colour. For example, if there is a specific colour that works best for abstract and standard designs or if there are colours that fit particular pictorial designs.

Finally, this study measured perceived comprehension and attractiveness of the four conditions based on statements. Therefore, it can not say much about the actual comprehension of the images. The actual comprehension could be measured in future research by asking content questions about the infographics. For example, in a study with similar data one could ask questions like what is the infographic about or how much money was spent on House and Senate campaigns in a specific year to measure actual comprehensibility. For future research, similar questions could be used the measure the actual comprehensibility of the infographics.

5.3 Implications

The study contributes to the ongoing debate about whether an infographic should be attractive or comprehensible, by examining what both designers and laypeople think is the best infographic in terms of comprehensibility and attractiveness. Based on the results of the current research, it can be recommended that designers carefully watch the purpose of a specific infographic, as different types could lead to different results in comprehensibility and attractiveness. For example, when an infographic should make data comprehensible (e.g., for scholarly or business purposes), designers should create abstract-standard infographics. However, if an infographic should stand out in a particular text (e.g., in marketing), designers should create a pictorial-non-standard infographic. Although, this advice should be taken with caution, as the particular design of the pictorial-nonstandard infographic in this study looked similar to a pictorial-standard design. Nonetheless, the results showed that it did not matter whether the infographic was standard or non-standard: as long as it was pictorial the attractiveness rating would be high.

Another recommendation that can be taken from this study is that designers should avoid creating an abstract-non-standard infographic, since it results in the lowest ratings for comprehensibility and attractiveness. Viewers do not like this type of infographic, at least not the one used in the current study. However, again, this recommendation specifically applies to the spider-web infographic. There are no firm rejections towards other types of abstract-non-standard infographics, as these have not been studied.

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Appendices

Appendix A: designer's introduction in English

Dear student,

My name is Robin and I am a student at Tilburg University in Tilburg. Right now I am doing my Master in Communication and Information Sciences and I am working on my thesis. For this, I am interested in what graphic designers think is a good infographic and what it would look like. Therefore, I would like to ask you to design an infographic for me that includes the details below. You are free to decide what the infographic looks like, as long as it contains all data stated below. Be creative! You will get a maximum of an hour to design the infographic and you can not use the internet or other tools. The designs can be handed in both on paper, as well as digital.

Title: Monstrous costs

Subtitle: Total House and Senate campaign expenditures in millions

Source: Citizens' Research Foundation

Data: 1972 – 60 million dollar

1974 – 80 million dollar

1976 – 130 million dollar

1978 – 195 million dollar

1980 – 245 million dollar

1982 – 300 million dollar

Could you also please answer these questions?

Age: _____ years old

Gender: m / f

College year: _____

If you designed the infographic on your computer, what/which progam(s) did you use to make it?

_____

Thank you in advance and goodluck!

Robin Tilburgs

Appendix B: designer's introduction in Dutch

Beste student,

Ik ben zelf een student aan Tilburg University waar ik op dit moment mijn Master doe in Communicatie- en Informatiewetenschappen. Op dit moment ben ik bezig met mijn master thesis waarvoor ik onderzoek wat graphic designers een goede infographic vinden en hoe deze eruit zou zien. Daarom is aan jullie de taak om met onderstaande gegevens een infographic te maken. De infographic mag eruit zien zoals jij wilt, zo lang alle gegevens er maar in terug komen. Leef je uit! Je krijgt maximaal een uur de tijd om de infographic te maken en je mag geen gebruik maken van het internet of andere hulpmiddelen. Je mag je uitwerking zowel op papier als digitaal inleveren.

Titel: Monstrous costs

Ondertitel: Total House and Senate campaign expenditures in millions

Bron: Citizens' Research Foundation

Data: 1972 – 60 million dollar
1974 – 80 million dollar
1976 – 130 million dollar
1978 – 195 million dollar
1980 – 245 million dollar
1982 – 300 million dollar

Daarnaast zou ik graag willen dat je onderstaande gegevens invult:

Leeftijd: _____ jaar

Geslacht: m / v

Studiejaar: _____

Als je de infographic op de computer maakt, welk(e) programma(s) gebruik je hier dan voor?

_____

Alvast heel erg bedankt en succes!

