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Website visuality and usability

How visual design can help prevent information overload on data-heavy websites

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ABSTRACT:
Due to technological development, the transmission of information via digital channels has increased and is constantly growing. A large amount of information reaches us every day, both in our free time and in our working life. It can be difficult to avoid the flood of information, and it may become impossible to filter the information needed at each moment from the huge information flow. This concept is known as information overload.

The aim of this study was to find out how the visual elements of websites can help and guide users to find information on data-heavy websites, and to discover how the visual elements affect the users' possible experience of information overload. In my research, I looked into the websites of the Finnish Institute for Health and Welfare THL, as well as the United Nations' World Health Organization WHO. The data analyzed in the study was collected by means of an expert analysis, a usability study, and a questionnaire.

At the beginning of the research, I conducted an expert analysis to identify which visual elements had been used on THL and WHO's websites. By comparing these elements with the usability study results, I was able to find out how these elements affected the users' actions on the websites. The study found that on both websites, the visual elements guided the users' navigation, and the way they looked for information on the websites. Since all participants of the usability study were able to complete their tests on both websites, it could be stated that the visual usability of both THL and WHO's websites is at a fairly good level.

Based on the participants' questionnaire answers and the results of the usability study, I identified six symptoms referring to information overload. The main contributors behind these symptoms were visual elements that affected the appearance of the links and navigation elements used on the websites. The participants found the THL website more difficult to use, and this finding was supported by the amount of time spent on performing the usability tests. Based on the research, it can be concluded that the visual elements of websites can have both positive and negative effects on the users' possible experience of information overload.

KEYWORDS: website, usability, visual usability, visualization, user experience, user interface, information overload, information density.

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TIIVISTELMÄ:
Teknologisen kehityksen myötä tiedonvälitys digitaalisia kanavia pitkin on lisääntynyt ja kasvaa jatkuvasti. Valtava määrä informaatiota tavoittavaa meidät päivittäin niin vapaa-ajalla kuin työelämässäkin. Informaatiotulvaa voi olla vaikea välttää, ja kussakin hetkessä tarvittavan tiedon suodattaminen valtavista tietomääristä voi olla jopa ylitsepääsemättömän vaikeaa. Puhutaan niin sanotusta informaatioähkystä.

Tämän tutkimuksen tavoitteena oli selvittää, miten verkkosivustojen visuaaliset elementit voivat auttaa ja ohjata käyttäjiä löytämään informaatiota suuria määriä dataa sisältäviltä verkkosivustoilta, sekä miten visuaaliset elementit vaikuttavat käyttäjien mahdollisesti kokemaan informaatioähkyyn. Tutkimuksessa tarkastelin Terveyden ja hyvinvoinnin laitos THL:n sekä Yhdistyneiden kansakuntien eli YK:n alaisen Maailman terveysjärjestö WHO:n verkkosivuja. Tutkimuksessa analysoitava data kerättiin asiantuntija-analyysin, käytettävyystutkimuksen ja kyselylomakkeen avulla.

Tutkimuksen alussa tunnistin asiantuntija-analyysin avulla mitä visuaalisia elementtejä THL:n ja WHO:n verkkosivuilla oli käytetty. Vertaamalla näitä elementtejä käytettävyystutkimusten tuloksiin pystyin selvittämään, miten nämä elementit vaikuttivat käyttäjän toimintaan verkkosivuilla. Tutkimuksessa havaittiin, että molemmilla verkkosivustoilla visuaaliset elementit ohjasivat käyttäjän navigointia ja tapaa, miten he etsivät informaatiota. Koska kaikki käytettävyystestien osallistujat pystyivät suorittamaan testit molemmilla verkkosivuilla, voitiin todeta, että sekä THL:n että WHO:n verkkosivustojen visuaalinen käytettävyys on melko hyvällä tasolla.

Tutkimuksen osallistujien kyselylomakkeeseen antamien vastausten sekä käytettävyystestien tulosten perusteella tunnistin kuusi informaatioähkyyn viittaavaa oiretta. Näiden oireiden taustalla olivat ennen kaikkea sellaiset visuaaliset elementit, jotka vaikuttivat verkkosivuilla käytettyjen linkkien ja navigointielementtien ulkoasuun. Testien osallistujat kokivat THL:n verkkosivut vaikeammiksi käyttää, ja tätä tuki myös käytettävyystestien suorittamiseen käytetty aika. Tutkimuksen perusteella voidaan päätellä, että verkkosivujen visuaalisilla elementeillä voi olla sekä positiivisia että negatiivisia vaikutuksia käyttäjien mahdollisesti kokemaan informaatioähkyyn.

AVAINSANAT: verkkosivu, käytettävyys, visuaalinen käytettävyys, visualisointi, käyttäjäkokemus, käyttöliittymä, informaatioähky, tietotiheys.

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Abbreviations

CSS = Cascading Style Sheets
HCI = Human-Computer Interaction
HTML = Hypertext Markup Language
ISO = International Organization for Standardization
THL = Terveyden ja hyvinvoinnin laitos; Finnish institute of health and welfare

UEQ = User Experience Questionnaire
UI = User interface
UID = User interface design
URL = Uniform Resource Locator, also known as web address
UX = User experience
UXD = User experience design
WHO = World Health Organization

1 Introduction

Almost all people today use the internet to complete their daily tasks and activities as more and more everyday services are moved online. There are activities such as online banking, news media, social media, educational platforms, food delivery services, streaming platforms, etc., which are available to the users via websites. As digitalization continues, huge amounts of information are being shared on the internet, and this amount is increasing exponentially all the time (Chen et al., 2014, p. 5067). Individuals are constantly surrounded by technological devices connected to the internet, and they have become tethered to all sorts of information. The internet has become an infrastructure which we rely on, and therefore it is important to understand how to process the seemingly endless amounts of information with which it provides us with. (Schroeder, 2018, pp. 101-103)

The concept of information overload has been recognized many times throughout history making it an old problem, which somehow always feels new (Bawden & Robinson, 2020). Chandler and Munday (2011) define information overload as a "…subjective experience of individuals in the modern world in which they feel overwhelmed by more data than they feel able to handle (p. 210)." This experience is certainly relatable to people living in the 21st century, as notifications about new incoming information on various topics are present all the time via digital devices. The negative effects of information overload are a significant problem, as they may result in people overlooking important information and having a lowered decision-making performance (Eppler & Mengis, 2004; Schultz & Vandenbosch, 1998).

Due to digitalization, societies have become used to having information constantly available. Before digitalization, the traditional media (i.e., newspapers, radio, television and other outlets that existed before the internet) would fight to deliver information to as wide an audience as possible. Since then, a shift has occurred, and now the new media (loosely defined as computer-based media, e.g., websites and social media) battles with the overabundance of information (Bawden & Robinson, 2020; Chandler & Munday,

2011, p. 293). Digitalized versions of traditional media, such as online news channels, battle to make their message stand out from the rest. At the same time, consumers' social media feeds might be full of information about their friends and families, as well as celebrities, organizations etc. all trying to grab the user's attention. This all affects the user's cognitive capacity to handle information. When that capacity is exceeded, the experience of information overload occurs. Eppler and Mengis (2004, p. 333) have listed many negative symptoms and effects that have been identified to be caused by information overload. These include, but are not limited to, a person's ability to structure information, decision accuracy, loss of control of information, as well as higher time requirements for information handling. To share information to the users, companies and organizations are therefore required to focus on the presentation of the information. This requires skills to know how to engage the user and how to format the information in a way that doesn't contribute to information overload.

The usability of user interfaces, (i.e., a platform via which users can interact with technology) and the presentation of information play a key role in communicating information to the users. Usability is an approach on the design of technological interfaces such as websites, which attempts to make them intuitive and easy to use (Chandler & Munday, 2011, p. 445). Websites are combinations of individual web pages, that belong to the same organization and can be accessed via the same web address. The importance of the usability of websites has been highlighted by research, as people are keen to leave a website if they get lost while navigating it or if the information on the website is hard to read and understand (see e.g., Lindgaard et al., 2006; Krug, 2018; Nielsen, 2012). This indicates that companies and organizations should consider what kind of content they share and how they want to present that content on their website. Organizations should also consider their target audience and how these users use the website. If the website leaves its users with a good user experience, they might just return to it. User experience (UX) is the overall experience a user has, while they use e.g., a website.

“A picture is worth a thousand words” is a manifesto that promotes the value and efficiency of visual communication. In their study, Eppler and Mengis (2004, pp. 335-336) listed visualization as one of the countermeasures against information overload. Similarly, Tractinsky (2014) states that visual aesthetics can indeed be used to guide a user to better understand and use information, thus having a positive impact on the UX. Visual usability focuses on the user interface’s look and how that affects the usability of the said interface. It focuses on the usage of visual elements of e.g., a website, to achieve a design that is intuitive and easy to use. Visual elements mean features such as colors, lines, symmetry, symbols etc., which can be utilized to guide the user on the website. Visual usability is a dimension website designers and content creators should consider focusing on with data-heavy websites. Focusing on visual usability can provide positive results by helping the users interpret information, resulting in reduced information overload and overall positive user experience. (Schlatter & Levinson, 2013; Silvennoinen, Vogel & Kujala, 2014)

1.1 Aim of the study

The objective of this thesis was to study how the visual elements on websites can assist users interact with and navigate information on data-heavy websites. The study focused on the user experience (UX), usability and in particular the visual usability of two health organizations’ websites. The chosen organizations were the Finnish Institute of Health and Welfare (THL) and the World Health Organization (WHO). The two organizations’ websites were first chosen as both have substantial amounts of information on them. The websites’ contents are also quite similar, as both organizations have the mutual goals of ensuring the health and well-being of all people. The main difference between the two is that THL’s main focus is on Finland, while the WHO works on a global scale. (THL, 2021; WHO, 2021)

In this thesis, I answered the following research questions:

1. What visual elements are used on the websites of this study?

2. How do these elements support the (visual) usability of the websites of this study?
3. How do the visual elements of the websites impact the possible information overload on the websites of this study?

The first research question identified the visual elements of the websites. By visual elements, I mean the visual characteristics used on the websites which designers can utilize to guide the user on the website. I divided these visual elements into two categories that are structural elements and content elements. Structural elements are features that influence the way how information can be presented on the website. Content elements on the other hand are features such as colors, fonts, and symbols. By first identifying the visual elements used on the websites, it was then possible to proceed to analyzing the visual usability of the websites.

The second research question was answered by conducting usability tests and comparing material gathered from the tests to the visual elements of the websites which were identified before. The usability tests provided both quantitative and qualitative data of the test users using the two websites while trying to navigate to certain web pages. In addition, the test users answered a questionnaire that gathered some information of the participants as well as the UX of the websites (see appendices 1 and 2). The participants also had the opportunity to write feedback of the usability tests and to write about their user experience in open format. This information was used to compare the visual elements of the website to the test users' usability test data in order to see how the visual elements guided the users while navigating the websites. The aim was to see how the visual elements affect different users and if certain elements are more effective than others.

The third research question was answered by doing a comparison of the websites' visual elements, the data of the usability tests, the participants' questionnaire answers, and analyzing the possible symptoms of information overload present on the users during the usability test. The symptoms of information overload analyzed on the users are

based on Eppler and Mengis' (2004) table of symptoms or effects of information overload (p. 333). The method was described in more detail in chapter 1.3.

My personal assumption is that digitalization and the constant availability of information has caused all humans to experience at least some symptom(s) of information overload even on a daily basis. This in turn, has made us so used to experiencing information overload, that we may or may not recognize the feeling in ourselves. By comparing the usability tests' data and Eppler and Mengis' (2004, p. 333) table, it was possible to try to identify if participants were experiencing symptoms of information overload, such as higher time requirements for information handling by comparing participants' results (between subject comparison). This in turn, made it possible to draw some conclusions on how visual elements affect the possible information overload.

In this thesis I focused on the websites of THL and WHO. The main purpose of this study was not to make a comparison between the two organizations' websites. However, as both organizations are in the health sector and their websites' purposes are similar as mentioned before, some comparison between the two was made in order to identify which visual elements of the websites better assist users to navigate the websites with high amounts of data. This comparison, however, was not in any way used to determine which website is better than the other and it was not the intention of the author to make such claims. Rather, the idea was to discover which elements are present to support users in their navigation of the respective information on the websites.

1.2 Data

The research data of my thesis was gathered using the websites of THL and WHO and it consists of three parts as presented in Table 1. The research data was gathered during January and February of the year 2022. Figures 1 and 2 present screenshots of THL and WHO's websites.

Table 1. The research data of this master's thesis.

Data	Description
Visual elements of websites	Structural elements and content elements
Usability test recordings	Videos following the test participants' gaze path while using the target websites.
Questionnaire	Participants' background information and user experience of the target websites during the usability tests.

The table 1 above presents the data of this thesis and which parts each section consists of. The data is further described in their respective chapters below. The data consists of three parts, which are: (1) visual elements of websites (i.e., structural elements and content elements); (2) usability test recordings (i.e., videos which show how the usability test participants' gaze moved on the websites during the tests); and (3) questionnaire (i.e., a questionnaire which collected the participants' background information combined with a user experience questionnaire).

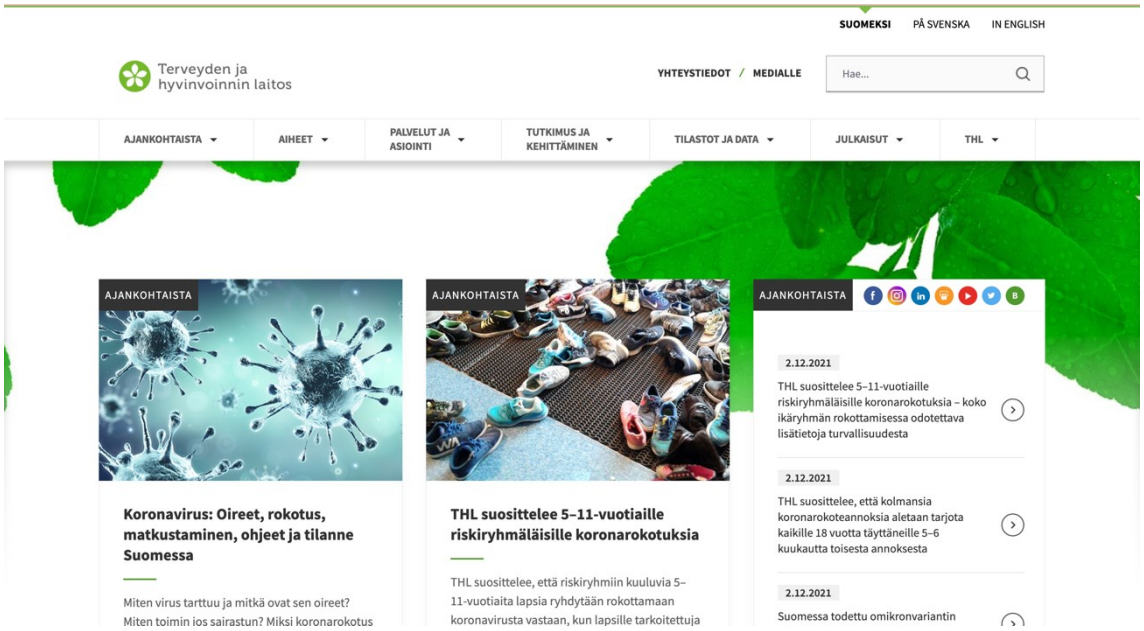

Figure 1. A screenshot of THL's website's front page.

The figure 1 presented above shows a screenshot of THL's website's front page (2021). The screenshot is taken of the Finnish language version of the website which was used

on the usability tests. The screenshot contains the upper part of THL's website, from where users can access navigational functions and see some featured content, like Covid-19 information which was relevant at the time.

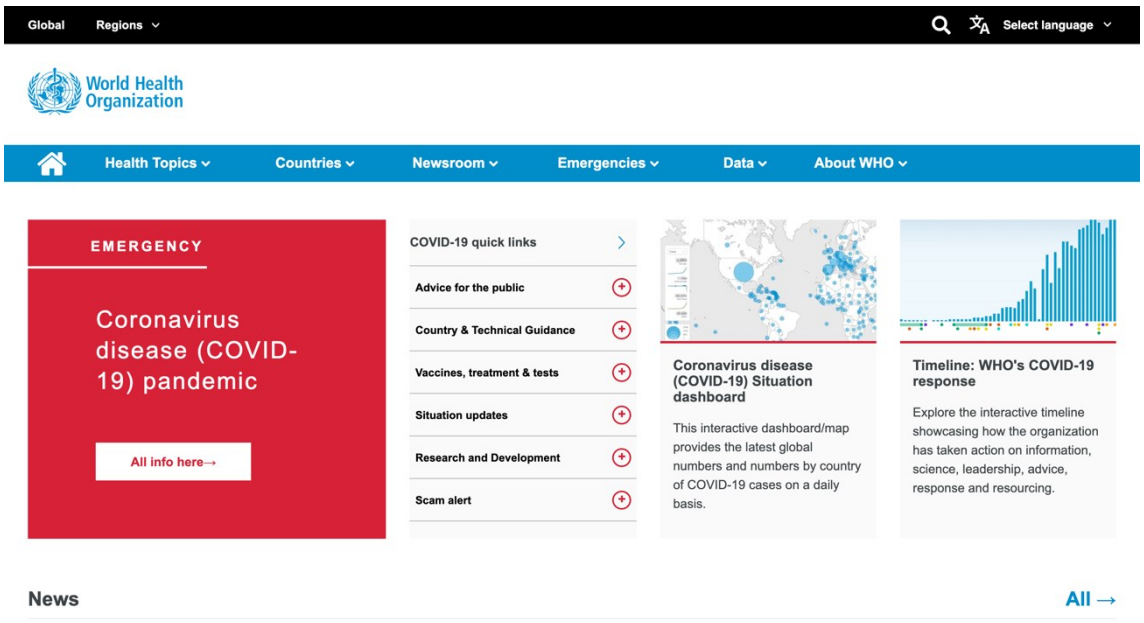

Figure 2. A screenshot of WHO's website's front page.

In figure 2 above is a screenshot of WHO's website's front page (2021). Similar to figure 1 about THL's website, the screenshot in figure 2 shows the upper part of WHO's website. It contains navigational functions, as well as relevant links about the Covid-19 pandemic, including small visualizations.

The data of this master's thesis is further described in the following subchapters. The data consists of a combination of three parts, which are (1) visual elements of the websites, (2) usability test recordings, and (3) questionnaire answers (see table 1).

1.2.1 Visual elements of websites

The first part of the research data consists of the visual elements of the two websites which were identified by conducting an expert analysis for the two websites. The visual

elements were divided into two categories, which are structural elements and content elements. The structural elements consist of the semantic layout elements of the websites, while the content elements consist of the content placed within these semantic layout elements. The visual elements of the two websites are further discussed in chapter 4.1.

1.2.2 Usability testing

The second part of the research data consisted of usability tests. The usability tests had ten (10) participants, and the tests were conducted in individual sessions at the University of Vaasa's Interaction Design Environment. The average length of each session was 38 minutes. The longest session lasted for 49 minutes, and the shortest session was 24 minutes. During these sessions, I first described to the participants what we were going to do, set up the usability test for each participant, conducted the usability tests, gathered answers to the questionnaire described in chapter 1.2.3, and had additional discussions with the participants about their general feelings after the tests.

