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The Rise of Dark Mode

A qualitative study of an emerging
user interface design trend

MAIN FIELD: *Informatics*

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Abstract

Purpose – As screen time per individual increases, more users of digital devices experience ocular related diseases. The purpose of this study is to gather reasons for the vast popularity Dark Mode gained in contemporary society, by investigating previous design eras. As a general lack of trend analysis within user interface design has been identified, the goal of the study is to lay the foundation for further research in the field of user interface design.

Method – The study relies on a qualitative literature review. Publications related to Dark Mode, light-on-dark color schemes and digital trends were analyzed for topic-specific content that was then elaborated to give a critically viewed framework of the emerging trend.

Findings – The results of our study indicate that various factors led to creation of the hyped trend, known as Dark Mode. It was first and foremost practicality of the light-on-dark color scheme that paved the way for Dark Mode. All operating systems, many apps, platforms and even websites incorporated it in their design. Being an optional feature, Dark Mode makes it more comfortable for users to use their devices outside the light hours or in environments with bad lighting conditions.

With Dark Mode users get a far-reaching personalization tool, that visually changes essentially the whole OS or app. From a psychological point of view this improves user satisfaction, as humans naturally are seeking way to be in control. Being in control of own devices is undoubtedly an important aspect of it.

Besides that, Dark Mode houses potential to lower energy consumption of devices and provides users with longer battery times. This, however, only applies to devices with display technology like OLED, where backlighting is at least divided into zones, that can be turned off when not in use. Devices with conventional LED displays cannot benefit from lower energy consumption.

Implications – The study indicates that individuals use Dark Mode for a more satisfying user experience as they feel e.g. less eye strain with a dark themed user interface. Editing and coding software is mostly designed in a light-on-dark color scheme, as users often work for long continuous hours on screen, surrounded by dark environment. As screen time per individual increases, more users are experiencing ocular diseases. In counteraction, society demanded dark themed interfaces for operating systems, websites, and apps. As individuals were already using unofficial dark themes on different interfaces, tech companies started releasing system updates to make Dark Mode a choice. As Apple released their user interface update just in 2019, Dark Mode is still a relevant trend discussed in the industry and society. Experts indicate that Dark Mode is here to stay, as it satisfies preferences of many users and makes current OLED screens and future digital devices with appropriate display technology more sustainable.

Limitations – The time frame of the study, as well as the Covid-19 pandemic greatly limited the possibilities of conducting the study. Due to the novelty of the trend, there is lack of previous research, which limited the view on the subject to only work available.

Keywords – Dark Mode, dark-on-light color scheme, retro trends, user interface design, user experience, digital trends, display, screen, screen time, eye strain

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1 Introduction

The chapter provides a background for the study and the problem area the study is built upon. Further, the purpose and the research questions are presented. The scope and delimitations of the study are also described. Lastly, the disposition of the thesis is outlined.

1.1 Background

In 2019 about 92 popular apps (Azimov, 2020) started to offer their services in Dark Mode as a response to the update of Apples and Androids interface design. Digital devices in Dark Mode reverse the traditional black text on white background as in the beginnings of monitor technology. Brage (2019) argues “that [a] large number of experimental and retro trends” are currently emerging. Focusing her work rather on Web Design, researching Brutalism, she mentions that trends are “unlikely to directly affect mainstream web design in its current state.” This explicit wording is what picked up our interest. In the further research section, she proposes to research other trends in web design that are currently emerging and have their roots in earlier eras of web design. Being part of the general digital design field, web design is closely related to User Interface (UI) Design and User Experience (UX) and instead of limiting ourselves to web, we decided to look at trends that are currently happening on digital devices in general. Browsing the world wide web is an important aspect of everyday use of digital devices, the devices themselves are worth to investigate. One of the newer trends that got high media attention is the so-called Dark Mode. Companies are arguing that the introduction of the latter results in higher user satisfaction and better user experience. Digital Design and User Interface Design are both very new design fields. With the development of machines, or computers, with screen-based interfaces, they became an important tool for Human-Computer Interaction. One of the challenges in Human-Computer Interaction (HCI) today is to provide the best possible user experience, by creating digital design that is usable and aesthetic (Bonnardel, Piolat, Le Bigot, 2010). After years of comprehensive investigation in usability, researcher take now more emphasis on the emotion of a user interacting with a digital product (Overbeeke et al, 2000), since studies have shown that decision making, whether we like a product or not, is not based alone on usability, but on the whole user experience. The usability can be perceived objectively, whereas the user experience is context-dependent and subjective (Zarour, Alharbi, 2017).