Robin Tilburgs

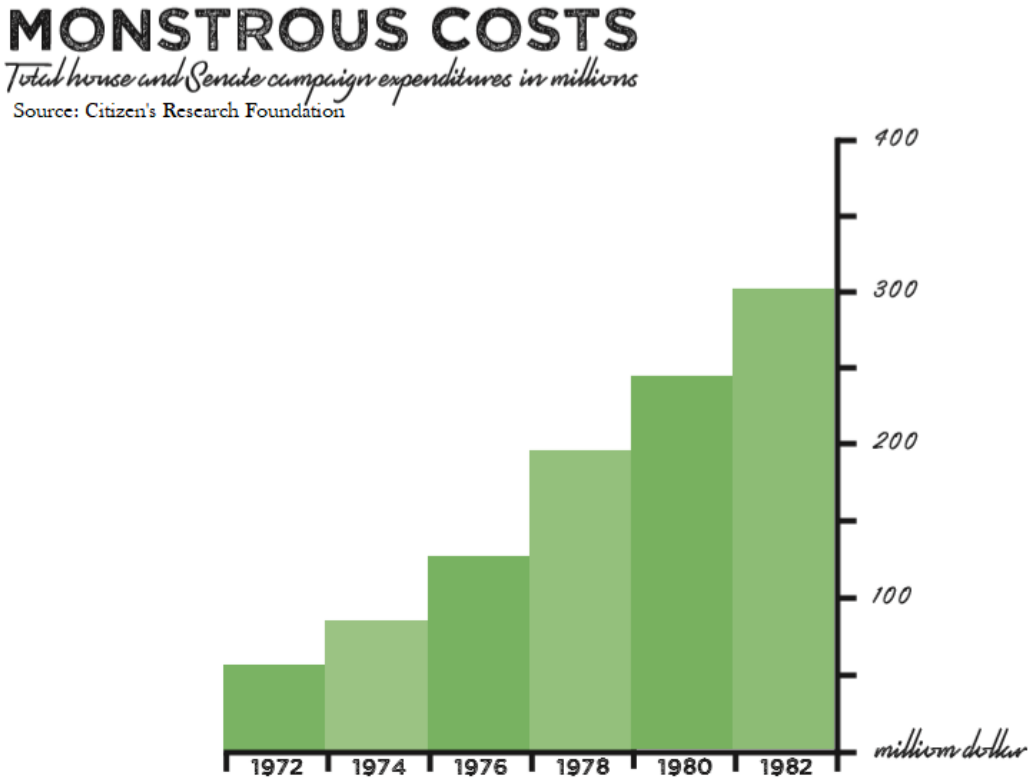
Appendix C: designer's survey in English

	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
While making this infographic I focussed on the attractiveness of the image.	0	0	0	0	0
While making this infographic I focussed on the comprehensibility of the image.	0	0	0	0	0
I think attractiveness of an infographic is important.	0	0	0	0	0
I think comprehensibility of an infographic is important.	0	0	0	0	0

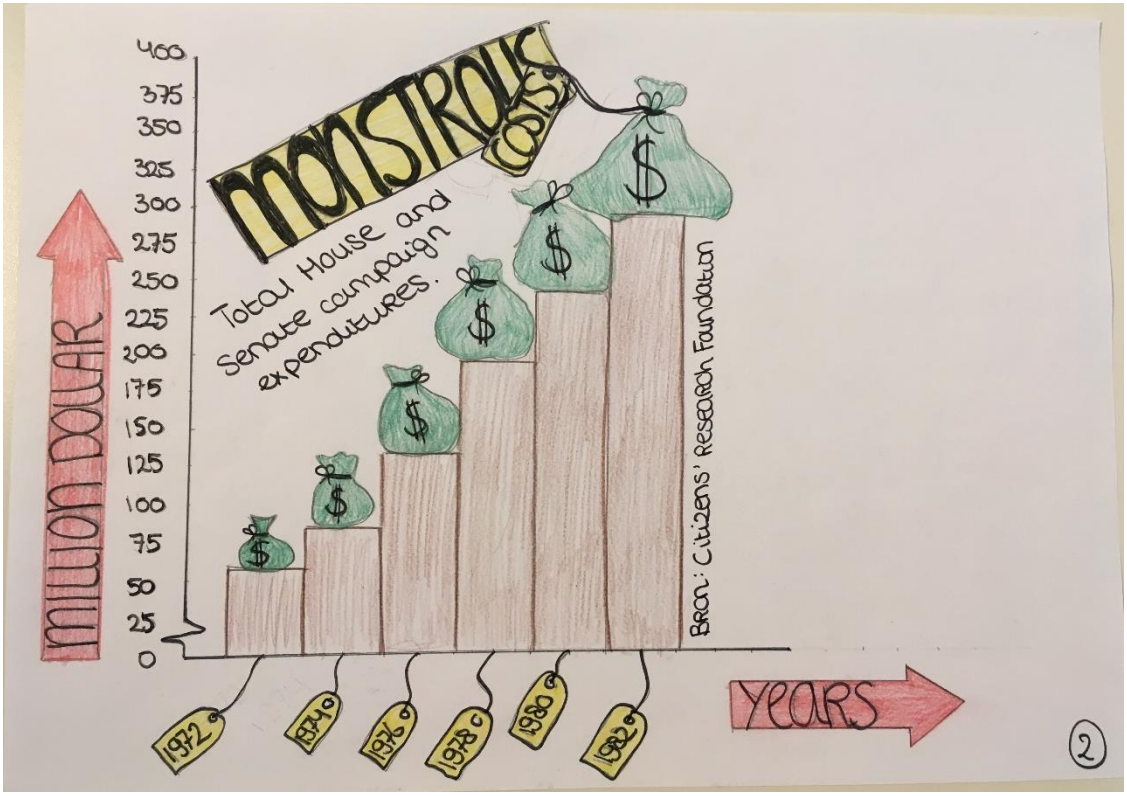
Appendix D: designer's survey in Dutch

	Heel erg mee eens	Mee eens	Niet mee eens/niet mee oneens	Mee oneens	Heel erg mee oneens
Bij het maken van deze infographic heb in aandacht besteed aan aantrekkelijkheid.	0	0	0	0	0
Bij het maken van deze infographic heb ik aandacht besteed aan begrijpelijkheid.	0	0	0	0	0
Ik vind zelf aantrekkelijkheid van een infographic belangrijk.	0	0	0	0	0
Ik vind zelf begrijpelijkheid van een infographic belangrijk.	0	0	0	0	0