As mentioned, the usability tests were conducted in individual sessions. At the beginning of each session, I first gave each participant a brief introduction to usability and usability testing as all but one of them were unfamiliar with the concepts before. The participants also had the opportunity to ask further questions about the topic. After setting the test environment, meaning adjusting the participant's position in front of the desktop computer and optimizing the eye tracker, the tests begun, and each participant was asked to find certain web pages on the THL and WHO's websites (THL, 2022; WHO, 2022) using the Mozilla Firefox web browser. The web pages to be found had been decided before the tests and the participants did not know of them before the tests begun.

It was pointed out and emphasized to each participant that there was no time constraint whatsoever during the tests and they could take all the time necessary to complete the assigned tasks. The decision of not having a time-limit during the tests was made, as the

purpose of the tests was to record how the users navigate the websites, and to see how the users were able to complete their tasks. The usability test sessions' purpose was to be a neutral setting, during which the participants' interaction with the websites could be recorded with as little external irritants as possible. As presented in Eppler and Mengis' (2004) table, one of the possible causes for information overload is time pressure (p. 332), and I did not want for the test sessions to contribute to the users' possible experience of information overload.

The usability test sessions were recorded using the Interaction Design Environment's eye-tracking equipment, the SMI iView REDn Scientific 30Hz eye-tracker. The equipment gathered advanced information of the users' activities on the websites, and the users were given the opportunity to review their own recorded information after the tests. All participants were able to find the target web pages, although there was variation on the amount of time the task took them (see table 6). The users had been instructed before the tests to not to use search options on the websites, as the focus was on studying how the users navigate the websites themselves. The test participants gave positive feedback about the test sessions and were interested about the topics of usability and user experience. The participants also enjoyed visiting the Interaction Design Environment, as none of the participants knew before the test sessions that University of Vaasa even had such a place.

1.2.3 User experience questionnaire and user backgrounds

The third part of the data consisted of questionnaire answers which were collected immediately after the usability tests. The questionnaire was given to each participant to be filled immediately after the tests without having any conversations about the tests they had just completed until after filling the questionnaire. The questionnaire collected the participants' background information as well as had the participants answer the User Experience Questionnaire, or UEQ, (UEQ, 2018), in Finnish (see appendix 1). The English translation of the participants' background questionnaire and the English UEQ can be

found in appendix 2. The UEQ is a “fast and reliable questionnaire to measure the User Experience of interactive products” (UEQ, 2018). The UEQ was chosen in order to gather and analyze UX efficiently, as the tool provides a way to collect UX data, and a way to analyze and present the results in a clear and comprehensive way. The UEQ is further described in the chapter 3.1.2, and the data it provided is available in chapter 4.3 as well as in appendices 3 and 4.

The questionnaire was tested prior to collecting answers, and additional questions were added to the participants’ background sections based on thesis supervisor’s suggestions. Since all the participants of the study were native Finnish speakers, a choice was made to conduct the usability tests and collect the questionnaire answers in Finnish. However, the WHO website does not have a Finnish language version, so the participants used that website in English. THL website was used in Finnish. All the participants have good skills in English and therefore participating in a usability test using both languages was possible for them.

The English version of the UEQ (2018) was included in the appendix 2 as it is, with the English translation of the Finnish questionnaire used to collect the test participants’ background information. However, as the questionnaire answers were collected in Finnish, some minor changes were made to the original Finnish translation of the UEQ (2018). This was due to the fact some of the translation’s words were not, in my personal opinion, as clear and comprehensible as they could be. I was unable to verify this from the UEQ’s (2018) website, but some of the Finnish word choices seemed as if they had been translated from the English version to Finnish using an online translation service, and the translations could have been approved by non-native Finnish speakers. However, the word changes made to the Finnish UEQ were very minor, as the majority of the words in the Finnish translation were well-written and usable as they were.

There were in total ten (10) participants in the usability tests. The participants were recruited via convenience sample, of close associates. All the participants are either

students or graduates of Finnish universities representing different academic backgrounds, and none of them have studied technical communication or communication sciences in general. Five of the participants were women and five were men. The age distribution of the participants was between 18 to 60 years, and the majority of the participants (eight) were under 30 years in age. All of the participants use a variety of websites on a laptop computers or similar devices (such as mobile phones) on a daily basis. Therefore, it can be stated that all the participants are advanced users of computing devices and websites.

One of the participants responded to have attended a usability test before, but this test had been for a mobile phone model prototype rather than a website, analyzing the usability of a physical device rather than a user interface. All but one of the participants had visited either THL or WHO's website at least once before participating in the tests, but none of the participants had visited the websites during the last six months before the tests. All the participants who had visited the websites before stated in the questionnaire, that they had been using the websites mostly after the beginning of the Covid-19 pandemic to find information about the virus and how to protect themselves and others.

As described above, the questionnaire gathered the participants' background information, but it also included separate sections for user experience questionnaires for both THL and WHO's websites, as well as an open question for each, in which the participants were freely able to give feedback on the usability tests. The participants also were encouraged to describe other feelings they were possibly experiencing while using the websites, if these were not covered by other parts of the user experience questionnaire. The participants were given also a brief definition of information overload as well as a question to survey whether the users had in their own opinion been experiencing information overload while using the websites during the usability tests. Out of the ten (10) participants, one (1) answered yes to this.

The questionnaire answers were gathered using Google Forms and its operability was tested prior to the usability study with other participants who did not take a part in the actual usability study. In the background section of the questionnaire, there were pre-filled options from which the participants could choose their answers, as well as options in which the participants had the option to describe their answer in their own words. Within the questionnaire, these options were presented with the text “Muu…” in Finnish and in the English translation version this option is presented with the text “Other…”. The Finnish questionnaire and its English translation are available in the appendices 1 and 2.

1.3 Method

The research method I used consists of four parts: (1) an expert analysis of the THL and WHO websites’ visual elements, (2) usability testing combined with collecting answers to the questionnaire, (3) comparison of the usability tests’ results and questionnaire answers to the identified visual elements, and (4) analyzing and identifying the visual elements that contributed to the visual usability of the websites. The following figure (Figure 3) illustrates the stages of my research, as well as the methods I used in my research and the models I applied.

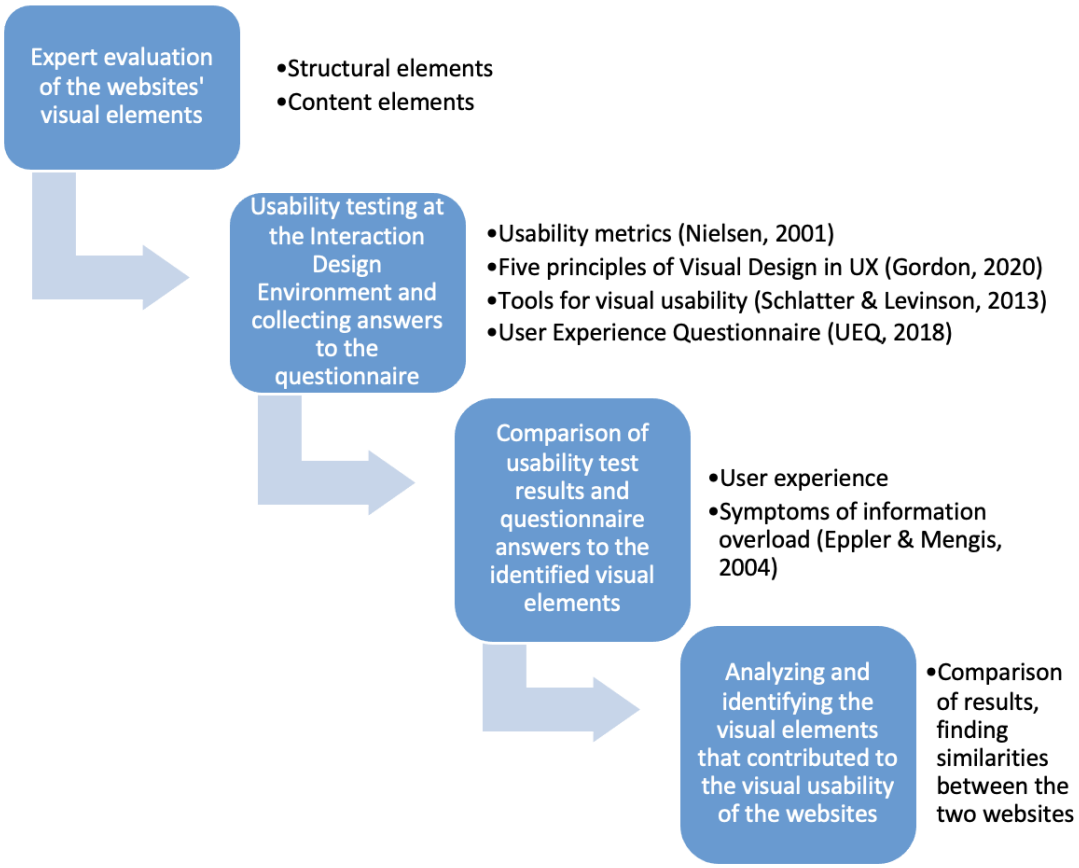

Figure 3. Stages of research and methods used in analyzing data.

The first stage of research was to conduct an expert analysis of the THL and WHO websites and to identify the visual elements of the websites from both structure and content perspectives. This stage is considered a part of collecting the research data, as well as the beginning of the analysis done in this thesis. The first step was to identify which structural elements were present on the THL and WHO websites. This was done by comparing the websites to the HTML layout elements presented in chapter 2.1. The second step was to identify content elements of the websites, such as colors, lines, text elements and their relative size, and so on. This step was conducted by considering Gordon's (2020) five visual-design principles in UX, as well as Schlatter and Levinson's (2013) tools for visual usability.

The second stage of research started with the usability testing at the University of Vaasa's Interaction Design Environment. The usability testing was conducted by utilizing the SMI iView REDn Scientific 30Hz eye-tracker on a desktop computer using the Mozilla Firefox web browser. Eye-tracking is a popular method used in studying web usability. The method is based on the mind-eye hypothesis, according to which people are usually thinking about what they are looking at (Nielsen & Pernice, 2010, p.9). The general assumption is, that if a person is looking at something, they are usually paying attention to it, especially if they are concentrating on a particular task. The method provides insights on which areas of the user interface have attracted the study participants' attention and in which order (Benyon, 2019, p. 245). Examples of the usability test recordings are available in the screenshots presented in figures 4 and 5.

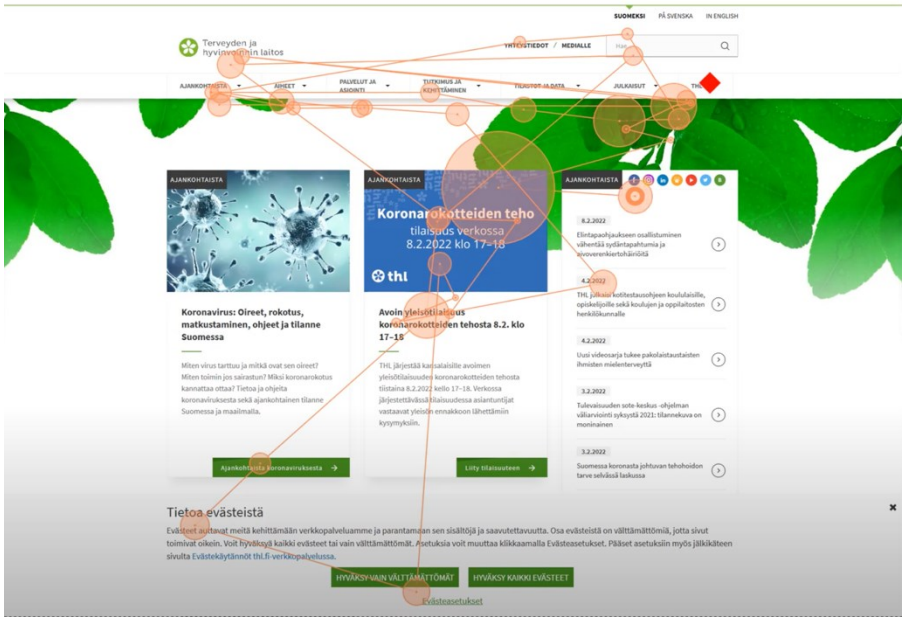

Figure 4. Example of a gaze path on THL's website.

The figure 4 illustrates how a usability test participant's gaze has been moving on the THL website, and figure 5 illustrates the same on the WHO website. The orange lines represent the direction the participant's gaze has moved to, and the orange circles represent the section where the participant's gaze has focused on the website. The larger

the circle is, the longer the participant's gaze has focused on the specific part of the web page.

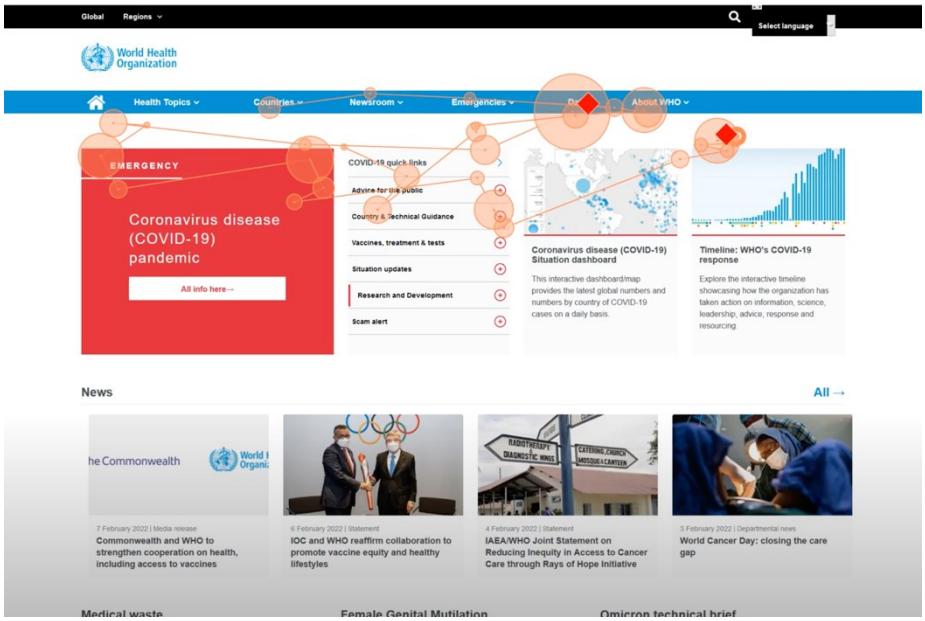

Figure 5. Example of a gaze path on WHO's website.

Taking note of the mind-eye hypothesis, the usability tests were designed to consist of one simple task on both THL and WHO websites as mentioned in chapter 1.2. From THL's Finnish language version of the website, the participants were asked to find the web page titled as "Sosiaali- ja terveysalan tilastollinen vuosikirja" (in English, "Statistical Yearbook on Social Welfare and Health Care") (THL, 2022). From WHO's English language version of the website, the participants were asked to find the web page titled as "World health statistics 2021: monitoring health for the SDGs, sustainable development goals" (WHO, 2022). Combined with the task of finding certain information on the websites, the eye-tracking method was used to analyze the usability of the websites, as the test participants were using the web interface in a semi-realistic scenario. The target information the participants were looking for was chosen randomly but keeping in mind that it could be relevant to people of many backgrounds. Participants could end up in real life looking for this kind of information e.g., out of pure interest towards the health sector related to Finland and on a global scale.

This method provided both quantitative and qualitative data. The quantitative data has been collected based on Nielsen's (2001) usability metrics, and the data consists of numbers i.e., the number of participants and video recordings, the amount of time each user needed to complete the tasks, the success rate of tasks, and so on. The quantitative data is presented in chapter 4.2. Qualitative data on the other hand, consists of usability test recordings, containing each user's gaze movements on the websites, presenting the users' navigational paths on the websites during the usability study sessions.

As set out in chapter 1.2., I asked the participants to respond to a questionnaire immediately after completing the usability test tasks. The questionnaire in Finnish and its English translation are available in the appendices 1 and 2. The questionnaire was constructed to gather information on the users' basic information and background, user experience during the usability tests, as well as to chart the possible feelings of information overload the users experienced during the test.

The study was based on empirical research and the qualitative data was analyzed using qualitative methods. This decision was based on Budiu's article (2017), according to which usability tests provide both quantitative and qualitative data. The qualitative data gathered through usability testing offers a researcher a direct assessment of the usability of a system, as the researcher will be able to observe a study participant struggle with specific user interface (UI) elements, and with this information the researcher is able to determine which parts of the design are potentially problematic and which work well. Quantitative data on the other hand, offers an indirect assessment of the design's usability, as the metrics are simply numbers and can be hard to interpret without a reference point. Therefore, as described in the next paragraph, the quantitative data would also need to be analyzed by using qualitative methods in order to be able to form any conclusions of the websites' usability (Budiu, 2017).

The quantitative data metrics gathered for this thesis by utilizing usability test methods include data such as the success rate, error rate, and the amount of time a user needed to complete the task(s). The success rate means the percentage of participants who were able to complete the assigned task or tasks. The error rate means the percentage of users that made or encountered a similar error, and the time to complete a task means the average time the users needed in total to complete the task(s). By comparing this quantitative data to the qualitative data, i.e., the usability test participants' eye-tracking data, as well as the answers to the user experience questionnaire, I was able to point out where the possible usability and visual usability issues are on the websites.

2 Human-computer interaction on visual web user interfaces

In this chapter, I introduce the concept of websites as visual user interfaces. I explain what websites are and describe how companies and organizations can utilize websites to communicate information to the user. I also briefly describe how the presentation of that information can affect the user's experience of the website in question, but that topic is further discussed in the third chapter. I also discuss how visualization can affect the presentation of the information, and how this can affect the user's ability to process the information on the website.

Human-computer interaction (HCI) is a field of study which focuses on the design, evaluation and implementation of interactive computing systems intended for human use. It also includes the study of major phenomena around them (Hewett et al. 1992, p. 5). In broad terms, HCI concerns all interaction humans have with different computing systems, such as computers, smart phones, tablets etc. In this thesis, I focus on the interaction of humans and websites used via a desktop computer.

2.1 Websites as visual user interfaces

Websites are organized collections of individual electronic documents called web pages. A web page can be viewed by anyone who has access to the internet. Most web pages consist of text and pictures, while they can also include data such as audio clips and videos. Usually, websites are considered to have a purpose behind them, and it can vary from sharing information to entertaining people and everything in between. This purpose and the information shared on a website depends on the person, company or organization who owns and manages the website. Websites can be accessed and used on web browsers, such as e.g., Google Chrome, Mozilla Firefox, or Safari. (Anniss, 2014, p. 5)

At their simplest forms, web pages consist of two technologies, which are the HTML and CSS codes (W3C, 2021a). HTML, or Hypertext Markup Language, creates the structure of a web page. The structure is used to define what elements a web page has, and what content goes within these elements. The content includes all the information presented on the web page, meaning the written text, images, links, etc. CSS, or Cascading Style Sheets, describes the presentation the web page. The CSS code is used to determine, for example, the relative position of the elements created in the HTML code, the size of these elements, the font of the texts, the color of the text in the elements, and so on. This is done by referring to elements in the HTML by their correct names or ID's that have been used within the document (W3C, 2021a). To put it simple, HTML is used to define the information on the web page and CSS is used to design how that information is visually presented.