1.2 Problem statement

Some of the earliest home computers used cathode ray tube (CRT) based monitors, that displayed light-colored text on a dark background. That changed during the 80s when Xerox and other companies designed more powerful computers and developed CRT monitors that were able to display information on white background to simulate their real-world counterpart ink on paper. In 2019 Apple revealed one of the most anticipated changes in iOS, the option to change the operating system into Dark Mode, a style that already occurred in the beginning of computer history. We still lack in understanding how these trends in interface design arise, but according to Chen, Crandall and Su (2017) advances in monitor technologies and changes in marketing strategies of companies may be a reason.

Design trends in user interfaces are a merely new scientific field, since monitors that allow a vary of design choices are not around for since many decades. For that reason, digital design periods and trends are not categorized as movements are in art history. Dark themes are already common in video and photo editing software user interfaces but in operating systems it is a

fairly new trend, which's lifecycle is unknown yet. Chen, Crandall and Su (2017) suggest reflecting over past design styles as they reveal the process society is going through gives explanation why current trends are emerging.

Six hours and 43 minutes is the amount of time an American spends on average looking at screens per day, according to a study with 2000 participants conducted by CooperVision (2018) in 2018. Visual fatigue (VF) and digital eye strain (DES) are directly linked to our overuse of digital screens in daily life, according to a study by Sheppard and Wolffsohn (2018). A solution to this condition can be found by giving the user the option to switch devices into Dark Mode, but human-computer interaction professors like Anna Cox argue whether this is the perfect answer. Hence, finding out the reason behind the rise of Dark Mode deems valuable, since definite answers, whether it is a retro trend or is reducing eye strain, cannot be found yet.

1.3 Purpose and research questions

Drawing on the problem statement, there is a research gap in the field of contemporary digital design trends. As shown in the study by CooperVision (2018), the screen time of an average American increased drastically over the years. The study indicates that digital devices are used more often in dark environments. Display usage in dark environments or environments with imperfect interior lighting led to an increase in ocular related diseases. Previous research of light-on-dark color schemes in user interfaces has shown that there are advantages related to eye strain when specific conditions are met (Austin et al., 2020). Dark Mode is essentially that color scheme, but furthermore it developed as a very active trend in recent years. There is a need for clarification and characterization of the current development, that brings several scientific fields together.

Brage (2019) describes the necessity to analyze emerging digital design trends, as further studies could help categorizing them into design periods. She also states that investigation into earlier eras of interface design could indicate why current trends are emerging.

Dark Mode is a new emerging design trend whose utilization can be observed in digital interface design as well as in web design. The reasons of its rise however are not totally clear yet. The underlying principle of Dark Mode is the usage of a light-on-dark color scheme when displaying information on screens. Light-on-dark color scheme itself is not a novel development in the digital world. The usage of dark background for computer user interfaces was common in the 70s and 80s, however it must be noted that it was not a voluntary design choice, but rather a necessity due to the lack of advanced technology. When the technology arrived allowing the mimicking of paper on screen, the CRT monitors with black background were viewed as inferior and thus obsolete. Furthermore, previous research conducted in connection with color schemes showed that bright on dark color schemes are generally inferior to their counterparts based on medical data and usability in everyday life. While facts and scientific findings are important, history has shown that trends are often based on subjectivity and personal value, as well as herd mentality. This makes it harder to analyze and assess the future behavior of trends. Trends, as well as trendsetters are very important in the field of design as they define future mainstream. It is crucial for designers to understand trends and their patterns to be able to adapt to changes in the design perception of the public and provide appealing and state-of-the-art design solutions. One of the current frequently selected design choices is the implementation of the Dark Mode in many applications, websites, web-based applications as well as whole operating systems that target not only mobile devices but also the desktop and portable devices segments.

Consequently, the purpose of this study is to define Dark Mode as a newly emerged design trend commonly found in the field of User Interface Design. The study aims to reveal and analyze the reasons why Dark Mode became a mainstream trend, and how it may develop in the future.

To be able to fulfil the purpose, it has been broken down into three questions.