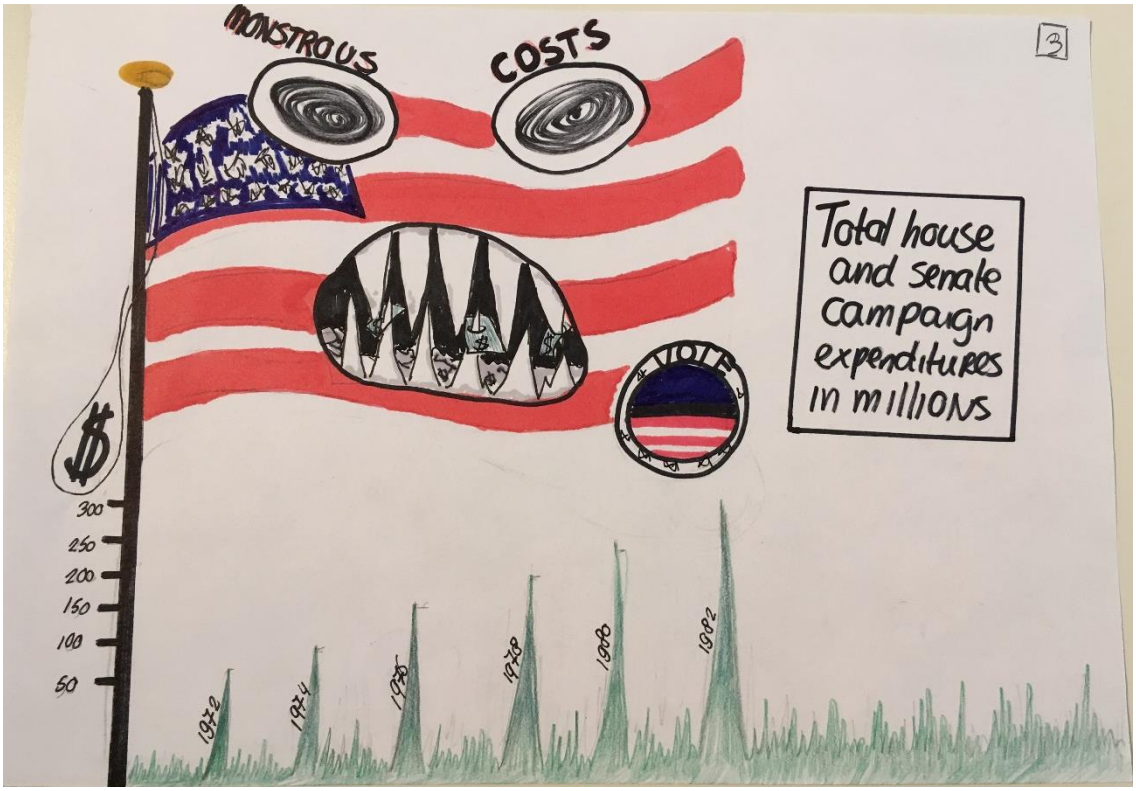
Appendix E: Infographic 1



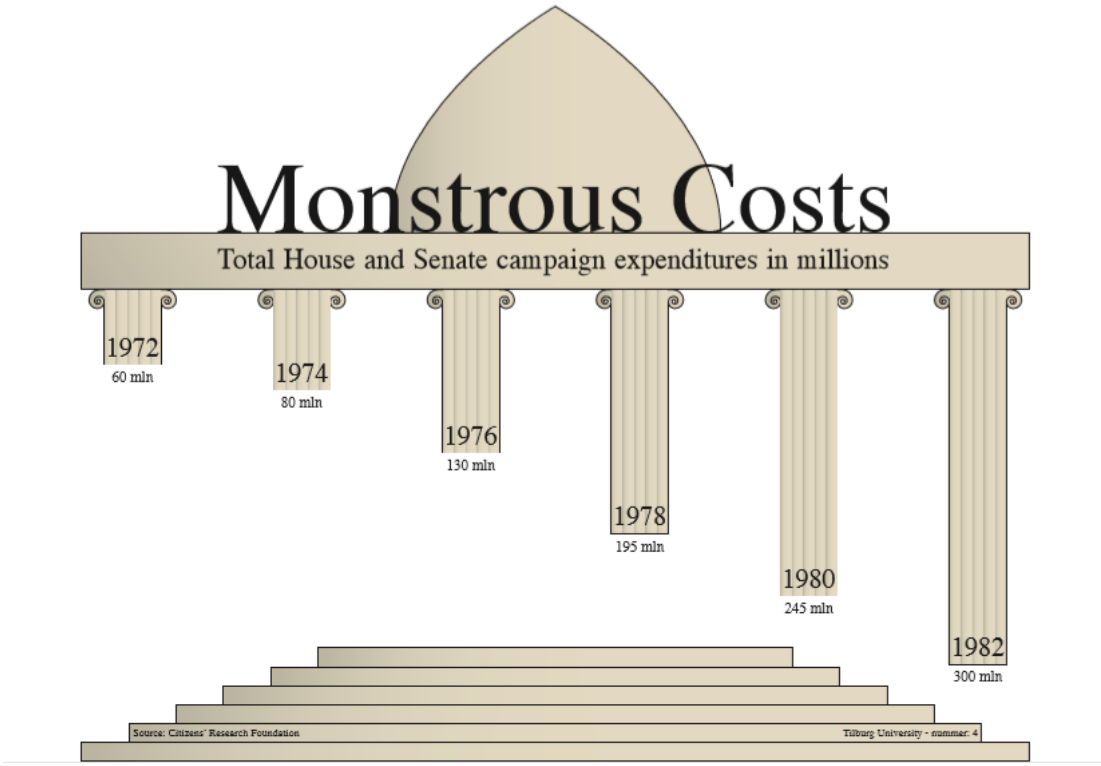
Appendix F: Infographic 2



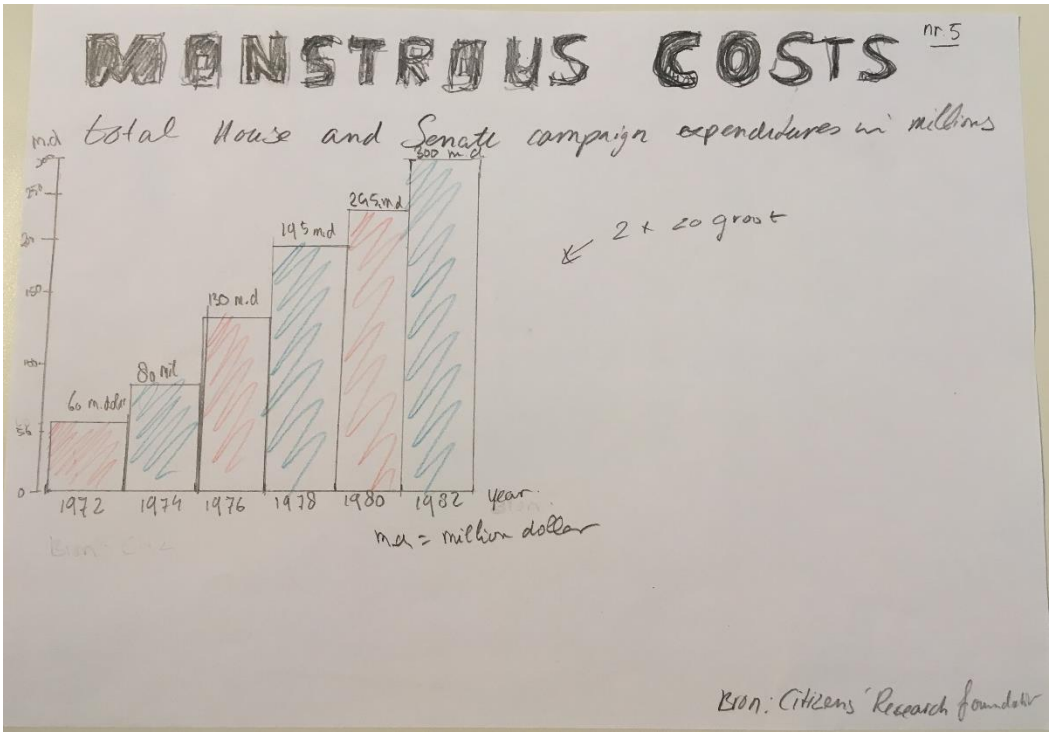
Appendix G: Infographic 3

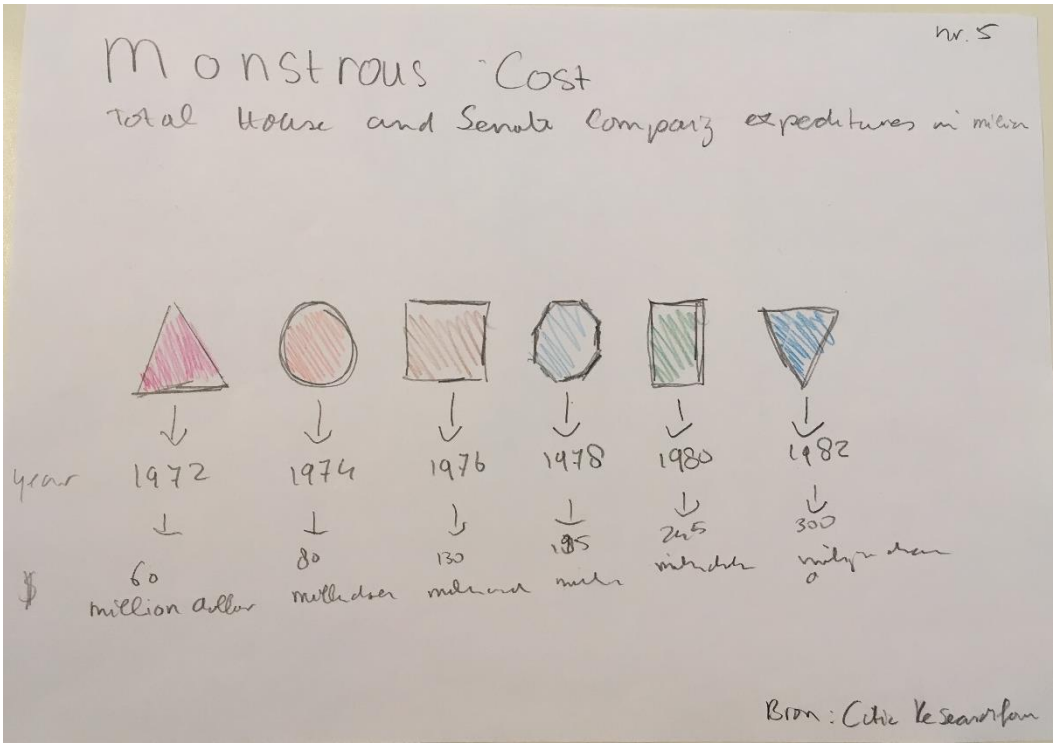


Appendix H: Infographic 4

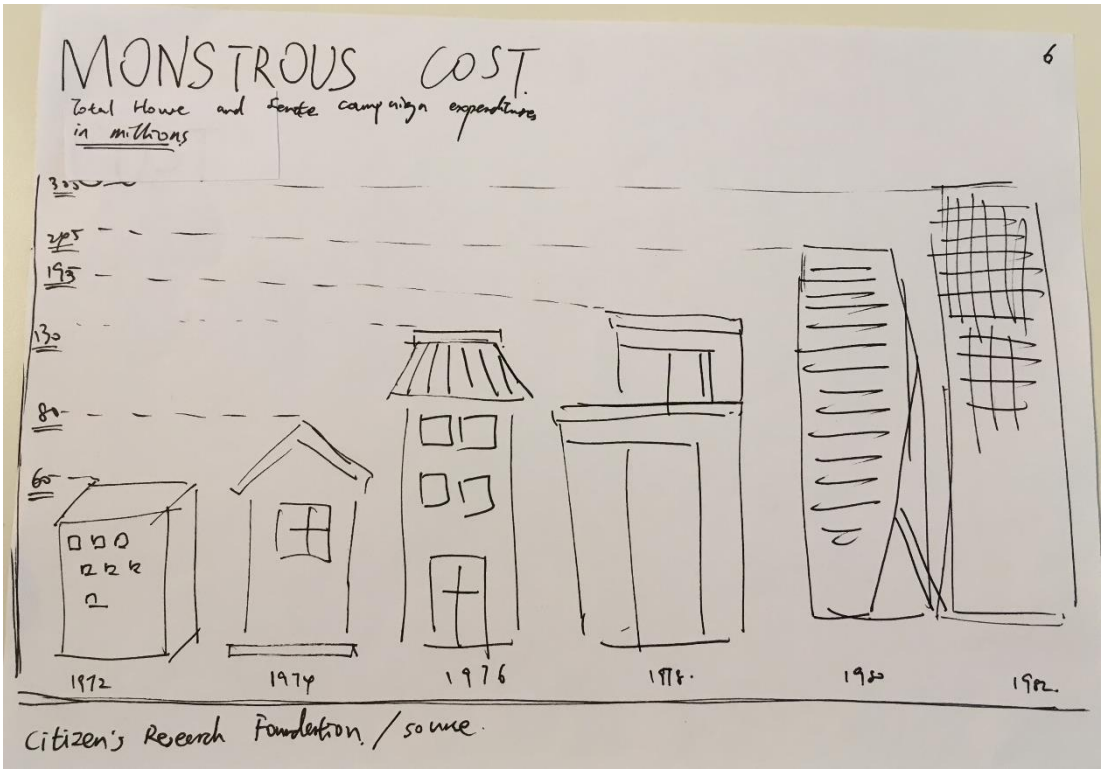


Appendix I: Infographic 5a and 5b

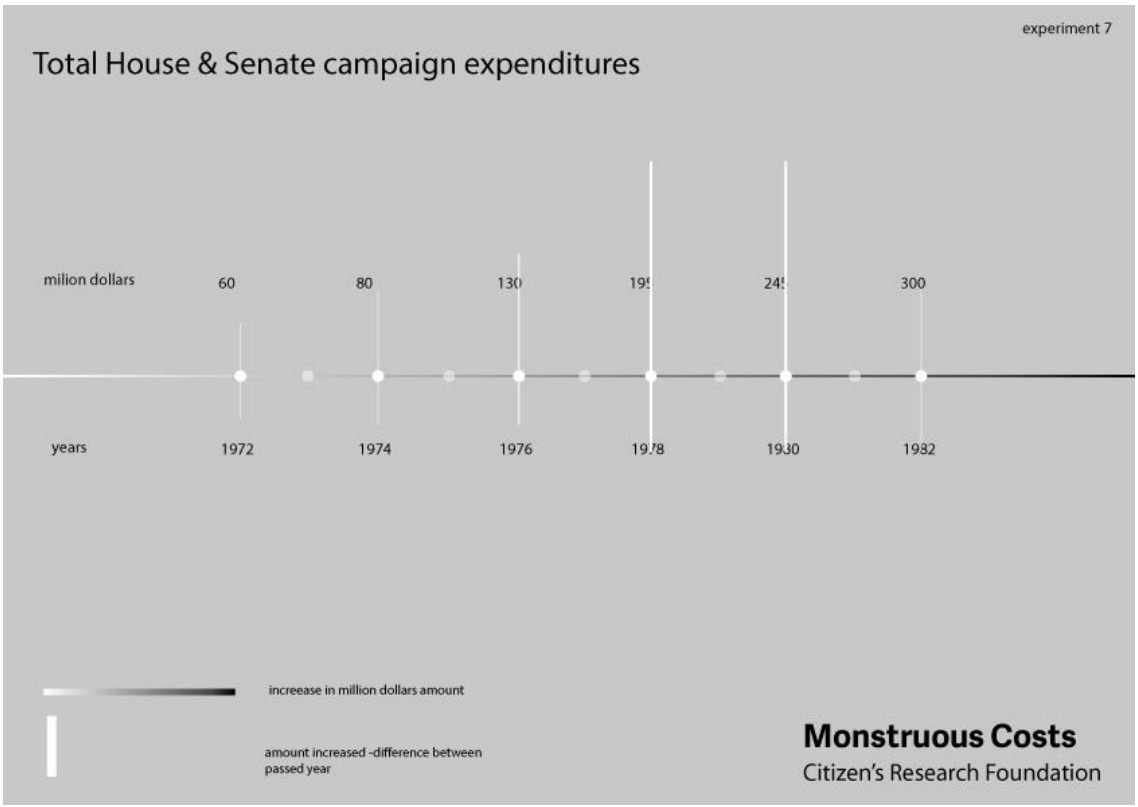




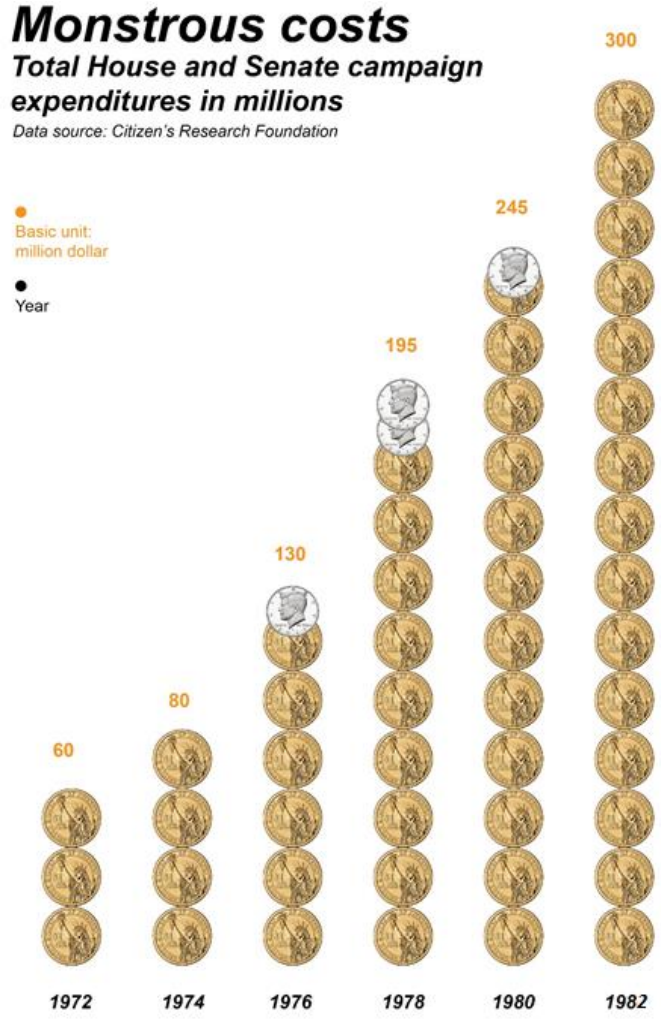
Appendix J: Infographic 6



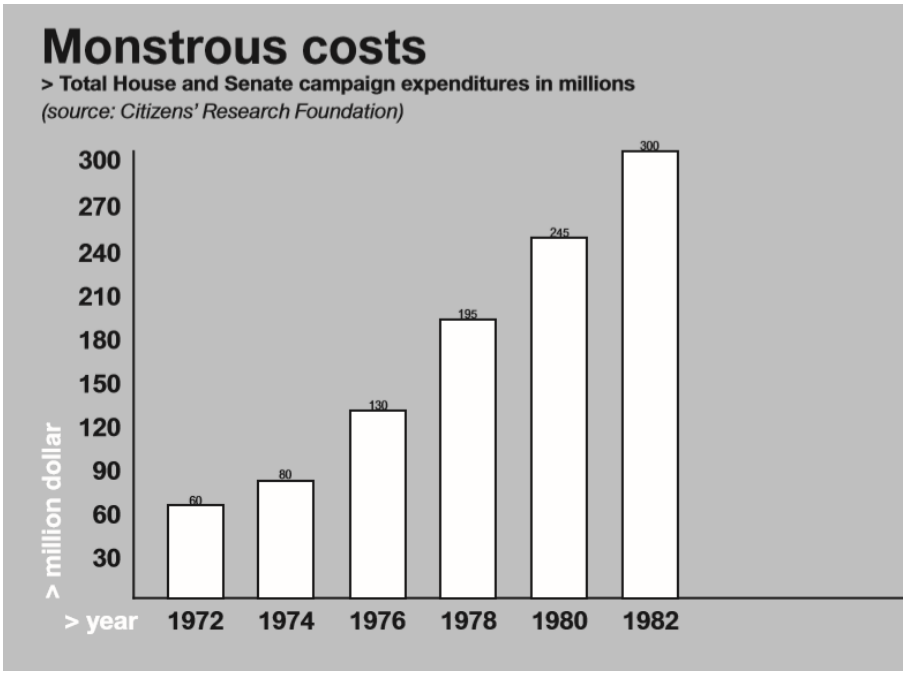
Appendix K: Infographic 7



Appendix L: Infographic 9



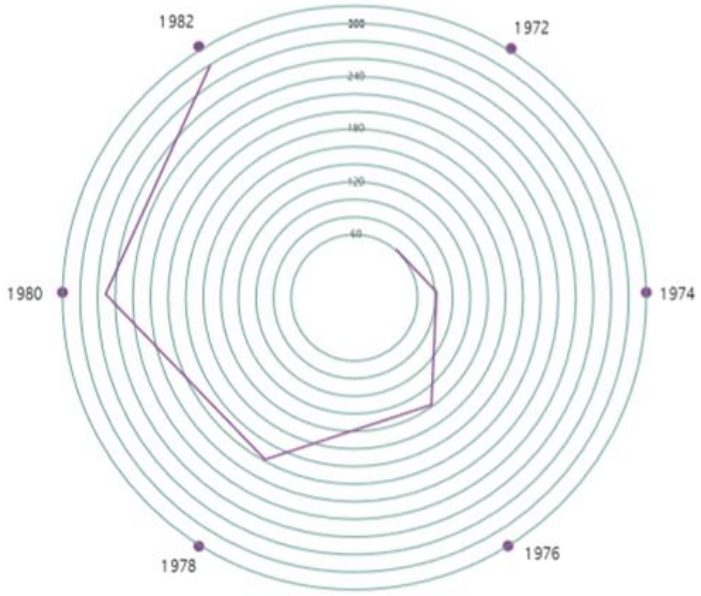