As said, the structural elements of the HTML code define the information presented on the web page. The information is divided into different elements to ensure it is easy to adjust the visual look of each specific type of information on the web page. Often the information on a web page is displayed in columns, like a newspaper (see figure 6) W3Schools, 2023a). The following figure shows six exemplary elements that can be located on a web page. The elements are header, nav, section, article, aside and footer.

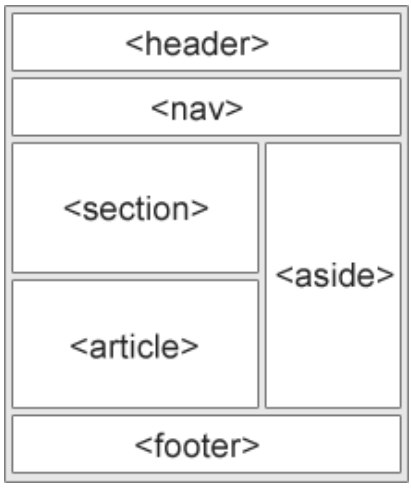

Figure 6. HTML Layout Elements of Websites (W3Schools, 2023a; W3Schools, 2023b).

The header element contains the heading elements of the web page or a website, which can be e.g., the name of the website or its owner. It can also contain authorship information, logos and icons, which are usually presented at the top of a web page. The nav element refers to a major block of navigation links that are used to move onto different web pages of a larger website. The section element is used to define a section of a web page, and it can be used to contain information such as introduction or news items. The article element specifies information that is independent and self-contained. This element can be used to contain e.g., blog posts, user comments and such. The aside element is used to define content on aside, meaning it can be e.g., the content next to an article element, and it is usually placed in and can be presented like a side bar. It should be indirectly related to the content it is placed with and can be used to further clarify a certain term for example. The footer element is located at the bottom of a web page, and it contains the information that is presented last on the page. It usually contains copyright and authorship information, links to related documents, and so on. The footer can also contain e.g., a company or organization's contact information. (W3Schools, 2023a; W3Schools, 2023b)

The structural elements of websites can be thought of as containers within the website, which define the layout in which the actual content is placed. The content elements are used to describe and present the actual information on the website. These content elements give a website its visual look and affect the users' first impressions of the website. These elements also affect the way people will start using the website, as the users will interpret what they can do with a website based on the visual elements (Schlatter & Levinson, 2013, p. 49). Schlatter and Levinson (2013) have identified five visual usability tools which categorize different visual content elements of websites with similar content elements. The five tools are layout, typography, color, imagery, and controls and affordances. These tools and the content elements included within them are further discussed in chapters 3.2.1 and 3.2.2.

It is common for web pages to contain so much information a user is not able to see all the structural elements at once. In these cases, the user needs to scroll down the page in order to see what structural elements are located e.g., below the article element. As the users will always see first the structural elements located on the upper parts of a web page, web pages are usually built from top down so that the more important structural and content elements are located in the upper elements, and the less important or less frequently needed information is located in e.g., the footer at the lower part of the web page. Different news agencies are a good example of organizations and companies with these kinds of websites, as it is a common practice for them to present all the latest news headlines on the front page, from where the users can see all of them by scrolling down the page, without having to navigate to different web pages unless they want to read more about some certain news. Other examples of websites with this type of design are those belonging to e.g., universities, as well as different health organizations such as THL and WHO.

2.2 Communicating to users via websites

As described in the introduction chapter, the amount of information on the internet can become problematic for both the users and the companies, organizations etc. managing the websites. Users browsing the internet are faced with huge amounts of information on multiple levels. Web pages can contain a lot of information while still being a part of an even more complex website. As the internet contains multiple websites around the same topics, the users' attention can easily be distracted from the original purpose of visiting a certain website. Companies etc. on the other hand must compete against other websites sharing similar information. It is necessary for them to concentrate on formatting the information on their websites in a way which contributes to the users' intended activities on the website. This is a challenge, as according to Lindgaard et al. (2006), users will assess the visual look of a website in 50 milliseconds, meaning they will form impressions of the website within that time. It is important to focus on giving the users a good reason to visit the website, a good reason to use the website, as well as give the users a

good reason to return to the website. Questions such as “What do we want to communicate to our audience?” and “How do we attract visitors to our website?” can be a good place to start when designing information for websites. (van der Geest, 2001, pp. 1-7)

Information design is a term used to describe the act of preparing information in order to make it easier to navigate and to understand (Chandler & Munday, 2011, p. 209; Horn, 1999, p. 15). The main idea is to present information so that it can be used efficiently and effectively. As Horn (1999, p. 16) puts it, we do not necessarily need more information to reach this goal, but the ability to present the right information to the right audience at the right time is important. Information design can be utilized to e.g., plan the hierarchy of websites and individual web pages. This way the website’s designer can present the website’s contents in the desired order, and to make sure the users of the website read the information in a way which can be used to support their ability to understand the contents on the website. Information design can also mean the utilization of visual elements in order to support the presentation of information on a website. As Schlatter and Levinson (2013) suggest, the visual elements on a website influence the way users navigate and process the information, and therefore, visualization is a principle which is necessary to be considered whilst designing the presentation of information.

Information architecture is a similar term to information design. It is used to describe the structural design of information on shared environments such as websites. It focuses on the design of organization, labeling, navigation and searching systems with the goal of helping people to find and manage information more successfully (Morville & Rosenfeld, 2007). Simply put, information design can be used to divide information between different sections which are then divided in between multiple web pages on a website by utilizing information architecture methods. Information architecture principles can be utilized, e.g., when planning the titles of different web pages. The titles should represent the content of the website in question. These titles can then be used in the navigational elements of the website. This way information presented on different web pages of a website can be findable to the users of the website.

Information density is a concept used to define the amount of information presented on a given space, such as a web page. The more information there is on a page, the denser it becomes, thus affecting the user's ability to read and comprehend the information. According to Woodruff et al. (1998), users tend to have a preference for lower visual density of information. However, this might not be true to all users, as e.g., Chinese users prefer higher amounts of information compared to western users (Alexander et al., 2017). Information density can e.g., cause the website's users to experience information overload, which is discussed in chapter 3.3.1. Information density is a principle to be considered when designing information e.g., on a website. As the various topics introduced on companies' and organizations' websites can include quite a lot of detailed information, the information should be divided into relevant sections which can then be spread out under various subtitles or even different web pages on the website. This promotes the information's readability and enables the users to quickly and effectively find the information they are looking for.

3 Evaluating websites from the perspective of HCI

In the previous chapter I described what a website is and how websites can be used to distribute information to users. However, to make sure the user is attracted and engaged to use a certain website, it should be taken into account how the user interacts with the website, what feelings he or she may be experiencing whilst using it, and especially whether the experience of using the website was such which may result in revisiting the website in the future. In this chapter, I define what user experience is from the point of HCI. I also define usability and visual usability of websites, what these consist of and how they can be evaluated.

3.1 User experience of websites

All sorts of (digital) applications have been designed for use. One of the most important things to understand about designing any product is to know what the designer is trying to achieve with the product (Norman & Euchner, 2016, p. 15). In the case of websites, they are used to present information to users in a variety of different forms. As the users discover and use websites, it is important to focus on how they feel like when using a website. If the user feels like the website is difficult to use, they might leave, which suggests that the information the website is trying to share might not be registered by the user. Therefore, it only makes sense to focus on how the users – humans – are using this technology by interacting with computers and/or other digital devices. This means focusing on the human-computer interaction, that is HCI. When considering HCI, there are many different aspects one can focus on. These include, but are not limited to, usability and user experience (UX). (Carroll, 2014)

Behind every website is a reason why it was created. In this thesis I focus on two websites which belong to organizations working on national scale (THL) and international scale (WHO). The websites' work as information sharing platforms to both organizations' audiences, and their importance is highlighted especially when people need information

about a disease and how to protect from it. For example, during the Covid-19 pandemic, these websites served as important channels through which millions of people were able to find reliable information from trustworthy sources. In order to share information to those users, the organizations behind these websites first have to get a user to visit the website. The next step would be to engage the user and to make sure he or she doesn't leave the website or even move on to another similar organization's website. To ensure this, the organization behind the website must focus on the user's experience of using their website.

There are different ways to define user experience. According to Nielsen and Norman (2021), who provide a more commercial way to define UX, user experience "…encompasses all aspects of the end-user's interaction with the company, its services and its products." This definition covers the whole interaction of the user and a company, as well as its services. Hassenzahl (2014) provides a slightly different view of UX. According to him, user experience is defined as the experiences that are created and shaped through technology. While Nielsen and Norman's definition of UX is thorough and it gives the reader a good idea of what user experience is, Hassenzahl's definition provides a broader perspective and more opportunities to think about user experience especially through the design point of view.

User experience is a key element which designers need to focus on when planning, creating, and updating websites. User experience design (UXD) is the process in which designer teams use to create products with the intent of providing the users with meaningful and relevant experiences. Designers need to focus on UX from a number of experiential viewpoints, i.e., regarding usability, they need to understand the previous experience people have had with technology, by considering questions such as what operating systems and design layouts they are familiar with. A good user experience is "one that meets a particular user's needs in the specific content where he or she uses the product." (Interaction Design Foundation, 2022) Or as Garrett (2011) defines it, UX means the experience a product creates for people who use it in the real world (p. 6).

3.1.1 User experience honeycomb

One way to think about user experience is to divide it into different parts. Morville and Sullenger (2010, pp. 34-35) present a user experience honeycomb, which divides user experience into seven parts (see figure 7). These seven parts represent areas which a website's owner or designer should consider when evaluating its user experience.

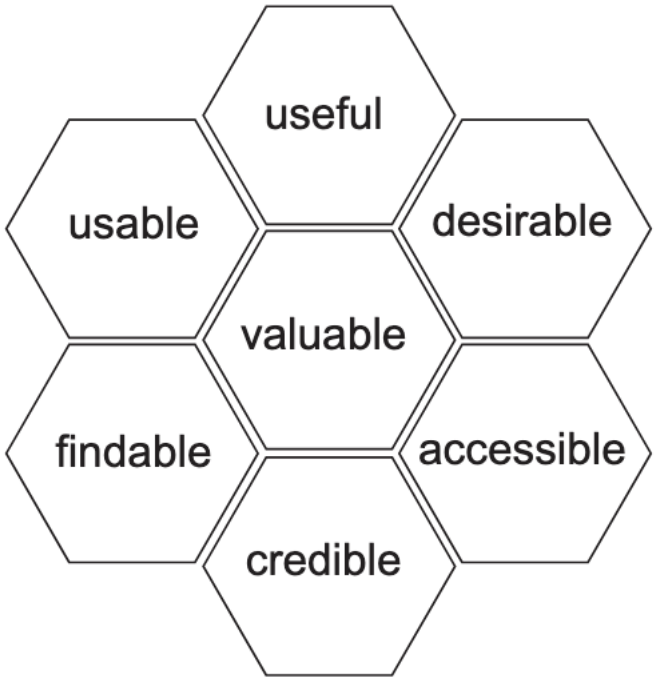

Figure 7. User experience honeycomb (Morville & Sullenger, 2010, p. 35).

From Morville's perspective (Morville & Sullenger, 2010, p. 35), the seven areas of user experience represented in the honeycomb interact with each other being equally important factors contributing to user experience of websites. Firstly, the websites should be usable to the people visiting them, meaning the websites should be simple and easy to use, while serving their intended purpose to the user. Secondly, the websites should

be useful, meaning the designers should continue to consider their websites' usefulness and improve the websites by asking questions such as "Could it be more useful?".

The third area, desirability, considers the visual aesthetics of websites. Morville and Sullenger (2010, p. 34) states, that *"…attractive sites work better, or at least users think they are more desirable."* This is in line with previous research that had similar findings (see, e.g., Tractinsky et al., 2000; Dion et al., 1972). However, this is not always true, as e.g., with websites, if a site looks good but has not been structured well, the beautiful design alone isn't going to lead to a positive user experience. As research suggests, the stereotypical approaches such as "what is beautiful is good," and "what is beautiful is usable" can negatively impact our perception. For example, in a test environment, a beautiful looking website might leave the users with at least a relatively good user experience and their minds satisfied by the aesthetics of the website, but if the user experience is compared with usability testing, the results might show less beautiful websites, if structured well, lead the users to better performance. (Eagly et al., 1991; Tissera et al., 2022)

The fourth factor of Morville's user experience honeycomb, findable, focuses on the users' ability to find the website in question, if a user can navigate the website, and if the users can find the products, services, or information, despite the website. The next factor, accessible, considers the websites reachability: to reach the largest audience with the website, it needs to be accessible to those with disabilities or conditions affecting their ability to navigate websites. This applies to technology as well, as the website needs to be accessible with different technological devices the users might be navigating to the website. (Morville & Sullenger, 2010, pp. 34-35)

The credibility of the websites focuses on making the website believable to the users (Morville & Sullenger, 2010, p. 34). Depending on the contents and target audience of the website, it needs to look appealing to the audience. This encourages the users believe that the author has credibility on the subject, and that the author's or authors' message is such that the users should read and can trust to be true (Robins & Holmes,

2008; Fogg et al., 2003; Oyibo & Vassileva, 2017). Without credibility, the users can even think the website to be a scam and they will be likely to move on to the next one.

Last but not least, Morville and Sullenger (2010, p. 35) point out the websites need to be valuable. Websites need to be designed in a way which creates value to the users, and at the same time promote the website owners' missions and goals. If the website is focusing on selling a product or a service, it needs to be able to sell them to as large an audience as possible. If it focuses on sharing information, it needs to get as many visitors as possible to visit the website and read the information in question.

By focusing on the seven attributes on Morville's user experience honeycomb, Morville and Sullenger (2010) suggest that the designers of any website can increase their website's findability. They argue that findability should be the number one goal, as the purpose of any website is to share information. By promoting the findability of a website, a designer is also increasing the findability of the information. As Morville puts it, "information that's hard to find will remain information that's hardly found" (Morville & Sullenger, 2010, p. 38).

3.1.2 User experience questionnaire

As previously described, user experience can be considered as the experience a person has while using technology (Hassenzahl, 2014). One way to evaluate this experience is to utilize a user experience questionnaire (UEQ). The UEQ is a tool originally created in 2005 in Germany. According to its creators Laugwitz, Held and Schrepp (2008), the questionnaire relies on theoretical framework of UX, which takes into account the perceived ergonomic quality, perceived hedonic quality, as well as the perceived attractiveness of a product (p. 4). The assumption of this framework is, that the perceived ergonomic and hedonic qualities describe independent dimensions of the UX, which are seen as categories summarizing different quality aspects (Laugwitz et al., 2008, p. 4). The perceived attractiveness, on the other hand, results from averaging of the perceived quality and

other relevant aspects in a usage scenario, i.e., for example, a usability test session. The UEQ has been designed for especially researchers and designers to use, but it includes thorough guidelines in order for e.g., students to be able to start using the tool as well. The UEQ provides its users with six scales that can be utilized to evaluate the user experience users have e.g., on a web user interface. The scales of the questionnaire measure both classical usability aspects, such as efficiency, perspicuity, and dependability, as well as user experience aspects, such as originality and stimulation, in order to provide a comprehensive understanding of the user experience. (UEQ, 2018; Schrepp, 2022)

The way in which the UEQ measures user experience is based on analyzing semantic differential items, meaning each item consists of two terms that have opposing meanings. Their order in the UEQ is randomized for each item, which ensures the participants of a UEQ will not detect a pattern whilst providing their answers. The UEQ utilizes a scale with seven stages, which also lowers the chance of getting only central responses. The scale for each item goes from -3 to +3, meaning that -3 indicates the most negative response whilst + 3 indicates the most positive response. The value 0 is considered to be a neutral response. (Schrepp, 2022 pp. 1-2)

The UEQ has six scales with 26 items. The six scales are (1) attractiveness, (2) perspicuity, (3) efficiency, (4) dependability, (5) stimulation, and (6) novelty. Attractiveness considers questions such as the overall impression users have about the product, and whether they like or dislike it. This scale includes six items, while all other scales have four items. Perspicuity takes into consideration whether or not it is easy to get familiar with the product, as well as if its usage is easy to learn. The efficiency focuses on if the users are able to solve their tasks without unnecessary effort. Dependability aims to answer whether the users feel that they control the interaction. The stimulation considers whether or not the user feels the product is exciting and or motivating to use, and the novelty focuses on the product's innovativeness and creativity, and whether or not the product gains its users' interest. The attractiveness is considered to be a pure value dimension, while novelty and stimulation are considered to be features of hedonic quality.

This means that they are not goal-directed, whilst the scales for perspicuity, efficiency and dependability are considered to be features for pragmatic quality, meaning that they are goal-directed (Schrepp, 2022, pp. 2-3). The UEQ can be utilized e.g., to determine if a product has sufficient user experience or to determine areas of improvement. The tool provides quantitative data which can be analyzed on its own or analyzed together with qualitative data. A common way to utilize the UEQ is to include it as a part of a usability study, where the UEQ should be desirably filled immediately after the usability test in order to get answers which haven't been influenced by e.g., lengthy conversations about the studied product such as a user interface (Schrepp, 2022, p. 8).

The UEQ is a good tool for measuring user experience, as the data analytics are made easy for those using the tool. From the UEQ's website (2018), anyone can download both the up-to-date version of the questionnaire, as well as Excel tools meant to be used for analyzing the data. The excel files are kept updated by the researchers working and maintain the UEQ, and the latest revisions are always available. The excel files for data analytics can be used with all the different language variants of the UEQ, and they include clear instructions on how to use the tools and what information and conclusions can be gathered from the data it provides.

3.2 Visual usability

According to usability specialist Jakob Nielsen (2012), usability is a quality attribute that is used to define how easy to use a user interface is. Nielsen has defined usability by using five quality components or heuristics, which are learnability, efficiency, memorability, errors, and satisfaction. These quality components are used to define the website's usability based on how the users experience these components while using the website. However, Nielsen's approach does not really take into account how the visual look of the website might affect the user's experience of perceived usability.

Visual and aesthetic factors play a big role on the users' impressions of a website, and the first impressions have an effect on how the users think of the website's trustworthiness and usability later on (Reinecke et al., 2013). In the previous text I described usability as an area of user experience in Morville's user experience honeycomb (Morville & Sullenger, 2010, p. 35). Quite often usability is seen as its own attribute, even though there is a bigger picture to usability. This can be faulty, as the feeling of a product being usable or unusable is dependent on other attributes as well (see e.g., Tractinsky et al., 2000). Considering e.g., Morville's user experience honeycomb, if a product would otherwise be usable but lacks credibility, a user's experience of the products usability can be negatively affected. Therefore, I would state that a better view of usability is to consider it as an aspect of user experience. This means, that when someone considers a website's or a product's usability, the overall user experience should be considered as the big picture of which usability is only a small part of. As Soegaard (2021) puts it, usability is important, but should be considered alongside other factors in order to create a great user experience.

Considering the importance of visual factors in leading to user's feeling of usability of a website, it is necessary to consider visual usability as a part of the user experience. Visual usability of websites focuses on how the visual elements and aesthetics of a website affect its usability and how these factors can improve or complicate a user's interaction with a website. It considers how the visual elements, such as colors, lines, symmetry, and visual rhythm guide the interaction of the user and the information (Schlatter & Levinson, 2013; Silvennoinen et al., 2014). Visual usability is about guiding the user to visualize elements of e.g., a website, and utilizing these elements to guide the user's gaze. It can promote users' performance on the website, by enhancing their ability to perform a certain task or find certain information.