First, it is crucial to elaborate what a trend is. Furthermore, we will describe the phenomenon in user interface design known as the Dark Mode and explain the reasons for why it is considered a trend. Looking at it closely and evaluate the reasons for its existence and explain its current state as a trend will make it possible to view it in the broader perspective of past and current trends for digital devices and media. Due to its nature, as it is not a design movement or a specific design style there are possible differences to other trends in the field of digital design. It might be not as consistent as other design trends.

Hence, the study's first research question is:

- [1] What are possible reasons, based on the scientific and social aspects, for the emerging popularity of the Dark Mode trend in User Interface Design?

During preliminary research and comparison to other digital trends we found that often modern trends are at least loosely based on historical design. One of the greater examples currently is the emergence of the brutalist style in web design. We found also that what is today described by the term Dark Mode, was already used in earlier interface designs, however due to different reasons. This led us to believe that Dark Mode is possibly a so-called retro trend and we want to find out if and how much it was influenced by earlier interface designs.

Hence, the second research question is:

- [2] What are differences and similarities between Dark Mode and the User Interfaces with dark color schemes in the 80s?

Due to their nature, trends are prone to fast changes and quick disappearances as trends. Many trends are changing and adapting over time or are superseded by other more state-of-the-art trends. An example for this is skeuomorphism as it existed for as long as it was needed to help users to adapt quicker to digital user interfaces in the 90s and 00s. For designers to be able to take advantage of trends to full extent it is crucial to understand and predict the possible future of the trend for faster adaptation of the designs. This is especially important for the Dark Mode as it is "controlled" by the operating systems as the main UIs of devices that introduce trends but also have the power to quickly "kill" them off by removing them from their operating systems. Designers of applications and other content for those operating systems must be prepared for changes and are required to adapt fast to changes.

Hence, the third research question is:

- [3] What is the possible future of Dark Mode based on observation of similar trends and the behavior of the industry?

To answer the questions and thereby fulfilling the purpose, qualitative research will be conducted in form of a literature review of topic relevant materials. On one hand materials from designers working in the field of digital design and professionals from the field of HCI- Human Computer Interaction. We are expecting to be able to answer the three research questions and support our own findings with the data collected from the literature review.

1.4 The scope and delimitations

The focus of this study lies on the definition and categorization of the Dark Mode trend. It includes the definition of the trend itself as well as research for its origins. After collecting the data, we will be able to answer the third research question and give an outlook on the possible future of the Dark Mode.

As Dark Mode we understand the usage of dark color schemes on various occasions, especially in app and software design and the interfaces of modern operating system such as MacOS, Windows, iOS, and Android. The research for reasons of its existence as a trend will be mainly conducted regarding practicality and aesthetics with supportive arguments in the medical, technical and design fields. As the topic is strongly related to the field of Human-Computer Interaction, related publications will be reviewed to get a broader and personal perspective on the Dark Mode trend. Due to the time limitation and lack of appropriate knowledge in the medical area we will only use proven facts and not go into detail. Also, since it is important to review data from industry related sources that work for companies and agencies that can be considered trendsetters of Dark Mode, media articles and opinions were analyzed.

Trends and their perception can be to some extent subjective, which could make the gathered data subjective as well.

Other trends will be not actively researched in this paper, as it is not relevant for the research questions. However, it will be necessary to shortly describe similar trends to be able to predict the development of the Dark Mode trend.

Since Dark Mode is not fully definable due to its broad nature as a phenomenon, we will not be able to cover all design implementations that are broadly referred to as Dark Mode. The focus will be on Dark Mode used in operating systems and the software and app adaptations to these operating systems.

1.5 Disposition

The report is logically structured with appropriate headings and subheadings for each of the chapters.

The following chapter is named Methodology and deals with the work process and describes the chosen research methods in detail. The last section deals with the validity of the used methods.

Chapter 3, titled “Theoretical Framework”, discusses theories that are relevant to the topic and the formulated research questions.

Next chapter is dealing with an objective representation of empirical data, that was collected during the study.

The analysis chapter formulates answers to the research questions formulated in 1.3, the theoretical framework as well as the collected empirical data are used in this part to answer the questions.

Discussion and Conclusion deals with the results of the conducted study. It provides a summary of the findings and discusses the limitations and implications. Based on that follows a conclusion with recommendations and suggestions for further research.