Appendix M: Infographic 10



Appendix N: Infographic 11

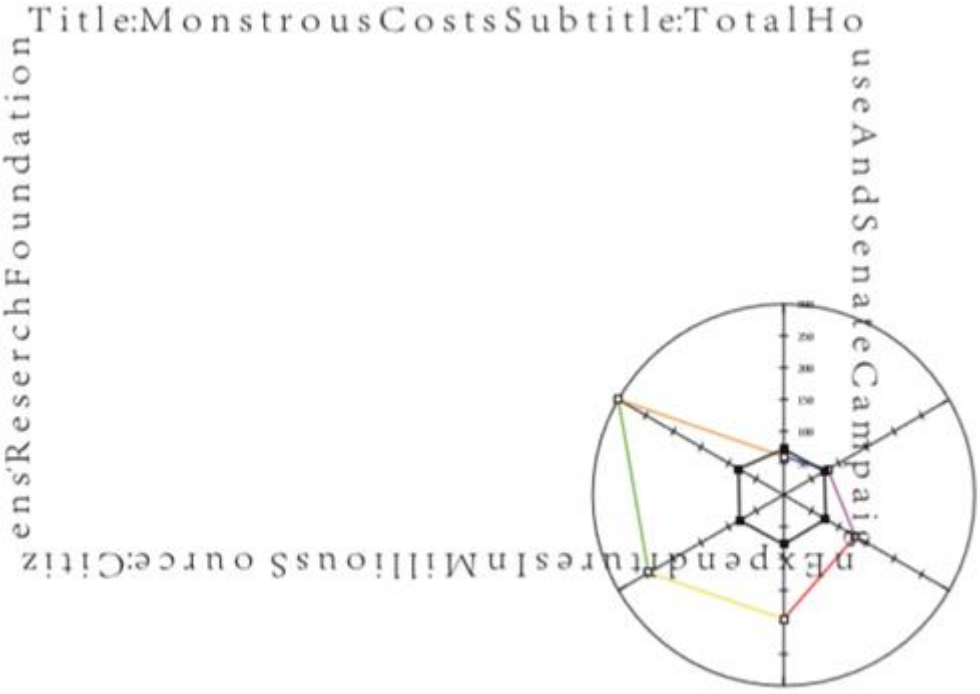
Monstrous costs

Total House and Senate campaign expenditures in millions

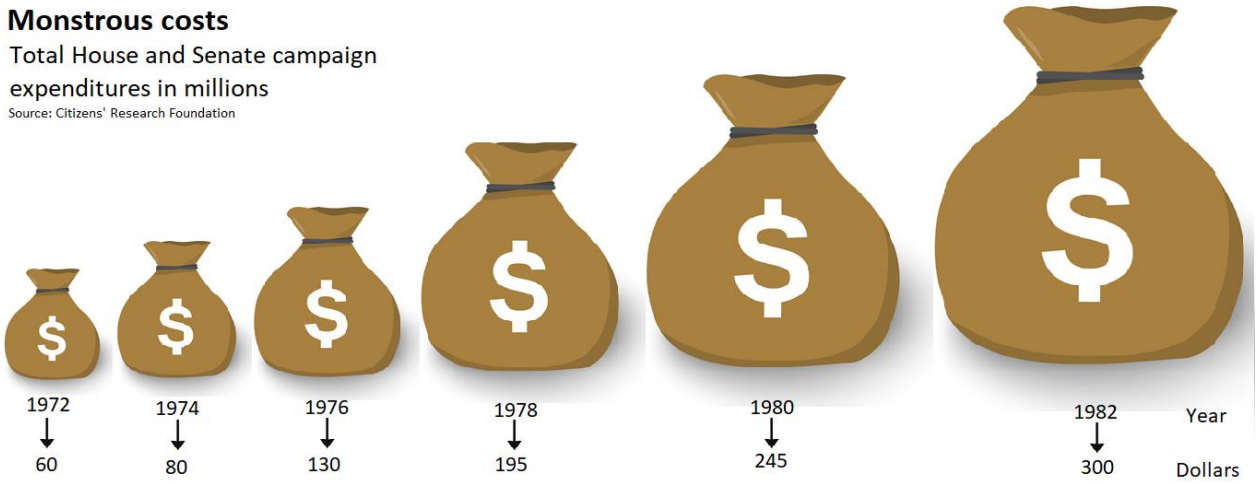


Source: Citizens' Research Foundation

Appendix O: Infographic 12



Appendix P: Infographic 13



Appendix Q: Dimensions of comprehensibility in Dutch

Deze infographic is ..		
Moeilijk	0 0 0 0 0 0 0	Makkelijk
Onduidelijk	0 0 0 0 0 0 0	Duidelijk
Overzichtelijk	0 0 0 0 0 0 0	Onoverzichtelijk
Logisch opgebouwd	0 0 0 0 0 0 0	Onlogisch opgebouwd
Bondig	0 0 0 0 0 0 0	Omslachtig