Considering Morville's user experience honeycomb (Morville & Sullenger, 2010, p. 35), the importance of visual aspects in user experience design are heavily highlighted. When describing desirability, the importance of visuals such as image, identity, and brand are

mentioned. When describing credibility, visual design is mentioned again. From Schlatter and Levinson (2013) as well as Silvennoinen et al.'s research (2014), it can be picked that the visual elements of websites also have an effect on the usability and findability of the websites as well, and if taken into further consideration, they can even affect accessibility and valuability to some extent. Therefore, the importance of visualization is highlighted in regards to all aspects of UX.

Schlatter and Levinson (2013), have emphasized the need for three meta-principles, consistency, hierarchy, and personality, as necessary contributors to achieve visual usability. These meta-principles focus on improving the website's visual usability by considering aspects such as utilizing consistency in order for information to be understandable, hierarchy to improve perception and interpretation of visual elements on websites, and personality to help build expectations of what a user interface does and who it is meant for. If applied properly, these meta-principles can help improve the visual look and aesthetic of websites as well as improve user performance on them by allowing them to be better at using the websites.

Good performance and pleasant aesthetics contribute well to Nielsen's (2012) five usability quality components as well. First of all, the learnability of websites can easily be promoted with thought out visuals, as visualization is a proven method to promote learning (see e.g., Klerkx et al., 2014). And by promoting the learnability of websites via visualization, the efficiency of using the websites as well as their memorability will be promoted as well. As good and well-designed visualizations can lead to guiding the users on the websites, it can boost the efficiency of using them without much effort, and a user can end up memorizing paths of how to navigate the website as well. Also, visualizations such as images, logos, etc. can affect the memorability of the websites. The visualizations on a website will have an impact on the errors and satisfaction on the website as well. Clear and descriptive visuals can reduce the users' errors and so-called misclicks on a website, as the user will be guided how to navigate on the website, and they will learn and remember the website's navigation for later usage. Visualization can also improve

their chances for recovering from an error made while using the website. Lastly, the other supposedly positive experiences on the website can lead to user satisfaction, and this can be further boosted with visuals that just generally look nice in the user's opinion.

3.2.1 Five visual-design principles for UX

To be able to provide users with pleasant or effective UX by using visual usability, it is crucial to use visualization in a way which does not confuse the users. This can be achieved by following e.g., Gordon's (2020) five visual design principles in UX, which are scale, visual hierarchy, balance, contrast, and Gestalt principles.

Scale is used to mark relative size between different objects, and it can signal importance and rank in a composition. For example, the potentially more important or interesting objects on a website can appear visually larger than the others, and the scale indicates a user's attention towards them. The visual hierarchy refers to the hierarchical placement of objects on e.g., a website, so the user's attention will be guided to visit different objects on their order of importance. This can be achieved by using different sized fonts on an article, for example. Balancing design elements on a website refers to their satisfying arrangements or proportions. This can be done by focusing on the elements' symmetry, location, and proportions compared to each other. The contrast on a website refers to the dissimilarities of the elements. Differently colored text elements, for example, might have different ranks or functions. Text in an article could be written with black font, whilst a link might be presented with a blue color. However, designers need to be wary when using contrasts, as the colors will need to be easy to distinguish from one another. The Gestalt principles refer to how humans make sense of a large composition of elements. For example, a series of lines in an abstract painting can turn into a face if looked at the right way. The Gestalt principles can also be utilized by having different amounts of empty space between e.g., a questionnaire text element, its answer's location, and its follow-up question etc. to differentiate where which answer should go to.

The visual design principles presented above can be utilized to increase websites' usability, provoke emotion and delight in the users, as well as strengthen the website's brand perception (Gordon, 2020). These all serve well to promote the areas of user experience by Morville and Sullenger (2010, pp. 34-35), further proving the importance of visualization in improving both usability and user experience of websites.

3.2.2 Five tools for improved visual usability

In order to improve visual usability, Schlatter and Levinson (2013), have identified five different tools for designers to utilize in order to understand and then improve user interfaces from visual usability's point of view. These tools are layout, typography, colors, imagery, as well as controls and affordances.

The first tool for visual usability is layout, which means the positioning of structural elements of websites in a way the users will understand and comprehend what they are seeing (Schlatter & Levinson, 2013, p. 103). The structural layout elements of websites were discussed in chapter 2.1. According to Schlatter and Levinson (2013, p. 103), successful layouts can support and reinforce the website's structural elements by consistent visual hierarchies, which in turn can help the users to navigate a web page by knowing where to look and when. It will enhance the user's ability to use and navigate websites consistently and logically. Unsuccessful visual layouts, however, will undermine this work by confusing the users. They will no longer know where to locate information, and the more important information can get lost in and confused with the less important information. The users might navigate a website unpredictably, and they would no longer follow the designer's plan on how to navigate the website, resulting in undermining the presentation of information on the website as well. This in turn could lead the users to experience information overload. The layout tool considers concepts such as alignment of elements, their proximity to one another, grid, scale, and white space (Schlatter and Levinson, 2013, pp. 103-138). These are the visual factors which can affect the information density of websites, which was discussed in chapter 2.2.

The second visual usability tool by Schlatter and Levinson (2013) is typography. Typography means the textual elements on the website, and how they are presented in terms of visual aesthetics. Typography covers the utilization of different fonts, the font size, color, weight, meaning boldfacing (i.e., levels of thickness and heaviness), and style, meaning italicizing (i.e., changes in letterform angle and shape) (Schlatter & Levinson, 2013, pp. 139-156). These features can be utilized in terms of assisting in the website's visual consistency, hierarchy, and personality. For example, companies and organizations can utilize same fonts consistently on their websites, making sure their brand is recognizable to the public. A known brand image can complement their website's visual usability and create trust in the website's users. Another example considers the utilization of colors. Although colors are considered a tool of their own in Schlatter and Levinson's (2013) list of tools, it is also a way to visually present the differently used typography on websites. For example, using the color blue is a publicly accepted way to present links on websites. Using another color, such as red to represent links could lead in confusing the users and thus reducing the level of visual usability on the website.

Color is considered the third tool of visual usability. Schlatter and Levinson (2013, p. 171) state that it is the most misunderstood tool user interface designers have. Colors can be used to provoke emotional responses in users, and when best utilized, it can enhance both the (visual) usability and the appeal of a website. Some ways to use color include e.g., complementing the possible brand image, highlighting important information, defining buttons, adding contrast between different elements, supporting accessibility i.e., considering those with difficulty in their vision such as color blindness, as well as adding aesthetic appeal, and conveying personality. Consistent utilization of colors on a website will help improve the visual usability, as it can have positive influence on the user's ability to understand and navigate the websites by helping them learn the website's structure and hierarchy. Thoughtful utilization of colors can help differentiate a website from its competitors, and it can help the website to achieve an aesthetic color scheme while promoting the website's visual usability as well. (Schlatter & Levinson, 2013, pp. 171-211)

The fourth tool, imagery, is described as a type of content, which communicates information itself rather than just something about the information. It covers all the visual means to communicate on a e.g., website, such as photographs, videos, illustrations, animations, logos, icons, symbols, data visualizations, interactive graphics, maps, patterns, textures, backgrounds, and gradations. According to Schlatter and Levinson (2013, p. 2016), there are three ways imagery can communicate. These are: (1) through its use, or its role in the interface; (2) through the subject matter of what's depicted; and (3) through the qualities of representation. The imagery's role is the reason why it is included in e.g., a website, and if it doesn't have a role, it should be removed. The role of an imagery can be e.g., to support communication by drawing attention or providing explanations. The subject matter is what the imagery depicts, e.g., a photograph taken in the woods can depict nature, a map can depict a route from one place to another, and so on. The subject matter might not always be clear, but as long as it subtly communicates a desired quality, there is no need for the people to know exactly what is depicted. The quality of imagery refers to e.g., the quality of a photograph on a website. In the worst-case scenario, a blurry image can lower the chances for effective communication on a website, whilst a sharp image can improve the communication. If utilized well, imagery can help promote visual usability of websites by providing an alternate method to communicate rather than using only written text. (Schlatter & Levinson, 2013, pp. 213-266)

The fifth tool, controls and affordances, considers the navigational features of a user interface such as website. In order to move from one web page of a website to another and to see the website's content, it must provide the user with controls that allow the user to navigate the website. Affordances are the different properties a user perceives about these controls, and the controls and their affordances can have a major impact on a website's user experience. Controls' affordances can be, e.g., the feeling that a button on a website is clickable, or that a slider is draggable. The affordances are implications, meaning that an interface control might imply a behavior based on the user's impression

of it. Schlatter and Levinson (2013, pp. 268-269) have placed types of controls and affordances into three categories, which are: (1) navigational controls, such as tabs and scrollbars; (2) data manipulation controls, such as form fields and submission buttons; and (3) information display controls, such as accordions and overlays suggesting reveal of more information on demand. As the controls and affordances are highly visual elements, it is crucial to analyze their intended functions and actual functions in order to understand whether or not the control and its affordance are communicating to the users clearly what will happen if they e.g., click the button.

3.2.3 Usability metrics

In the earlier chapters I introduced methods which can be utilized to analyze websites visual usability. However, in order to get a thorough understanding of a website's usability, the application of more traditional usability measurement tools should be considered, as even a smaller sample of usability tests is better than performing none at all (Krug, 2018).

A typical way to measure usability is by analyzing user performance on a given set of tasks. The tasks can be completed and recorded in a usability test setting. Based on these tasks, it is possible to identify four usability metrics, which are: (1) success rate, meaning whether the users can perform the given task at all; (2) the time a task requires; (3) the error rate; and (4) the users' subjective satisfaction. Other possible usability metrics which can be identified include the percentage of time the usability test participants followed an optimal navigation path, and the number of times the users got so sidetracked they needed to go back to the previous web page or web pages. (Nielsen, 2001)

According to Nielsen (2001), usability tests provide for qualitative and quantitative data. For qualitative user testing, Nielsen states having three to five test users is enough, however, for quantitative usability testing he recommends having 20 users for each design being analyzed. For example, when testing different versions of websites, there could be

20 test users for the first version of the website and 20 users for the improved design version.

3.3 Communicating to the user through dense information

The study of usability focuses on making sure that websites are as easy to use as possible. However, as technology has advanced, designers now have what feels like unlimited options on how to exactly present information on a website. Visualization can be used to improve usability and user experience, but it is a challenge for designers to know how exactly the information should be visualized, as not all information should be presented similarly. As large organizations have enormous amounts of information presented on their websites, it can become too much for the user to navigate and process the information, resulting in negatively affected usability and the user experience. Designers need to consider the information density of the websites, as well as the possibility of information overload.

3.3.1 Information density related to information overload

As defined previously in chapter 2.2, information density refers to the amount of information presented on a given space. If there is too much information presented on a website, it can lead the users to experience information overload.

Information overload is the feeling a user experiences e.g., on a website that presents so much data the user is unable to process all the information they receive (Interaction Design Foundation, 2020; Bawden & Robinson, 2020). It refers to the simple notion of receiving too much information. In research, the term is also referred to as e.g., cognitive overload (Vollmann, 1991), sensory overload (Libowski, 1975), communication overload (Meier, 1963), knowledge overload (Hunt & Newman, 1997), and information fatigue syndrome (Wurman, 2001). In their article, Eppler & Mengis (2004, p. 326) state, that

according to research, an individual's performance, meaning quality of decisions and reasoning in general, correlates positively with the amount of information they receive up to a certain point. After this, if the individual is presented with even more information, their performance will rapidly decline, and any information presented after this point will not be integrated with their decision-making process. As a result, the individual experiences information overload.

The experience of information overload can result in many symptoms such as the user's confusion and or inability to make a decision, loss of control of the information, inefficient work, demotivation, and so on (Eppler & Mengis, 2004, p. 333). The era of digitalization has caused the concept of information overload to become a part of our everyday lives. Eppler and Mengis (2004, p. 332) list different causes for information overload, which are grouped into five categories that are: (1) personal factors; (2) information characteristics; (3) task and process parameters; (4) organizational design; and (5) information technology.

The first category, personal factors, focuses on an individual's personal abilities, including traits such as possible limitations on the individual's own information-processing capacity, motivation and attitude, as well as personal traits such as skills and experience. The common denominator between these causes for information overload is that all of them come from the individual themselves and haven't been created by an external influence. As a solution to prevent information overload, Eppler and Mengis (2004, p. 335) have listed countermeasures such as improving the individual's personal time management skills and techniques, as well as training to become better at processing information such as emails and digital files. (Eppler & Mengis, 2004, pp. 331-337)

The second category, information characteristics, considers the properties of the information, such as its novelty, complexity, and ambiguity. This category focuses only on the quality of the information itself, and the information processing an individual's own abilities would be seemingly of no use in trying to avoid information overload. Eppler and

Mengis (2004, p. 335) seem to have come to the same result, as their listed solutions mainly focus on raising the quality of the information itself, as well as editing the information via simplifying the text, using visualization, compressing, and structuring the information, and so on. (Eppler & Mengis, 2004, pp. 331-337)

The third category called task and process parameters, focuses on the ways the information is to be worked with, for example in a work setting. This category lists task and process-related causes for information overload, such as time pressure, task interruptions, complexity of tasks, and interdisciplinary work. The causes listed here seem to be types that could be battled with overall managerial skills. The countermeasures against information overload listed for this category include actions such as allowing more time to perform tasks, scheduling uninterrupted time-blocks for critical work, as well as communicating information needs to providers. (Eppler & Mengis, 2004, pp. 331-337)

The fourth group, organizational design, lists causes for information overload which may occur in a setting where the contribution of multiple people is needed for an individual to process the information. These are, e.g., centralization or bottlenecking of information, accumulation of information to demonstrate power (over others), and new information and communication technologies. The countermeasures against these kinds of causes include standard group working techniques, such as creation of lateral relationships, reducing divergence among people through socialization, coordination by goal setting, but also hiring additional employees (Eppler & Mengis, 2004, pp. 331-337). This, however, could be risky as there is always the chance for it to increase the centralization of information by not sharing necessary information with new employees.

The fifth and final category, information technology, lists causes influenced by the technology being used. It considers the influence of push systems like notifications, speed of access, and rise in the number of television channels. The countermeasures listed include actions such as intelligent information management via prioritization, as well as

utilizing systems which offer intelligent information organization options. (Eppler & Mengis, 2004, pp. 331-337)

The symptoms and effects of information overload are grouped into four categories, which are: (1) limited information search and retrieval strategies; (2) arbitrary information analysis and organization; (3) suboptimal decisions; and (4) strenuous personal situation (Eppler & Mengis, 2004, p. 333). Eppler and Mengis present a total of 25 different symptoms for information overload, which can offer a good insight into what will happen if a person is experiencing it. For example, a person's ability to identify and select relevant information may become difficult, and they might experience a loss of control over information. Possible information overload can also be detected from symptoms, such as higher time requirements for information handling and time delays, as well as inefficient work, negatively affected satisfaction, and demotivation.

The article by Eppler and Mengis (2004) lists quite a lot of causes and countermeasures for information overload. However, the article was published almost twenty years ago, and since then, a lot of new information sources have risen. The problem is, in the modern world an individual needs to continuously process a lot of information they receive via technology, people, their surroundings, and so on. Information flows endlessly around us, and the challenge of processing all the information and recognizing the important and meaningful things from the less important ones is present in all areas of life, resulting in a higher chance for people to experience information overload. This means companies and organizations need to focus on making their information as easy as possible for people to process and focusing on information density on their websites can be one way towards achieving this.

3.3.2 Visual usability as a solution for information density and information overload

As information density relates to the amount of information given on a certain page, it is certain the concept is applicable on websites as well. Especially on the websites

focusing on information sharing, such as news agencies', organizations', and government entities' websites, there can occur a lot of data on a single web page of a website, and this in turn can lead the users of the websites to experience information overload. It is the designer's responsibility to construct websites in a way that does not contribute to the possible information overload.

Information overload is a factor that can reduce the overall user experience and usability of websites. As studies have shown, if a user is presented with too much information or too many options to choose from, it can cause them to experience information overload and even leave the website (see e.g., Malhotra, 1982; Eppler & Mengis, 2004; Parra & Ruiz, 2009; Zhuang et al., 2011). As Eppler and Mengis presented in their article (2004, pp. 335-336), one way to prevent information overload is to focus on the information characteristics and how they can affect the users. By guiding and focusing the user's attention to the most important pieces of information, the data presented on the websites can become easier to understand and process, thus helping to prevent information overload. This can be achieved by focusing on the visual usability of websites. As described in chapter 3.2, visual usability is a concept which focuses on utilizing visualization methods to guide the users' attention on the information, attempting to help the users understand better what they're seeing, and improving usability along the way.

By considering the influence of data visualization on websites, the information presented to users can be better modified to help them navigate and process the information they receive. This type of visual usability can be achieved e.g., by considering the visual elements presented on the websites and how they affect the user's navigation on the website. As described in chapter 3.2.2, Schlatter and Levinson (2013, pp. 101-309) have categorized five different tools, layout, typography, colors, imagery, and controls and affordances, which designers can use to identify the level of visual usability on the website, and then proceed to improve the user interface from the visual usability's point of view. Also, the consideration of visual-design principles by Gordon (2020), can help in achieving visual usability. The simplification of the information on websites will help the users

to navigate the information presented to them, but also benefit the companies and organizations trying to communicate to the users. By identifying how the users navigate the visual user interface on the websites, and how they interact with the system, the designers will be able to modify the information presented to the users in a way which will balance the information to manageable pieces. For example, content can be grouped rhetorically, organized visually to show contrast, or so that it signals structural relationships (Schriver, 2013). By combining good information architecture and design which promotes visual usability, the designers may guide the users to the information they are looking for, thus helping the users to navigate and process the information more effectively (Schlatter & Levinson, 2013). If the users feel like they are in charge of the information they are receiving, the chances for them to experience information overload are reduced.

4 Websites' visual usability

In this chapter I analyze the THL and WHO websites in order to make conclusions on which visual elements of the websites contribute to the websites' supposed visual usability and which elements complicate this. The research method is based on comparative content-analysis which is a common method used in researching phenomena in the field of HCI. The research method draws on Nielsen's Usability Metrics (2001), the UEQ Handbook (2022), Gordon's Five Principles of Visual Design in UX (2020), Schlatter and Levinson's (2013) listed visual usability tools, as well as Eppler and Mengis' (2004) list of symptoms of information overload. These topics were introduced in chapter 3.

The first stage of the analysis is to identify the visual elements of the THL and WHO websites, which also answers to my first research question, what visual elements are used on the websites of this study. The second stage of the analysis consists of analyzing the video recordings of the usability study. The visual elements of the websites identified in the first stage of the analysis are then utilized to analyze the impact of the elements on the websites, in order to answer the second research question, how do these elements support the (visual) usability of the websites of this study. This stage also takes into account the UEQ's answers. The third stage of the research analyzes the users' possible information overload on the websites, by identifying symptoms of information overload, considering the users' questionnaire answers, and finally by identifying which visual elements had an impact on this. The third stage of the research answers the third research question, how do the visual elements of the websites impact the possible information overload on the websites of this study.

As mentioned in the introductory chapter, there were a total of ten (10) participants in the usability test. The participants' usability test recordings and questionnaire answers are handled anonymously and to keep that anonymity I will be referring to the participants with pronouns they and them. For the purpose of this analysis, when presenting examples of individual participants, I decided to refer to each participant with a tag "P" for participant, and a number from 1—10 in order to know which analyzed phenomenon

are related to which recording and questionnaire answer. For example, I will be referring to the participants with a tag [P1], and so on.

4.1 Identifying visual elements on websites

In my thesis, I study the visual usability of websites and how the visual usability can help prevent information overload on data-heavy websites. As the concept of visual usability is based on guiding the users to identify visual elements on the website, guiding the users' gaze, as well as creating a mental image of aestheticism and communicativeness, it is crucial to first start the analysis by identifying the visual elements used on the websites. As described in chapter 2.1, websites consist of both structural elements and content elements. The analysis begins by first identifying the structural elements of both THL and WHO's websites, and then proceeds to identify the content elements of both organizations' websites.

4.1.1 Structural elements

The structural elements of websites were introduced in chapter 2.1. As mentioned, the structural elements of websites are those structural elements built with websites' HTML source code, that are visible to the users. As the structural elements are visible on the websites, I first identified them by comparing the websites' visual look to the HTML Layout Elements of Websites (W3Schools, 2023) presented on figure 6. I also utilized Mozilla Firefox browser's "inspect" ability to compare my identified structural elements presented in the websites' HTML source code in order to make sure I had properly understood the element. After identifying the structural elements from the websites, I analyzed the type of information each element contained and their purpose on THL and WHO's websites in order to compare how these elements were utilized on both websites. The identification of the structural elements' contents also briefly prepares for the next stage of the expert analysis presented in chapter 4.1.2, which analyzes the content

elements of the websites. The structural elements of THL's website are presented in table 2, and the structural elements of WHO's website are presented in table 3.

Table 2. Structural elements on frontpage of THL's website.

Element's name	Element's contents	Purpose
Header	• Language settings • THL's logo • Contact information • Information for the media • Search field • Navigation bar	• Users can customize the website's language. • Logo identifies this website belongs to THL. • Navigation.
Section 1	• Highlighted releases • Current news • Social media links	• Highlights current information. • Navigation to THL's social media profiles.
Section 2	• Highlighted topic of the month • Links to information under different topics	• Highlights current information. • Navigation.
Section 3	• Links to THL's publications • Links to electric documents • Links to online services	• Navigation.
Section 4	• Links to events • Links to blog posts • Links to picked up topics	• Navigation.
Footer 1	• THL's logo and name • Social media links • Same links as included in the navigation panel of the header element	• Logo and name identify the website belongs to THL. • Navigation to THL's social media profiles. • Navigation.
Footer 2	• Copyright information • Contact information • Links to feedback, more information of the website, accessibility statement, and detailed contact information	• Copyright identifies the website belongs to THL. • Informs users how to contact THL. • Navigation.
Footer 3	• Link to navigate to other websites belonging to the administrative branch of Finland's Ministry of Social Affairs and Health • Description of the purpose of THL	• Navigation. • Informs users about who owns the website.

As presented in table 2, I identified three types of structural elements from the front page of THL's website, which were one (1) header element, four (4) section elements,

and three (3) footer elements. As described in W3Schools' website (W3Schools, 2023b), these elements can be used to define different parts of a web page.

The header element is typically used as a container for introductory information or to contain a set of navigational links, and a web page can contain more than just one header element (W3Schools, 2023b). In the case of THL's website, there was one header element which was used for both these purposes, as it contains THL's logo and a navigation bar. It also contains links to THL's contact information, information THL wishes for the media representatives to see, a search field, as well as language settings from which the user can choose their preferred language version of the website.

The section element typically contains thematically grouped information with perhaps a relevant title (W3Schools, 2023b), and this was true for THL's website as well. I found four section elements in total, and each of them is used to contain different information such as news releases, links to different topics THL provides information about, and links to THL's products such as publications. The sections were presented under each other, and they had relevant titles describing what kind of information each section contained.

THL's website contains three footer elements, and each element is used to contain different information. This is practical, as the footer element typically defines a footer for a document or section, and I think in this case the website's designer has thought to use the different footers to describe the ending of certain information. The first footer element contains THL's logo and name, links to their social media pages, as well as a sitemap containing the same links the user can reveal from the navigation bar in the header element. This footer ends the main contents of the front page. The second footer element contains the copyright information, contact information, as well as links to pages such as feedback and accessibility statement. This footer is used to describe the ending of THL's contents on the web page. The third footer is interesting, as it contains the description of what THL does, as well as a link to different websites which belong under the administrative branch of Finland's Ministry of Social Affairs and Health. I imagine the last

information can certainly be surprising to some users of THL's website, but it is useful to provide as THL does belong under this administrative branch together with organizations such as the Finnish Medicines Agency Fimea. Considering the last information also indicates the ministry's ownership over THL, the last footer is used to indicate the ending of the whole web page.

Table 3. Structural elements on the frontpage of WHO's website.

Element's name	Element's contents	Purpose
Header	• Link to global website • Link to regional websites • Search field • Language settings • WHO's logo and name • Navigation bar	• Navigation. • Users can customize the website's language. • Logo and name identify the website belongs to WHO.
Section	• Highlighted information with links • Links to highlighted emergencies • Link to all emergencies • Links to highlighted news • Link to all news • Links to selected topics, such as publications, WHO's video channel etc. • Links to selected campaigns • Link to all campaigns • Links to upcoming events • Link to all events	• Navigation. • Distribution of current information and latest releases.
Footer	• Links to regional information • Links to WHO's policies about different topics • Links to pages with more information about WHO • Link to subscribe to WHO's newsletter • WHO's logo and name • Link to privacy legal notice • Links to social media channels • Copyright information	• Navigation. • Users can subscribe to receive latest information WHO wants to share with the public. • Logo and name identify the website belongs to WHO. • Navigation to WHO's social media profiles. • Copyright identifies the website belongs to WHO.

Compared to THL's website, WHO's website contains the same structural elements on its front page, but instead of having multiple sections and footers, it only contains one of

each. The header element on WHO's website contains mostly the same information as on THL's website. It does not contain separate links to contact information or information specifically for the media. Instead, WHO's website has links to their global web pages as well as web pages containing information for different regions in the world, grouped by different continents. WHO's website also offers seven language versions, compared to the three provided by THL.

The section element on WHO's website begins by having highlighted information about a single topic spreading the whole width of the web page. This information contains links to learn more about the highlighted topic, as well as contains relevant photography which further highlights the presented information. Similar to THL's website's section elements, the one section element on WHO's website also has different sorts of information categorized under relevant titles. The major difference is that there appears to be less links to different information on WHO's website, but all the titles categorizing different information have a link to e.g., all events next to the title.

The WHO website's footer element contains similar information to THL's website. There are only three main differences. The first difference is that unlike THL's website, WHO's website's footer does not have a sitemap containing all the same links as the header element's navigation bar does. Instead, the sitemap contains links to different regions' web pages, links to policies, etc. The second difference is that unlike THL's website, WHO provides the users with a link to subscribe to their newsletter. This would indicate that THL might not have a newsletter, and as I was browsing their website, I found no mention of one. The third major difference is that whilst THL's website has links to different organizations' websites working under the administrative branch of Finland's Ministry of Social Affairs and Health, there is no such links on WHO's website. It is not an issue, but I imagine WHO could very well have similar links on their website, as the organization is an agency working under the United Nations (UN). Therefore, the WHO's website could technically include links to other UN agencies' websites, such as the United Nations Educational, Scientific and Cultural Organization, UNESCO. However, it would potentially

be a very big political discussion about which organization to include and which to exclude.

THL and WHO's websites mostly consisted of the same structural elements as presented in table 2 and table 3. The only exception was on THL's website when navigating to different web pages from the header element's navigation bar. An additional navigation bar was added to the left side of the web page on quite a few web pages, for example, on the pages describing different statistics and data by category, each category was presented on the left side of the page in order to the users to be able to navigate from one category to another effectively.

4.1.2 Content elements

As described in chapter 2.1, the content elements of websites are the actual content which is located within the structural elements of websites. The content elements present the information on the website and define the visual look and aesthetic of a web page and can be utilized to e.g., create a brand specific visual look on companies' websites.

The visual content elements are divided into five categories following Schlatter and Levinson's (2013) five tools for visual usability (see chapter 3.2.2). These tools were combined with Gordon's (2020) five visual-design principles for UX presented in chapter 3.2.1, and together they were used to identify the content elements of both THL and WHO's websites. The five categories are (1) layout, (2) typography, (3) color, (4) imagery, and (5) controls and affordances.

Table 4. Content elements on the frontpage of THL's website.

Category	Content elements	Purpose
Layout	• White space • Alignment • Proximity	• Creating empty space between objects and information,

	• Grid • Scale	promoting readability and lowering information density. • Presenting the information understandably. Positioning the information in a way it's easy to distinguish the beginning and end of certain information.
Typography	• Display typeface • Body typeface • Monospaced typeface • Weight	• Display typeface distinguishes the website's headline. • Other typefaces used to distinguish regular text, titles, and descriptions of information type. • Weight used to lead the users to identify headlines or more important information, as well as links. • Utilization of different typefaces to support hierarchy and consistency.
Color	• Buttons with green background • Shading under highlighted topics and under elements containing navigational links • Photographs with colors significantly different from the background • White background with green leaves • Black background on descriptive information • Darker background colors on footer elements • Brand-specific colors on social media icons • Repetition of THL's logo's colors on website • Color change on rollover over links • Contrast	• Color used to differentiate a possible button or descriptive information from the other content. • Shading used to indicate the ending of a container used for specific information. • Color used to differentiate elements from the background. • Color used to define different structural elements on the website. • Color used to represent the brands of different social media channels. • Color used to define THL's own brand and to create a specific visual look and aesthetic. • Utilization of contrast to promote readability of written text and to differentiate links from text.
Imagery	• Lines • Arrows • Logos • Photographs • Textures • Background	• Separating content. • Indication of the possibility to learn more by clicking a link. • Representation of different companies, like social media channels.

		• Photographs to draw attention. • Textures used to indicate where the user's cursor is currently on the screen. Indicates the presence of a link. • Representation and supporting of brand image. • Distinguishing relevant and irrelevant visual content elements.
Controls and affordances	• Navigation controls • Information display controls • Changing color on rollover • Underlining on rollover	• Navigation controls indicate a possibility to navigate to a different web page via link. • Information display controls to show more information on demand, e.g., in the navigation bar. • Changing color and underlining used to present users' cursor location on the screen, and to indicate a link is clickable.

The visual content elements used on THL's website are applied consistently and in a way which supports the website's readability and hierarchy on the front page of the website (see table 4). The layout choices made on the website support the presentation of information in a way that does not appear too dense. Although the different information containers, e.g., the quadrilateral containers for news releases, are located close to each other, there is enough white space in between the objects to distinguish them from one another (see figure 8).

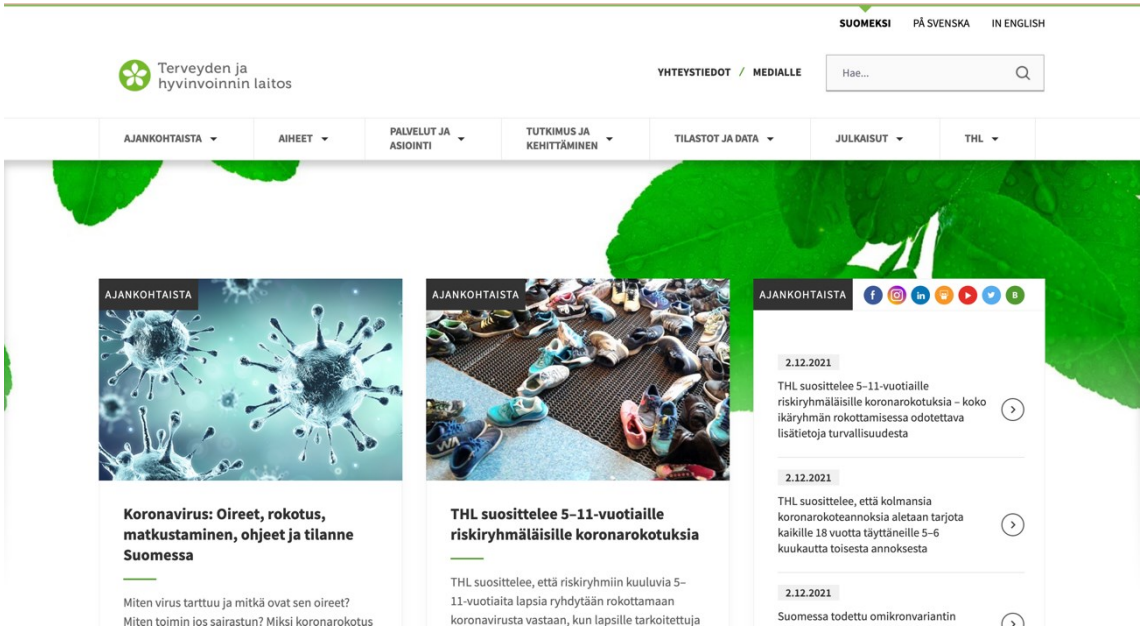

Figure 8. The latest releases contain white space, lines, and shadows between them, indicating the contents are different to one another.

The utilization of color in THL's website can be considered strategic. The green color used in the background of the web page, behind stationary objects, as well as its application behind text on rollover to distinguish links both supports the consistency of the website's visual look and aesthetic, but also work in order to create and support THL's brand. The green color is utilized in THL's logo, and it is a good choice to include this color in the website's color scheme as well as it repeats the color and emphasizes the brand. The green color is also an interesting choice if the possible symbolic meaning behind it is considered. As Schlatter and Levinson (2013, p. 178-179) state, the color green can be associated with concepts such as nature and environment, money, green light, or as an indicator to be allowed to "go" depending on the context. The association of nature is highlighted by the chosen background on the website, as the upper part of THL's website's front page contains green leaves in the background. It is tricky though to use the association to nature and perhaps relate that to sustainability, as it can also be associated as possible greenwashing as THL is not e.g., an environmental organization. The possible indication of green light and being allowed to "go" are presented on THL's website with the green color on links both in their background as well as on the rollover. The green color can also be associated to represent general wellbeing, which suits the context well

as supporting and improving people's wellbeing is considered THL's main goal (THL, 2023).

Table 5. Content elements on the frontpage of WHO's website.

Category	Content elements	Purpose
Layout	• White space • Alignment • Proximity • Grid • Scale	• Creating empty space between objects and information, promoting readability and lowering information density. • Presenting the information understandably. Positioning the information in a way it's easy to distinguish the beginning and end of certain information.
Typography	• Display typeface • Body typeface • Monospaced typeface • Weight	• Display typeface distinguishes the website's headline. • Other typefaces used to distinguish regular text, titles, and suggestions. • Weight used to lead the users to identify headlines from additional information, such as publication dates, event dates and types of news. • Utilization of different typefaces to support hierarchy and consistency.
Color	• Shading under event titles • Different colors on between header, section and footer elements • Photographs with colors significantly different from the background • Black color on the background of buttons with different functionalities • Repetition of WHO's logo's colors on website • Color change on rollover over links • Contrast	• Shading used to indicate the end of specific information. • Color used to differentiate elements from the background. • Color used to differentiate structural elements on the website. • Color used to define WHO's own brand and to create a specific visual look and aesthetic. • Utilization of contrast to promote readability of written text and to differentiate links from text.
Imagery	• Lines • Arrows • Logos	• Separation of content. • Indication of the possibility to learn more by clicking a link.

	• Photographs • Textures • (Background)	• Representation of different companies, like social media channels. • Photographs to draw attention. • Textures used to indicate where the user's cursor is currently on the screen. Indicates the presence of a link. • Distinguishing relevant and irrelevant visual content elements.
Controls and affordances	• Navigation controls • Information display controls • Changing color on rollover • Underlining on rollover	• Navigation controls indicate a possibility to navigate to a different web page via link. • Information display controls to show more information on demand, e.g., in the navigation bar. • Changing color and underlining used to present users' cursor location on the screen, and to indicate a link is clickable.

The content elements on WHO's website are presented in table 5 above. Both THL and WHO's websites' front pages use tools like controls and affordances in a way which feels relevant considering possible users of the websites. The changing color on rollover over links makes accessing e.g., the links in the navigation bar clear and the affordance of a clickable link supports the user's interpretation of what they are doing. The content elements under controls and affordances category on both websites were consistent and I did not identify any functional differences between the two. Color wise, the color change on rollover was clear on both websites. However, whilst THL's website uses green color while hovering over links on the navigation bar (see figure 9), WHO's website uses orange color which is clearly distinguishable from the navigation bar but seems inconsistent with the applied color scheme of the website (see figure 10). It quite surprised me to see a color that was used nowhere else on the web page. On THL's website, the green color used on rollover matches the shade of green used elsewhere on the website, and it complements the visual look and aesthetic of the website.

Figure 9. The green background color on text elements on THL's website indicates of a possible link or a button.

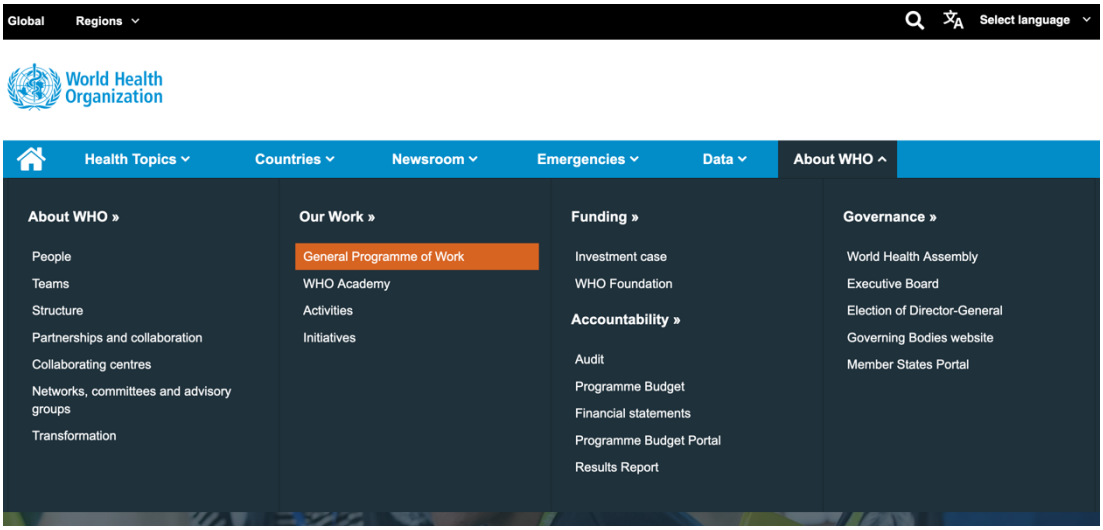

Figure 10. The orange background color on text elements on WHO's website indicates of a possible link or a button.

Another clear difference between the two organizations' websites was detected in the background elements of the websites. Whilst THL's website's background consists of green leaves on white color, WHO's website didn't have any other elements than white coloring present on the background. Compared to background of the THL website, WHO's website's background appears empty. There is an abundance of negative space,

although having just plain white color serves well to provide sufficient contrast to black text elements. The only factor lacking on WHO's website compared to THL's website is the additional support the background imagery gives to the organization's brand image.

4.2 Visual usability of THL and WHO's websites

Within the previous chapter, I identified visual elements on THL and WHO's websites from structural and content perspective by conducting an expert analysis. These visual elements represent components on the websites which designers can utilize to guide the users to navigate on a website. The question lies in finding out which of the identified visual elements support the websites' assumed visual usability, and which elements possibly challenge the visual usability.