Appendix R: Dimensions of attractiveness in Dutch

Deze infographic is ..		
Interessant	0 0 0 0 0 0 0	Oninteressant
Afstandelijk	0 0 0 0 0 0 0	Aansprekend
Boeiend	0 0 0 0 0 0 0	Saai
Eentonig	0 0 0 0 0 0 0	Afwisselend
Aantrekkelijk	0 0 0 0 0 0 0	Onaantrekkelijk

Appendix S: Survey as was shown in Qualtrics (in Dutch)

Introduction

Beste deelnemer,

Allereerst heel er bedankt voor het helpen met mijn onderzoek!
Op dit moment ben ik bezig met mijn master in communicatie- en informatiewetenschappen, aan de Universiteit van Tilburg. Voor mijn afstuderen doe ik onderzoek naar infographics, met name wat nu precies een infographic goed maakt.

Deelname aan dit onderzoek is geheel vrijwillig en duurt ongeveer 5 minuten. De vragenlijst begint met een aantal vragen over uzelf, vervolgens krijgt u 4 infographics te zien met vragen. De resultaten worden geheel anoniem verwerkt. Door op de blauwe pijl rechtsonder te klikken geeft u toestemming om uw gegevens te gebruiken voor dit onderzoek.

Aangezien de afbeeldingen die getoond worden vrij groot zijn, wordt het aangeraden de vragenlijst op een pc of laptop in te vullen!
Mocht u nog vragen of opmerkingen hebben over het onderzoek, stuur dan even een mailtje naar

Nogmaals bedankt voor het helpen!