The visual usability of the two organizations' websites was studied by conducting usability testing on both organizations' websites. The usability tests were conducted in the University of Vaasa's Interaction Design Environment, and each test session was recorded using the laboratory's SMI iView REDn Scientific 30Hz eye-tracker. The study had ten (10) participants who attended the individual test sessions at different times. The participants' background information was described in chapter 1.2.3.

Based on Nielsen's (2001) usability metrics, I identified the following quantitative data from the two organizations' websites. The success rate of both THL and WHO's websites' usability tests was 100%, as all the ten participants were able to complete both tasks they were given. The time each task required varied a little. Based on the video recordings of the usability test sessions, the average time to complete the usability test on THL's website was 2 minutes 38,5 seconds. On the WHO website the average time was 1 minute 45,3 seconds. The average time spent on the usability tests' tasks was significantly longer on THL's website. On THL's website, the fastest time in which the task was completed was 80 seconds, whilst on WHO's website the fastest time was 25 seconds. The longest time spent to complete the task on THL's website was 6 minutes 18 seconds,

compared to WHO's website's 2 minutes 48 seconds. The time each participant spent on the tasks as well as the average time spent on the tasks can be reviewed from the table 6 shown below.

Table 6. The time it took for each participant to complete the usability test's tasks.

Participant	**THL's website**	**WHO's website**
P1	1 min 20 s	1 min 28 s
P2	2 min 10 s	2 min 49 s
P3	2 min 20 s	2 min 8 s
P4	1 min 25 s	1 min 43 s
P5	6 min 18 s	25 s
P6	3 min 15 s	28 s
P7	2 min 16 s	1 min 3 s
P8	3 min 17 s	2 min 48 s
P9	1 min 29 s	1 min 20 s
P10	2 min 35 s	2 min 1 s
Average	**2 min 38,5 s**	**1 min 45,3 s**

As seen from the table 6, on average, the participants were able to complete their tasks on WHO's website. Interestingly, the participant who took the longest to complete their task on THL's website managed to complete their task fastest on WHO's website. Both tasks were possible to complete with only one or two clicks on the websites, but it is still surprising that there were two participants who took less than 30 seconds to complete their task on WHO's website. Considering Nielsen's (2001) usability metrics, the results presented on table 6 would hint that the usability of WHO's website is on a higher level than on THL's website.

4.2.1 Elements affecting positively on the visual usability

The usability test recordings indicate that on both THL and WHO's websites, the users' gaze was first focused on the header elements and the controls elements located in the navigation bars on the top of the web pages. On THL's website, the users' gaze reviewed the main headlines on the navigation bar and then proceeded to the other headline

elements on the website, such as the latest releases' titles. Similar activity was detected from the recordings on WHO's website as well.

The importance of the navigation bar was highlighted on the usability test recordings, as the users clearly spent the majority of their time considering the contents of the navigation bars and the links they contain. This was extremely useful on WHO's website, as the fastest users to complete the usability test's task on WHO's website were able to navigate to the correct page in 25 seconds [P5] and 28 seconds [P6]. This is significantly faster if compared to the fastest participant's time on THL's website, as the fastest participants were able to complete their tasks in 1 minute and 20 seconds [P1], and 1 minute and 25 seconds [P4]. In all these recordings, the users' focus first went to the navigation bar, from which the users continued to the next web pages. On THL's website, the second web pages the users navigated to included an additional navigation bar on the left side of the web page (see figure 11), and on WHO's website an additional navigation bar was added to the top of the screen under the main navigation bar used on the front page of the website (see figure 12).

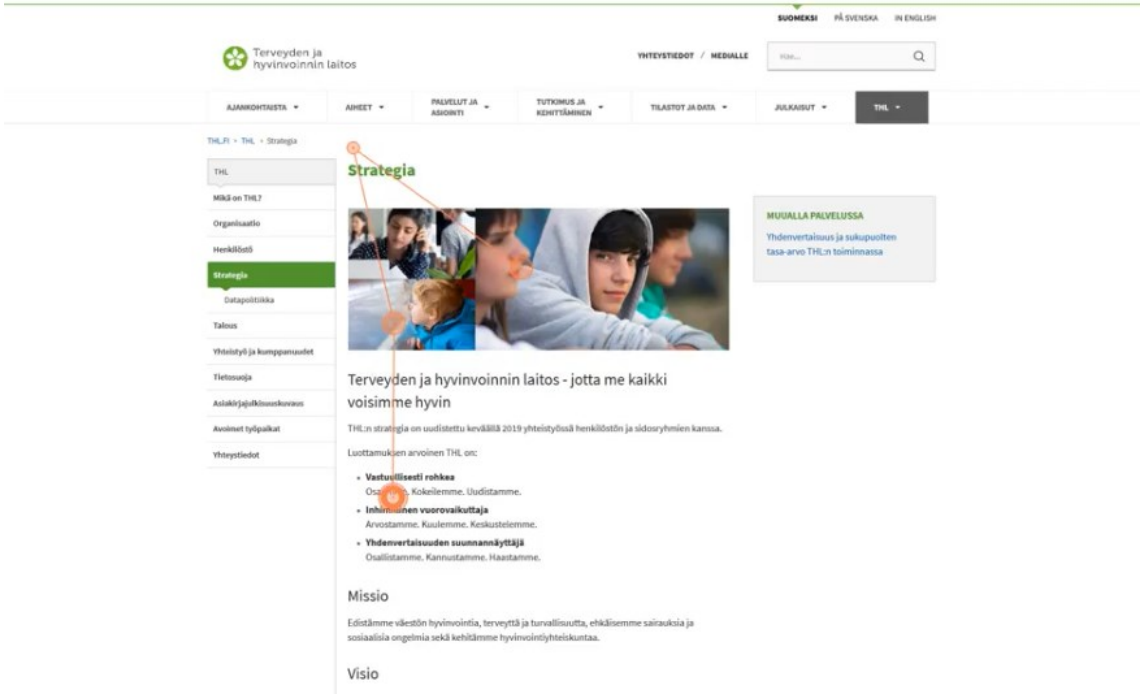

Figure 11. Screenshot of a usability test participant's gaze path recording on THL's website [P3].

In figure 11 the user's gaze was first located in the middle of the web page, where an image was located. From the image, the participant's gaze started to move towards the navigation bars on the top and on the left side of the web page. However, the participant's gaze went towards the boldfaced text elements below the image.

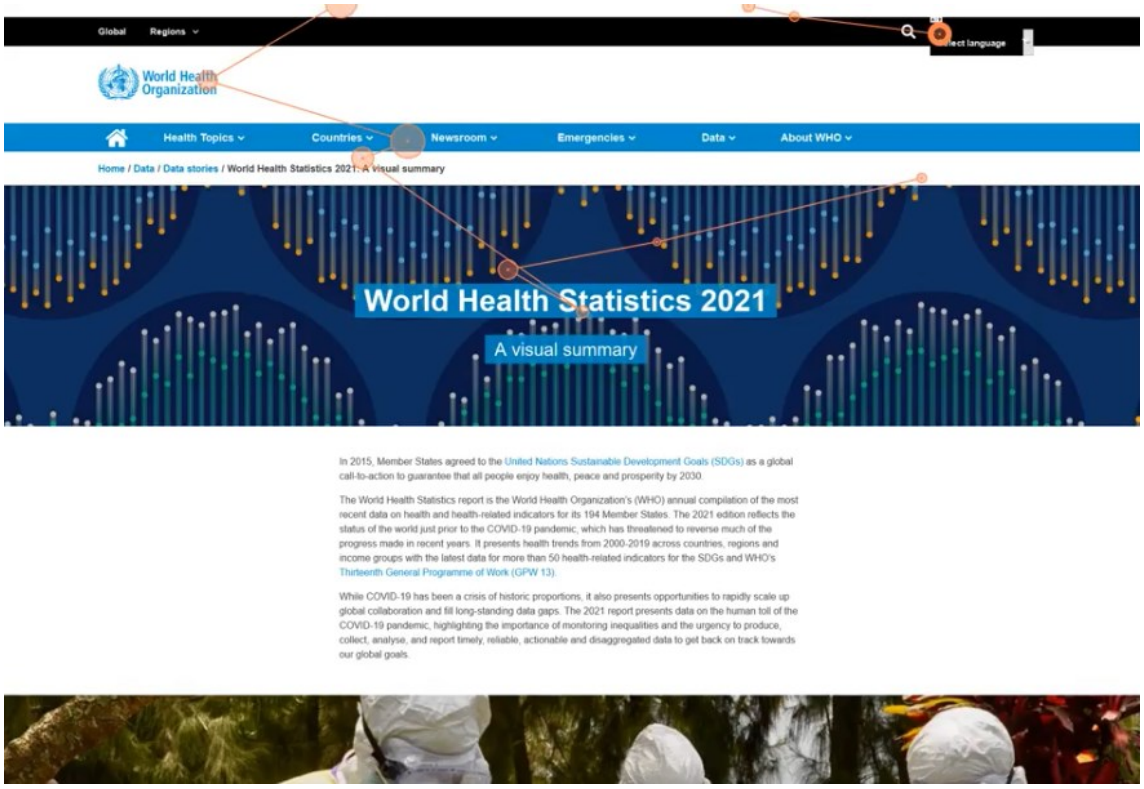

Figure 12. Screenshot of a usability test participant's gaze path recording on WHO's website [P4].

Besides the control elements such as navigation bars, other elements which affected positively on the visual usability of the two organizations' websites were typographic elements utilizing weight of the text by boldfacing e.g., headlines and important information. Other typographic elements which contributed well to the visual usability were the different typefaces which were used to distinguish different types of information. Also, the influence of white space cannot be forgotten, as it is an important factor in reducing the information density of the websites as it improves the users' ability to understand the websites' contents and distinguish different information from one another. For example, in the navigation bars of both websites, white space is utilized to add space between the different controls via which the user is able to go to other web pages. The added white space helps the users to identify where the division goes between different buttons, and this helps the users to avoid clicking on the wrong button while trying to proceed to a new web page on the website. The white space contributed to Gordon's (2020) Gestalt principle, and participants were able to identify the structure of the

website so that they were able to find the different buttons and links from the rest of the information present.

4.2.2 Elements affecting negatively on the visual usability

Based on the usability test recordings, while navigational elements on THL and WHO's were able to influence the websites' visual usability positively, there were some navigational elements which did the opposite. On both THL and WHO's websites there were navigational links which affected negatively on the visual usability as these elements got the participants to focus on information which was irrelevant to the task at hand and didn't help the participants to complete their tasks.

On THL's website, not one but three participants' gaze first went to the navigation bar on top of the screen, but shortly afterwards they continued to look into the news releases and other elements at the lower halves of the web page. These participants were [P2], [P7] and [P8]. This technique could have been successful, as in the case of THL's website, the fastest way to complete the assigned task would've been by opening the correct web page with one click from the correct link. As shown in figure 13, the participant [P8]'s gaze even focused on the correct link, but somehow the participant must have missed it.

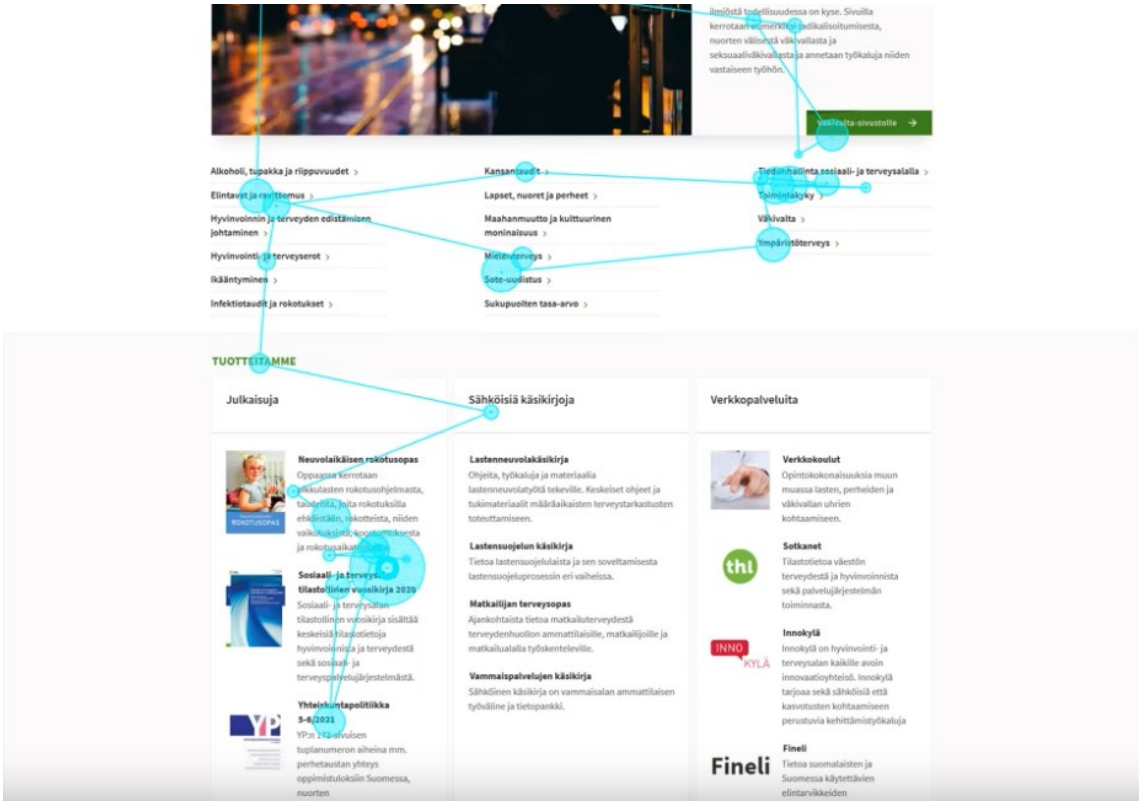

Figure 13. Participant [P8]'s gaze path on different elements on THL's web page.

On WHO's website, the highlighted information was also conflicting to some users. For example, in figure 14, participant [P4] has navigated to a page under which different data has been organized, and their gaze moves rapidly between the different highlighted information without focusing on any of them for very long. In this case, each of the highlighted information have a differently colored background, which could have affected on the participant's inability to focus on each information in a systematic order.

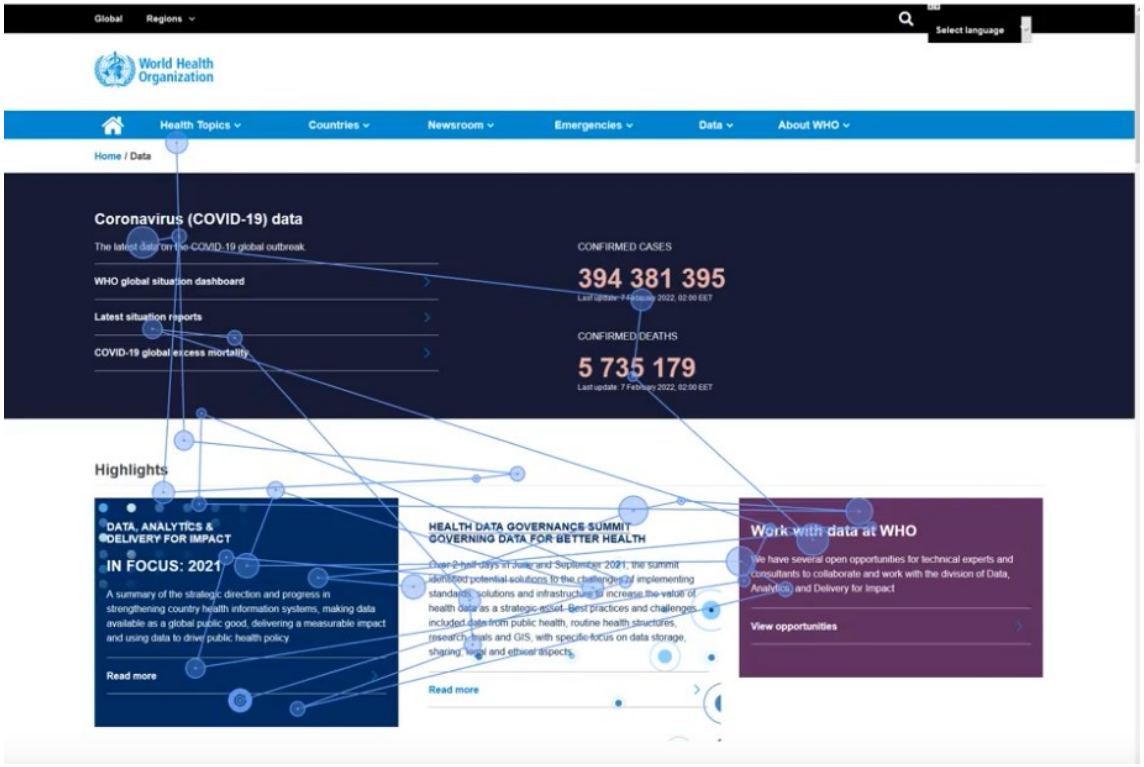

Figure 14. Participant [P4]'s gaze path on different elements on WHO's web page.

4.2.3 Similarities on THL and WHO's websites' visual usability

Both THL and WHO's websites' level of visual usability seems to be at a satisfactory level, as all the usability test participants were able to complete their tasks on both websites in a reasonable amount of time. The main visual content elements contributing on the two websites' visual usability were related to the controls and affordances. On both websites, the participants were heavily focused on the navigation bar and the links, objects, menus etc. it offered to navigate to other web pages on the website.

Considering Gordon's (2020) visual design principles for UX, both THL and WHO's websites utilized scale and visual hierarchy to present the visual content elements in a way which contributed to the websites' usability. On both websites, the relative size between different objects was used to guide the users' gaze to the larger elements, such as the highlighted articles. However, the visual hierarchy on the websites made sure the users'

gaze moved starting from the upper parts of the websites and the header elements towards to bottom part and the footer. Some participants did not even go as far as to reach the bottom of the web page, and especially on WHO's website the usability test participants were mostly focused only on the top half of the website.

The information on the websites was balanced, and the utilization of color and contrast on both websites was successful. As described in chapter 4.1.2, the colors were used in a way which aided the users to identify e.g., links and buttons on the websites. Especially the texture used on both websites to add and/or change color behind text when hovering over links to other web pages was beneficial, as it contributed to the users' ability to recognize different affordances indicating about a possible control function. The underlining of the text when hovering over links further added to this contribution on both websites.

4.3 User experience questionnaire

This section of the analysis focuses on the UEQ responses the participants submitted immediately after their own usability test sessions. The UEQ and how it works is described in chapter 3.1.2. The questionnaire was used to gather information on the usability test participants' backgrounds, and a summary of that information is available in chapter 1.2.3. In order to analyze the user experience, I used the UEQ Data Analysis Tool's 12th version, which was provided with the UEQ on the UEQ's website (UEQ, 2018).

The first step was to enter each user's usability test answers into the relevant data fields in the Excel-based data-analytics tool. In the UEQ, there were 26 items in total. Each item represents a pair of two opposing terms, which are used to describe the website in question. When answering the UEQ, the participants need to answer each item by choosing a number between 1—7 to indicate which of the two opposite terms better represent their opinion about the website in question (see figure 15).

Figure 15. A screenshot of the Finnish UEQ.

The numbers each user gave for each item were entered to the data field. The UEQ then automatically analyzed the data and converted the participants' numbers into a scale range from -3 (horribly bad) to +3 (extremely good). The data analysis tool automatically converted the participants' number 1 is into number -3, the number 4 was converted to 0, and number 7 was converted to +3. The UEQ shows the analyzed data in different visualizations. The detailed visualizations of how each item in the UEQ contributed to the UEQ scales on the data analysis is shown in the appendices 3 and 4. The detailed visualizations also tell the viewer which items of the UEQ affect which of the six scales.

4.3.1 User experience on THL's website

The UEQ results about THL's website did not indicate directly any positive or negative tendencies. As shown in figure 16, almost all of the scales are located between the numbers -0,8 and +0,8 range, indicating more or less neutral evaluation results. The only scale scoring outside this range was the novelty scale which received the result -1,225, meaning it received a negative evaluation from the participants of the usability test sessions. The visualization of mean value per item also shows, that the items received values from both sides of zero, as 11 items had a value above zero and 15 items a value below zero (see appendix 3).

UEQ Scales (Mean and Variance)		
Attractiveness	0,283	0,59
Perspicuity	0,050	2,08
Efficiency	0,050	0,82
Dependability	0,550	0,96
Stimulation	-0,425	0,58
Novelty	-1,225	1,35

Figure 16. UEQ scales of the UX on THL's website. Created with the UEQ Data Analysis Tool (2018).

The UEQ results are in line with the answers the participants had given to the open question in the questionnaire, in which they were encouraged to share possible other feelings they had about THL's website and the test situation as whole. In example 1, the participant gives a quite neutral description about the website, indicating that the participant's experience of it was somehow on the more negative side, but it also had some positive aspects.

(1) Pretty boring website. However, the content was quite easy to find and therefore the website was effective. [P4]

(2) THL's website was confusing, but otherwise their usability was ok. [P5]

The second example also offers two contradicting opinions, given that in the example the participant states that they thought that THL's website was confusing, yet somehow the participant still thought the usability of the website was alright. However, the participant from example 1 is on agreement with the participant from example 2, as the person also stated they thought the website was "effective".

The UEQ results could be quite useful to THL in terms of understanding the novelty effects of their website. They may use these to indicate the stability and timelessness of the web design, or if wanting to create a novel affect, take stance and systematically change the elements that induce a sense of datedness. As seen in the appendice 3, all the four items affecting the novelty scale have a score between -1,0 to -1,5. This indicates

that the novelty scale got a negative evaluation on all aspects, and it would probably be something the designers of THL's website should focus on in order to provide the website's users with a better user experience. The only other two items that received a negative evaluation affected the stimulation and efficiency scales. However, both two scales received a positive evaluation of one item per each, which balanced their overall evaluation to locate in the neutral area.

4.3.2 User experience on WHO's website

WHO's website's UEQ analysis reveals, that the website's overall user experience received a neutral evaluation. As figure 17 reveals, all but one of the scales received a neutral evaluation, and the scale for dependability even received a positive evaluation with the score of +0,950.

UEQ Scales (Mean and Variance)		
Attractiveness	0,700	0,54
Perspicuity	0,275	1,46
Efficiency	0,125	1,13
Dependability	0,950	0,79
Stimulation	0,525	1,84
Novelty	-0,125	1,43

Figure 17. UEQ scales of the UX on WHO's website. Created with the UEQ Data Analysis Tool (2018).

The test UEQ items affecting the scales were all able to receive either a neutral or positive evaluation. The highest evaluations were given to items affecting stimulation, which received a positive score of +1,9, and attractiveness, which received a positive evaluation of +1,8 (see appendix 4). Looking into the mean value per item, the visualization shows that from the 26 items, only five received a mean value which was below zero, but still on the range to receive a neutral evaluation. This indicates that the overall user experience of the website leans more towards positive rather than negative evaluation, and the same perception was present in the participants' comments as well.

(3) Nice websites, I could have browsed more. Lots of interesting stuff. [P2]

In the example 3, the participant indicates that in their opinion THL's website was nice, and they could have even spent more time browsing it. However, the idea of the website being "nice" might be challenged.

(4) This is what websites looked like in the 90s. [P6]

In the example 4, a participant suggests that WHO's website looks the way websites did in the 90s. However, the participant does not make it clear whether they think this is positive or negative. Either way, this opinion suggests the website's visual appearance might not, in the participant's opinion, be modern. This opinion is in line with the UEQ results, as the scale of novelty was the only one to receive an evaluation below zero, with the score -0,125 (see figure 17).

4.3.3 Comparison of the UEQ results on THL and WHO's websites

Comparing the UEQ scores of THL and WHO's websites, it is visible that both websites received an overall neutral evaluation. The difference is that THL's website received one negative evaluation for the scale of novelty (see figure 16), while WHO's website received one positive evaluation for the scale of dependability (see figure 17). All the other scales received a neutral evaluation on both websites.

Observing both of the UEQ evaluations, it appears that THL's website's user experience was overall lower than the user experience of WHO's website. The largest difference is the THL's one negative evaluation compared to the one positive evaluation WHO's website received. If looking into the other evaluations, WHO's website received only one evaluation with a value below zero, while THL's website received two (see figure 16 and

figure 17). The usability test participants' comments also tell the same story (see example 5).

> (5) WHO's website was easier to use. I think there was more information, but THL's website was confusing and I didn't find the information from there as easily. [P8]

In example 5, the participant describes that in their opinion WHO's website was easier used than THL's website. The participant justifies their statement by declaring that the information they were looking for during the usability test was easier to find from WHO's website. The participant's feeling is in line with the usability test recordings as well, as they were able to complete the task faster on WHO's website compared to THL's website (see table 6).

> (6) A positive thing here and on THL's website was the absence of advertisements. [3]

Despite the differences, both THL and WHO's websites still received an overall neutral evaluation from the UEQ. This could be due to the context of the websites, as the organizations work in the health sector and might thus want to limit unwanted surprises. In example 6, the participant suggests that a positive thing on both websites was the absence of advertisements. This was an interesting observation to me, as I had not considered the presence or absence of adverts when choosing the websites to be studied in this thesis. The participant's comment indicates that both websites probably left them with a more positive than negative feeling, as they chose to leave a comment with a positive observation rather than with a negative one. As the figures 16 and 17 reveal, both THL and WHO's websites received more evaluations with a score above zero. This would indicate, that even though there are things on both websites which can be improved, their overall user experience still ended up on the positive side.

4.4 Signs of information overload

As described in chapter 3.3.1, information overload is the feeling a user experiences when they are presented with more information than they can process. The identification of information overload can be tricky for an individual, as they might not recognize it in themselves. However, for the purpose of this study I was able to recognize some signs indicating possible information overload by comparing the usability test recordings and the participants' questionnaire answers to Eppler and Mengis' (2004, p. 333) list of symptoms of information overload. In this chapter, I identify the symptoms of information overload from the data and analyze the impact THL and WHO's websites' visual elements had on the information overload. The identified symptoms of information overload are listed in table 7.

Looking into the video recordings of the usability test sessions, the majority of the participants were able to complete the usability test's task faster on WHO's website. However, there were three participants who managed to complete the task faster on THL's website (see table 6). The participants, P1, P2 and P4, point out in their comments on the questionnaire the data on WHO's website (see examples 3, 7 and 8). In the example 7, the participant states that WHO's website was more difficult to use compared to THL's website. The participant suggests that there would be more data on WHO's website, which may be true considering the organization works on a global scale and could therefore have more information on their website compared to THL, which works in and is focused on Finland. The participant also states that the amount of data on the website made it difficult to complete the task.

(7) WHO's website was more difficult to use than THL's, because it seemed that there was more data than THL's website. So there was a lot of data, which made it difficult to find exactly the page you were looking for. I also think I took a different path to the desired page than intended. I found the page just by searching the search menus for the right keywords and scrolling down the pages. I found the page slower. [P1]

From the participant's comment in example 7, I first identified one symptom of information overload, which is the higher time requirement for information handling. The participant's description on how they were able to complete the task would also suggest a possible loss of control over the information on WHO's website, as the amount of data made it difficult for them to find the web page they were looking for during the task. The participant's usability test recording shows that besides the navigation bar, they were heavily focused on the boldfaced typefaces on the website, which differentiated the highlighted the titles of materials and links from the other textual content (see figure 18). The participant's comment also indicates, that even the navigation bar itself may have contained too much or too little information for them to handle, as the participant had to search for information on the navigation bar to be able to proceed with the task.

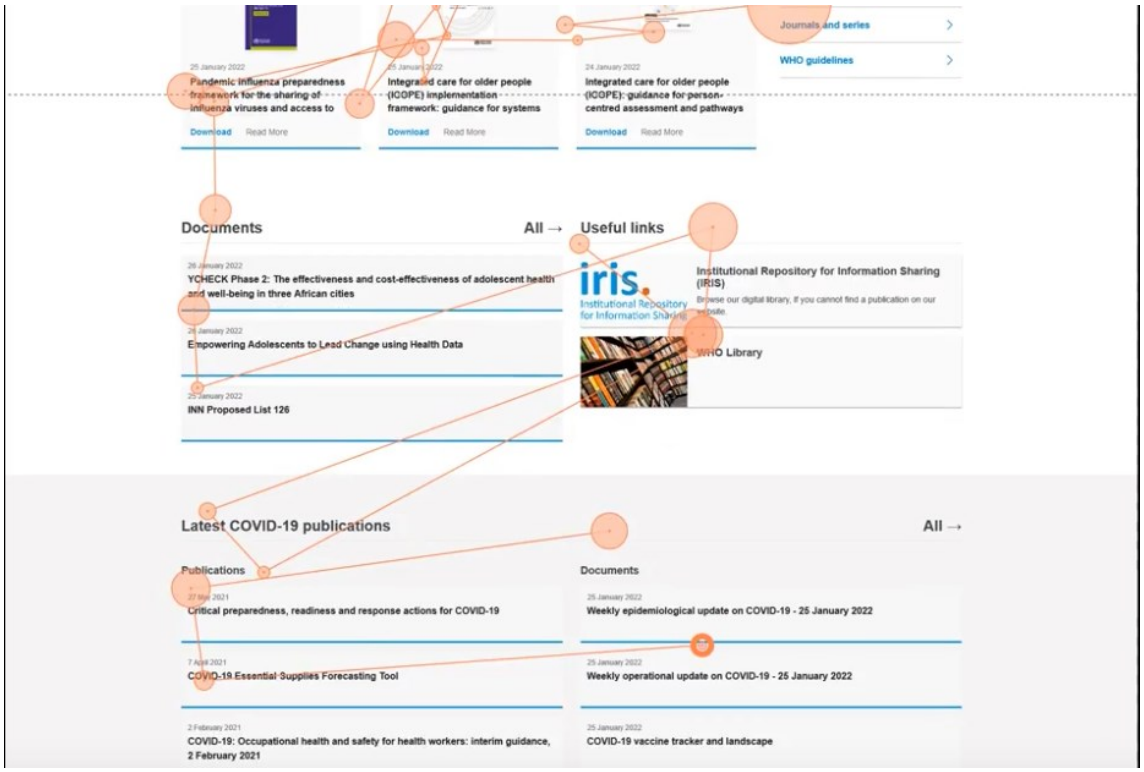

Figure 18. Participant's gaze locates on the different boldfaced typeface elements on WHO's website. [P1]

(8) Interesting pages with factual content. Information easy to find. [P4]

In examples 3 and 8 the participants also point out the amount of data on WHO's website, but their comments were left with a more positive note compared to example 7. In example 3, the participant states that they could have browsed the website for even longer. In example 8 the participant points out they thought the website's contents to be interesting. Even though it took these participants longer to complete the tasks on WHO's website, it is possible that they did not experience information overload. From the comments the two participants made, it seems to me that they simply found the contents of the website so interesting they would have wanted to spend more time browsing the websites, and that is why they were not able to complete the task as quickly as on THL's website. However, one of the Eppler and Mengis' (2004, p. 333) listed symptoms of information overload is that the identification and selection of relevant information becomes increasingly difficult. Considering this symptom, it could be so that the participants in examples 3 and 8 did get overloaded by the information after all. Yet, they found the information so interesting they did not realize they were focusing on information irrelevant to the task at hand. From the two participants' usability test recordings, it can be seen that both of them considered the navigation bars and control elements on WHO's website, but also the highlighted elements on the website's front page.

Another symptom of information overload can be found in figure 14, in which the participant's gaze is moving back and forth between the highlighted information on WHO's website. From the way the participant's gaze moved between the objects, it seems as if they had difficulties in deciding which information to focus on. This would indicate that the participant was experiencing information overload which lowered their decision-making capability. Similar symptoms of information overload were not detected from THL's website. While navigating THL's website, all the users were more or less systematically moving between the different visual elements on the website. Any of the video recordings did not show an inability to make a decision on where to click. However, on THL's website one of the participants, P5, had to return to the front page of the website a total of five times during their navigation on the website. This affected the amount of time the participant needed to complete the task, and it took the participant over six

minutes to complete the task on THL's website (see table 6). From the participant's video recording, I would also state that their ability to recognize the relationship between the different links' titles and the big picture became less clear, which is another symptom of information overload. The participant tried to find the task's information from several web pages which were completely irrelevant to the task at hand, and which no other participant visited during the test. The participant also experienced negative satisfaction while using THL's website, which was identified from their evaluation of the UEQ's items.

Table 7. Symptoms of information overload identified from the research data.

1. The need for more time to complete the given task	2. Loss of control over information on the website
3. Focuses on information irrelevant to the task at hand	4. Lowered decision-making capability
5. Inability to recognize relationship between information such as title and content	6. Satisfaction negatively affected

The symptoms identified in the participants regarding information overload during the usability tests are shown in table 7. All of the symptoms indicating information overload were recognized from or somehow identified from the users' interaction with the visual elements on the websites which contained textual elements. The most common elements identified to have caused information overload on the participants were found to be related to the navigational elements of the websites, such as the navigation bar and, e.g., different links. This would suggest that there are some problems with the control elements and their affordances. The control elements clearly stood out from the other information on the websites in terms of visualization, as visual usability tools such as underlining and on THL's website the addition or changing of color while hovering over links were used to suggest that the links and buttons are clickable. On WHO's website the different links were further clarified in the section element of the website by adding a blue line in between the different clickable elements (see figure 18). As seen on e.g., figure 13, THL's website didn't include a similar object under clickable elements on their website, and the absence of this separational element perhaps added to the users' information overload while navigating the website.

5 Summary and conclusions

In this chapter, I give a summary of this thesis, including the stages of the study and how each stage was conducted. I also summarize the findings of the research. I consider how I felt while working on this thesis, and reflect on what I did, what worked and what could have been done differently. Even though there was quite a lot of material to be analyzed, only a total of 10 people participated in my thesis, so the sample was limited. Therefore, the results of this study cannot be generalized without a larger study involving more participants.

The point of this thesis was to analyze two organizations' websites from the visual usability point of view, and to identify which visual usability components helped in preventing the feeling of information overload in the usability test participants possibly experienced whilst using the websites. The two websites chosen for this thesis were THL and WHO's websites. As the thesis' title "Website visuality and usability: How visual design can help prevent information overload on data-heavy websites" suggests, it was decided to choose websites with high amounts of data in order to analyze the effects visual usability would have on the possible information overload. It was also decided that the two websites should belong to organizations with relatively similar field, and thus THL and WHO's websites were chosen for this research.

Research question 1: What visual elements are used on the websites of this study?

The research data for the analysis was gathered using three methods. The first method was the expert analysis, during which I identified the visual structural and content elements from both THL and WHO's websites. By identifying these elements, I also answered the first research question. The identification of the visual elements was done by comparing the websites' contents to the structural elements of the websites presented on W3Schools website (2023a; 2023b) and the content elements were identified utilizing Schlatter and Levinsons' (2013) tools for visual usability to categorize elements and to find what their role was on the website.

The other two methods used in gathering the research data were usability testing and collecting participants' answers to a questionnaire. The usability tests were conducted in individual sessions in the University of Vaasa's Interaction Design Environment. During the tests, the participants were asked to navigate the THL and WHO websites trying to find a prespecified web page on both websites. All the participants were able to complete their tasks. Immediately after the usability tests, the participants answered to a questionnaire which gathered their background information, as well as had them answer to user experience questionnaire about both websites.

Research question 2: How do these elements support the (visual) usability of the websites of this study?

The usability tests were recorded using the SMI iView REDn Scientific 30Hz eye-tracker. During the tests, the participants navigated on THL and WHO's websites on a desktop computer using the Mozilla Firefox web browser. The test recordings show how the users navigated the websites, and how their gaze moved across the websites while using them. By comparing the usability test recordings and the visual elements of THL and WHO's websites identified in answering the first research question, I was able to identify how the visual elements of both THL and WHO's websites supported the visual usability of the websites. I found that the visual elements of both websites did indeed direct the users' gaze on the website, and the visual look of the elements did have an effect on how the users used the websites. The test results indicate that all the users considered the visual look of different elements on the websites, and that the elements' visual look impacted the users' interaction with these elements.

Research question 3: How do the visual elements of the websites impact the possible information overload on the websites of this study?

The analysis revealed that the participants of the study experienced at least six different symptoms of information overload (see table 7). Based on the usability test recordings and the participants' questionnaire answers I found that even though the elements such as controls and their affordances positively influence the websites' visual usability, they were also the main visual element causing the participants to experience information overload. The amount of different controls and affordances in e.g., the navigation bars of both websites might have contributed to the information overload and therefore having less of them could be beneficial for both organizations (Eppler & Mengis, 2004, p. 332). Other elements adding to the feeling of information overload were related to the textual content of these controls. Especially the typography of these elements was identified as a factor which added to the participants' experience of information overload. As Schlatter and Levinson (2013) put it, the typographic choices should remain consistent throughout a website, and if used e.g., as titles, there should be a significant difference in the sizes of different typographic contents to indicate a difference in hierarchy (pp. 166-169). Also, the utilization of colors should remain consistent throughout the website if used to indicate e.g., the presence of a possible link in a control function (Schlatter & Levinson, 2013, p. 166). These two aspects have room for development on both websites.

Before the study, my general assumption was that in the modern world, people are so used to experiencing symptoms of information overload that they might not recognize it themselves. The assumption is based on the fact that people today are bombarded with information from many directions all the time, and the availability of all the information e.g., via internet causes us to experience information overload even on a daily basis (see e.g., Eppler & Mengis, 2004; Savolainen, 2007). This assumption was found to be true in the participants of this study as well, as the majority of the participants showed at least some symptoms of information overload even though only one of them had answered to have experienced the feeling during the usability tests. I also found, that even though some users showed symptoms of information overload, it did not affect their user experience on either of the two websites. All of the test participants found

THL's website to be more difficult to use than WHO's website, and the usability test recordings suggested the same.

One limitation of the study is that in the research my focus was only on the visual elements of the websites and how they affected the participants of the study. Future research would benefit from studying both the visual elements of the websites and the contents of the text elements in them. For example, in this study the results show that the participants struggled the most with different control elements present on the websites. Even though these elements were clearly differentiated from the body text elements on the websites using visual usability tools, the users still had trouble with them. It would be interesting to study how the contents of the text affect the visual usability, by e.g., comparing usability study results to the results of formal concept analysis.

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Appendices

Appendix 1. Kyselylomake ja käyttäjäkokemuskysely (UEQ, 2018).