Robin Tilburgs
Communicatie- en informatiewetenschappen student
Tilburg University

Demographic questions

1. Wat is uw geslacht?
   - Man
   - Vrouw
2. Wat is uw leeftijd?

_____

3. Wat is uw hoogst genoten opleiding (of: opleiding waar u nu mee bezig bent)?
   - Basisonderwijs
   - Middelbaar onderwijs
   - Middelbaar beroepsonderwijs (MBO)
   - Hoger beroepsonderwijs (HBO)
   - Universiteit (WO)

4. Bent u kleurenblind?
   - Ja
   - Nee

Infographic questions (per infographic)

Deze infographic is ..

5.	Moeilijk	0 0 0 0 0 0 0	Makkelijk
6.	Onduidelijk	0 0 0 0 0 0 0	Duidelijk
7.	Overzichtelijk	0 0 0 0 0 0 0	Onoverzichtelijk
8.	Logisch opgebouwd	0 0 0 0 0 0 0	Onlogisch opgebouwd
9.	Bondig	0 0 0 0 0 0 0	Omslachtig

Deze infographic is ..

10. Interessant	0 0 0 0 0 0 0	Oninteressant
11. Afstandelijk	0 0 0 0 0 0 0	Aansprekend
12. Boeiend	0 0 0 0 0 0 0	Saai
13. Eentonig	0 0 0 0 0 0 0	Afwisselend
14. Aantrekkelijk	0 0 0 0 0 0 0	Onaantrekkelijk

15. Deze infographic krijgt van mij het cijfer:

Heel slecht									Heel goed
0	0	0	0	0	0	0	0	0	0
1	2	3	4	5	6	7	8	9	10

Bekijk de infographics nog eens kort en beantwoord de onderstaande vraag.

16. Welke infographic vond je het beste?
    - 1
    - 2
    - 3
    - 4