Osio 1. Perustiedot

1. Sukupuoli
    - Mies
    - Nainen
    - En halua kertoa
    - Muu…

2. Ikä
    - 18-25 vuotta
    - 26-30 vuotta
    - 31 vuotta tai enemmän
    - En halua kertoa

3. Koulutustausta (yliopisto, ammattikorkeakoulu, tms.)
    - Opiskelija
    - Valmistunut, alempi korkeakoulututkinto
    - Valmistunut, ylempi korkeakoulututkinto
    - Muu…

4. Olivatko käytettävyystestin verkkosivut sinulle ennestään tuttuja?
    - Kyllä, molemmat
    - Kyllä, vain THL
    - Kyllä, vain WHO
    - Ei kumpikaan

5. Jos verkkosivu tai verkkosivut olivat sinulle ennestään tuttuja, kerro lyhyesti missä tarkoituksessa ja miten usein olet niitä käyttänyt.

6. Oletko osallistunut aiemmin käytettävyys- ja / tai käyttäjäkokemustutkimukseen?
    - Kyllä
    - Ei

7. Jos olet osallistunut aiemmin käytettävyys- ja / tai käyttäjäkokemustutkimukseen, kerro lyhyesti millaiseen tutkimukseen osallistuit ja milloin.

Osio 2. Käyttäjäkokemuskysely THL:n verkkosivuista

1. Miten kuvailisit THL:n verkkosivuja?

Ärsyttävä	1	2	3	4	5	6	7	Nautittava
Vaikeasti ymmärrettävä	1	2	3	4	5	6	7	Helposti ymmärrettävä
Luova	1	2	3	4	5	6	7	Tylsä
Helposti opittava	1	2	3	4	5	6	7	Vaikeasti opittava
Arvokas	1	2	3	4	5	6	7	Vähäarvoinen
Pitkäveteinen	1	2	3	4	5	6	7	Jännittävä
Yksitoikkoinen	1	2	3	4	5	6	7	Kiinnostava
Arvaamaton	1	2	3	4	5	6	7	Ennakoitava
Nopea	1	2	3	4	5	6	7	Hidas
Kekseliäs	1	2	3	4	5	6	7	Perinteinen
Vaikeuttava	1	2	3	4	5	6	7	Kannustava
Hyvä	1	2	3	4	5	6	7	Huono
Monimutkainen	1	2	3	4	5	6	7	Helppo
Vastenmielinen	1	2	3	4	5	6	7	Houkutteleva
Tavanomainen	1	2	3	4	5	6	7	Huippulaatuinen
Epämiellyttävä	1	2	3	4	5	6	7	Miellyttävä
Turvallinen	1	2	3	4	5	6	7	Epäturvallinen
Motivoiva	1	2	3	4	5	6	7	Epäinnostava
Odotuksiani vastaava	1	2	3	4	5	6	7	Ei vastaa odotuksiani
Tehoton	1	2	3	4	5	6	7	Tehokas
Selkeä	1	2	3	4	5	6	7	Sekava
Epäkäytännöllinen	1	2	3	4	5	6	7	Käytännöllinen
Järjestelmällinen	1	2	3	4	5	6	7	Epäjärjestelmällinen
Viehättävä	1	2	3	4	5	6	7	Epäviehättävä
Käyttökelpoinen	1	2	3	4	5	6	7	Käyttökelvoton
Konservatiivinen	1	2	3	4	5	6	7	Innovatiivinen

2. Millaisia muita tuntemuksia THL:n verkkosivut mahdollisesti herättivät sinussa? Miltä testitilanne tuntui? Sana on vapaa.

3. Information overload (suom. informaatioähky) on tila, jossa ihminen on kykenemätön käsittelemään vastaanottamaansa tietoa ja suodattamaan tarvitsemaansa tietoa informaatiovirrasta. Informaatioähky voi aiheuttaa monia negatiivisia tuntemuksia, kuten ahdistuneisuutta ja turhautumista. Se voi vaikuttaa myös yksilön suorituskykyyn ja tulla ilmi esim. hidastuneena työtahtina.

Jälkikäteen ajateltuna, koitko informaatioähkyä käyttäessäsi THL:n verkkosivuja? Voit myös kuvailla tuntemuksiasi omin sanoin.

Osio 3. Käyttäjäkokemuskysely WHO:n verkkosivuista

1. Miten kuvailisit WHO:n verkkosivuja?

Ärsyttävä	1	2	3	4	5	6	7	Nautittava
Vaikeasti ymmärrettävä	1	2	3	4	5	6	7	Helposti ymmärrettävä
Luova	1	2	3	4	5	6	7	Tylsä
Helposti opittava	1	2	3	4	5	6	7	Vaikeasti opittava
Arvokas	1	2	3	4	5	6	7	Vähäarvoinen
Pitkäveteinen	1	2	3	4	5	6	7	Jännittävä
Yksitoikkoinen	1	2	3	4	5	6	7	Kiinnostava
Arvaamaton	1	2	3	4	5	6	7	Ennakoitava
Nopea	1	2	3	4	5	6	7	Hidas
Kekseliäs	1	2	3	4	5	6	7	Perinteinen
Vaikeuttava	1	2	3	4	5	6	7	Kannustava
Hyvä	1	2	3	4	5	6	7	Huono
Monimutkainen	1	2	3	4	5	6	7	Helppo
Vastenmielinen	1	2	3	4	5	6	7	Houkutteleva
Tavanomainen	1	2	3	4	5	6	7	Huippulaatuinen
Epämiellyttävä	1	2	3	4	5	6	7	Miellyttävä
Turvallinen	1	2	3	4	5	6	7	Epäturvallinen
Motivoiva	1	2	3	4	5	6	7	Epäinnostava
Odotuksiani vastaava	1	2	3	4	5	6	7	Ei vastaa odotuksiani
Tehoton	1	2	3	4	5	6	7	Tehokas
Selkeä	1	2	3	4	5	6	7	Sekava
Epäkäytännöllinen	1	2	3	4	5	6	7	Käytännöllinen
Järjestelmällinen	1	2	3	4	5	6	7	Epäjärjestelmällinen
Viehättävä	1	2	3	4	5	6	7	Epäviehättävä
Käyttökelpoinen	1	2	3	4	5	6	7	Käyttökelvoton
Konservatiivinen	1	2	3	4	5	6	7	Innovatiivinen

2. Millaisia muita tuntemuksia WHO:n verkkosivut mahdollisesti herättivät sinussa? Miltä testitilanne tuntui? Sana on vapaa.

3. Information overload (suom. informaatioähky) on tila, jossa ihminen on kykenemätön käsittelemään vastaanottamaansa tietoa ja suodattamaan tarvitsemaansa tietoa informaatiovirrasta. Informaatioähky voi aiheuttaa monia

negatiivisia tuntemuksia, kuten ahdistuneisuutta ja turhautumista. Se voi vaikuttaa myös yksilön suorituskykyyn ja tulla ilmi esim. hidastuneena työtahtina. Jälkikäteen ajateltuna, koitko informaatioähkyä käyttäessäsi WHO:n verkkosivuja? Voit myös kuvailla tuntemuksiasi omin sanoin.

Appendix 2. English translation of the background questionnaire and the English version of the User Experience Questionnaire (UEQ, 2018).

Section 1. Background information

1. Gender
    - Male
    - Female
    - I don't want to tell
    - Other…

2. Age
3. 18-25 years
4. 26-30 years
5. 31 years or more
6. I don't want to tell

7. Educational background (university, university of applied sciences, etc.)
8. Student
9. Graduated, lower university degree
10. Graduated, higher university degree
11. Other…

12. Were you already familiar with the websites of the usability study?
13. Yes, both
14. Yes, only THL
15. Yes, only WHO
16. Neither

17. If the website or websites were already familiar to you before the usability test, briefly state for what purpose and how often have you used them.

18. Have you previously participated in usability and/or user experience study?
19. Yes
20. No

21. If you have previously participated in a usability and/or user experience study, briefly state what kind of study you participated in and when.

Section 2. User experience questionnaire about THL's website

1. How would you describe THL's website?

Annoying	1	2	3	4	5	6	7	Enjoyable
Not understandable	1	2	3	4	5	6	7	Understandable
Creative	1	2	3	4	5	6	7	Dull
Easy to learn	1	2	3	4	5	6	7	Difficult to learn
Valuable	1	2	3	4	5	6	7	Inferior
Boring	1	2	3	4	5	6	7	Exciting
Not interesting	1	2	3	4	5	6	7	Interesting
Unpredictable	1	2	3	4	5	6	7	Predictable
Fast	1	2	3	4	5	6	7	Slow
Inventive	1	2	3	4	5	6	7	Conventional
Obstructive	1	2	3	4	5	6	7	Supportive
Good	1	2	3	4	5	6	7	Bad
Complicated	1	2	3	4	5	6	7	Easy
Unlikeable	1	2	3	4	5	6	7	Pleasing
Usual	1	2	3	4	5	6	7	Leading edge (technology)
Unpleasant	1	2	3	4	5	6	7	Pleasant
Secure	1	2	3	4	5	6	7	Not secure
Motivating	1	2	3	4	5	6	7	Demotivating
Meets expectations	1	2	3	4	5	6	7	Doesn't meet expectations
Inefficient	1	2	3	4	5	6	7	Efficient
Clear	1	2	3	4	5	6	7	Confusing
Impractical	1	2	3	4	5	6	7	Practical
Organized	1	2	3	4	5	6	7	Cluttered
Attractive	1	2	3	4	5	6	7	Unattractive
Friendly	1	2	3	4	5	6	7	Unfriendly
Conservative	1	2	3	4	5	6	7	Innovative

2. What other feelings did you experience whilst using THL's website? How did the test situation make you feel like? Please share your experience.

3. Information overload is a condition during which a person is unable to process and filter the information he or she receives from the information flow. Information overload can cause many negative feelings, such as anxiety and frustration. It can also affect an individual's performance which could appear as a slower work pace. Thinking backwards, did you in your opinion experience information overload while using THL's website? You can also describe your feelings in your own words.

Section 3. User experience questionnaire about WHO's website

1. How would you describe WHO's website?

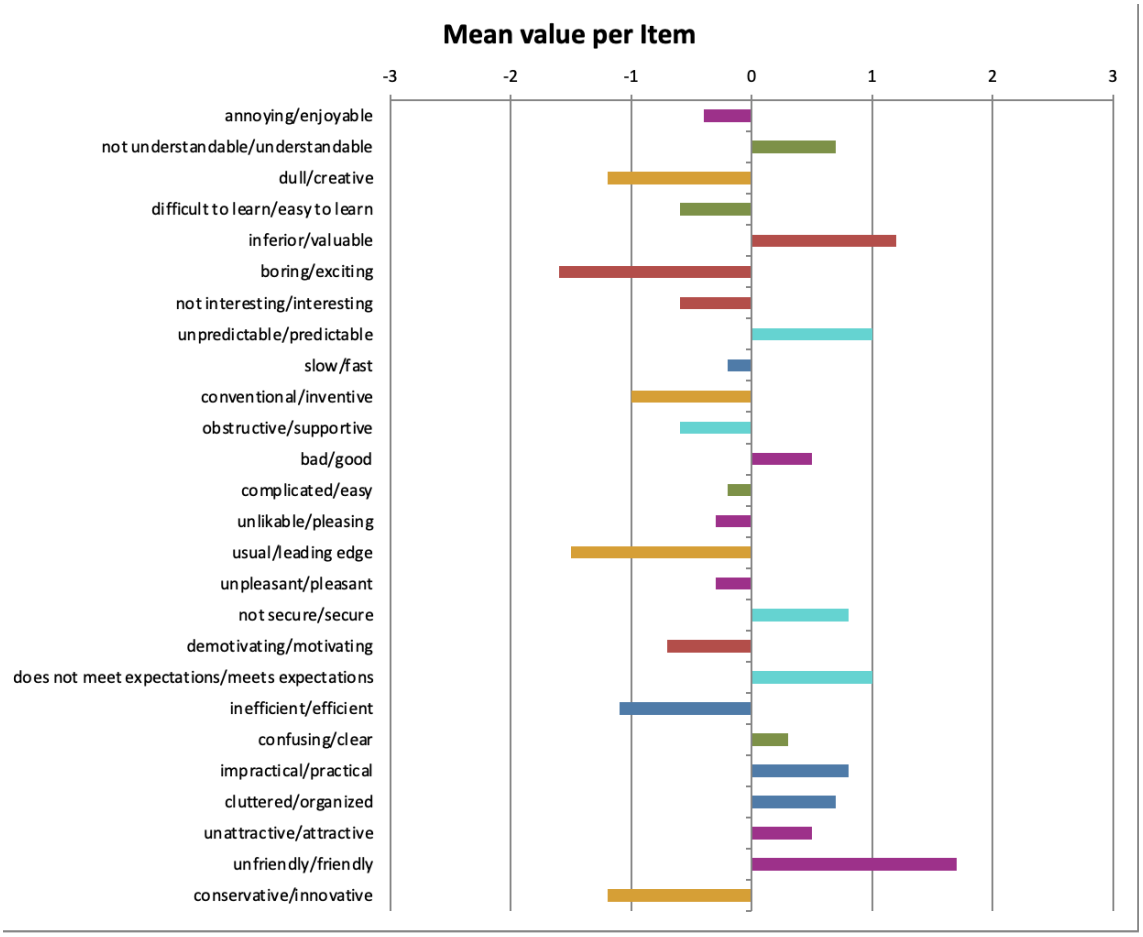
Annoying	1	2	3	4	5	6	7	Enjoyable
Hard to understand	1	2	3	4	5	6	7	Easy to understand
Creative	1	2	3	4	5	6	7	Boring
Easy to learn	1	2	3	4	5	6	7	Difficult to learn
Valuable	1	2	3	4	5	6	7	Of little value
Tedious	1	2	3	4	5	6	7	Exciting
Monotonous	1	2	3	4	5	6	7	Interesting
Unpredictable	1	2	3	4	5	6	7	Predictable
Fast	1	2	3	4	5	6	7	Slow
Inventive	1	2	3	4	5	6	7	Traditional
Difficult	1	2	3	4	5	6	7	Encouraging
Good	1	2	3	4	5	6	7	Bad
Complex	1	2	3	4	5	6	7	Easy
Repulsive	1	2	3	4	5	6	7	Attractive
Ordinary	1	2	3	4	5	6	7	Top quality
Unpleasant	1	2	3	4	5	6	7	Pleasant
Safe	1	2	3	4	5	6	7	Unsafe
Motivating	1	2	3	4	5	6	7	Disinspiring
Meets expectations	1	2	3	4	5	6	7	Doesn't meet expectations
Ineffective	1	2	3	4	5	6	7	Effective
Clear	1	2	3	4	5	6	7	Confusing
Impractical	1	2	3	4	5	6	7	Practical
Systematic	1	2	3	4	5	6	7	Unsystematic
Attractive	1	2	3	4	5	6	7	Unattractive
Usable	1	2	3	4	5	6	7	Unusable
Conservative	1	2	3	4	5	6	7	Innovative

2. What other feelings did you experience whilst using WHO's website? How did the test situation make you feel like? Please share your experience.

3. Information overload is a condition during which a person is unable to process and filter the information he or she receives from the information flow. Information overload can cause many negative feelings, such as anxiety and frustration. It can also affect an individual's performance which could appear as a slower work pace. Thinking backwards, did you in your opinion experience information overload while using WHO's website? You can also describe your feelings in your own words.

Appendix 3. UEQ data about THL's website.

Item	Mean	Variance	Std. Dev.	No.	Left	Right	Scale	
1	-0,4	2,3	1,5	10	annoying	enjoyable	Attractiveness	
2	0,7	2,7	1,6	10	not understandable	understandable	Perspicuity	
3	-1,2	1,3	1,1	10	creative	dull	Novelty	
4	-0,6	2,7	1,6	10	easy to learn	difficult to learn	Perspicuity	
5	1,2	1,7	1,3	10	valuable	inferior	Stimulation	
6	-1,6	2,3	1,5	10	boring	exciting	Stimulation	
7	-0,6	1,8	1,3	10	not interesting	interesting	Stimulation	
8	1,0	2,0	1,4	10	unpredictable	predictable	Dependability	
9	-0,2	2,4	1,5	10	fast	slow	Efficiency	
10	-1,0	4,0	2,0	10	inventive	conventional	Novelty	
11	-0,6	0,7	0,8	10	obstructive	supportive	Dependability	
12	0,5	2,1	1,4	10	good	bad	Attractiveness	
13	-0,2	3,3	1,8	10	complicated	easy	Perspicuity	
14	-0,3	1,8	1,3	10	unlikable	pleasing	Attractiveness	
15	-1,5	2,1	1,4	10	usual	leading edge	Novelty	
16	-0,3	3,1	1,8	10	unpleasant	pleasant	Attractiveness	
17	0,8	2,4	1,5	10	secure	not secure	Dependability	
18	-0,7	0,9	0,9	10	motivating	demotivating	Stimulation	
19	1,0	3,3	1,8	10	meets expectations	does not meet expectations	Dependability	
20	-1,1	1,7	1,3	10	inefficient	efficient	Efficiency	
21	0,3	6,2	2,5	10	clear	confusing	Perspicuity	
22	0,8	2,2	1,5	10	impractical	practical	Efficiency	
23	0,7	2,0	1,4	10	organized	cluttered	Efficiency	
24	0,5	1,6	1,3	10	attractive	unattractive	Attractiveness	
25	1,7	1,1	1,1	10	friendly	unfriendly	Attractiveness	
26	-1,2	1,5	1,2	10	conservative	innovative	Novelty	



Appendix 4. UEQ data about WHO's website.

Item	Mean	Variance	Std. Dev.	No.	Left	Right	Scale
1	0,8	2,0	1,4	10	annoying	enjoyable	Attractiveness
2	0,7	3,6	1,9	10	not understandable	understandable	Perspicuity
3	0,6	2,9	1,7	10	creative	dull	Novelty
4	0,6	3,8	2,0	10	easy to learn	difficult to learn	Perspicuity
5	1,9	1,2	1,1	10	valuable	inferior	Stimulation
6	-0,1	3,2	1,8	10	boring	exciting	Stimulation
7	0,3	3,8	1,9	10	not interesting	interesting	Stimulation
8	1,4	1,6	1,3	10	unpredictable	predictable	Dependability
9	-0,6	4,9	2,2	10	fast	slow	Efficiency
10	-0,3	2,5	1,6	10	inventive	conventional	Novelty
11	0,2	2,2	1,5	10	obstructive	supportive	Dependability
12	0,3	3,8	1,9	10	good	bad	Attractiveness
13	-0,3	4,0	2,0	10	complicated	easy	Perspicuity
14	0,6	1,2	1,1	10	unlikable	pleasing	Attractiveness
15	-0,4	3,8	2,0	10	usual	leading edge	Novelty
16	0,4	2,3	1,5	10	unpleasant	pleasant	Attractiveness
17	0,7	3,6	1,9	10	secure	not secure	Dependability
18	0,0	2,7	1,6	10	motivating	demotivating	Stimulation
19	1,5	3,2	1,8	10	meets expectations	does not meet expectations	Dependability
20	0,5	1,2	1,1	10	inefficient	efficient	Efficiency
21	0,1	1,9	1,4	10	clear	confusing	Perspicuity
22	0,6	0,9	1,0	10	impractical	practical	Efficiency
23	0,0	2,4	1,6	10	organized	cluttered	Efficiency
24	0,3	2,7	1,6	10	attractive	unattractive	Attractiveness
25	1,8	0,6	0,8	10	friendly	unfriendly	Attractiveness
26	-0,4	2,7	1,6	10	conservative	innovative	Novelty