At the very end is the reference list followed by appendices.

2 Methodology

The chapter provides an overview of the work process of the study. Further, the approach and design of the study are described as well as the data collection and data analysis. The chapter ends with a discussion about the validity and reliability of the study.

2.1 Link between research questions and methods

The following chapter describes the chosen methods for data collection and data analysis as well as how they answer the research questions.

The three research questions are closely related, of which the second and third question are continuations of the first. The first research question is about understanding how and why trends are emerging by using the popular Dark Mode trend as current example. The second question gives answers of what a retro trend is and how Dark Mode is connected to this concept. The last question gives indications on how Dark Mode is going to be a key factor in technical innovations. All questions are answered by analyzing already existing literature, that address digital trends and Dark Mode.

2.2 Work process



Figure 1 *The work process of the study*

2.3 Approach

The aim of the current study is to examine Dark Mode as an emerging trend by analyzing its origin, current state, and future. This will be performed by building our research on already existing literature on Dark Mode, light-on-dark color schemes and digital trends. According to Snyder (2019) a literature review addresses research questions with a power that no study can have, since it is based on a collection of critically analyzed publications. Dark Mode is a newly emerging topic in the research community; therefore, the purpose of this study is to set a framework for future studies within the field. Pursuing an integrative literature review makes the study a combination of past publications with different insights and perspectives, which lead to an objective more comprehensive understanding of Dark Mode as a trend (Snyder, 2019) As we lay a groundwork for a new research area and want to provide a better understanding of Dark Mode as a trend, this study matches an exploratory research approach (Dudovskiy, 2011).

2.4 Design

Our study employs a qualitative research method to get an understanding of the underlying reasons how and why digital trends emerge in present times (Silverman, 1997) In order to answer our research questions a literature review was required, for which certain steps had to be followed. After identifying relevant research questions, a search strategy for finding applicable publications was developed. This process included listing search terms, e.g. Dark Mode, dark-on-light color scheme, dark user interface design, with whom we found relevant scientific articles, books, and reports in different online research communities, mainly found through Google Scholar. The literature was not solely oriented on Dark Mode, as there are only a small number of scientific papers published about the topic. Similar research topics like Skeuomorphism as a trend in user interface design were explored in great depth and scientific papers about it became part of the theory, we build our research on. Generally, we aimed to include recent published papers, especially as e.g. trend lifespans and cycles changed due to the influence of social media (Snyder, 2019).

2.5 Data collection

After planning our literature review, we started conducting a pilot test to ensure that we are using relevant search terms and the right set of limitations to find publications that contain the needed knowledge for our study. The search terms that were selected as the most promising, were “Dark Mode trend”, “Effects of Dark Mode”, “OLED energy saving”, “Screen type technology”, “Trend Cycles”, “Retro Trends”, “Light-on-Dark Color Scheme” and “CRT monitors”. As we finished our pilot test successfully, we began conducting our actual literature review. Due to time limitation we were not able to read all relevant literature in their entirety. We read the abstracts, headings, and conclusions and by that we determined whether the publication was relevant for our study and scanned the papers for previously listed keywords to ensure that we read all necessary information. Highly relevant papers were read in their entire length after we selected them judged by their abstract, headings and conclusion.

Austin et al. (2020) was included for their extensive of effects of Dark Mode on human’s eyes and general wellbeing. Although the work focuses more on application of Dark Mode in VR, it clearly poses value for the general topic of Dark Mode.

An-Hsiang et al. (2003) was chosen due to information on different screen types as well as the focus on sustainability and energy saving that come with the introduction of new display technologies.

Wickman (2012) explored how trends reappear in a determined span of time. His study deemed valuable, as we got to understand how retro trends find its popularity in contemporary society. The studies by Xue, Almeida (2011) and Werman (1977) gave us a better understanding for why humans desire nostalgic objects, music, and design. Through the work of Gordon (2017) we got to understand how trends develop to then decrease in desire of society.

The study of Deguang et al. (2016) showed us how OLED screens can be used in a more effective way when interfaces of devices are modified. Since it is connected to the reasoning of success factors of Dark Mode, it helped answering the first research question.

The article written by Weinschenk (2013) was included since it deals with psychological phenomenon “choice” and therefor was reviewed in connection to the decision theory in the theoretical framework part.

Sheppard and Wolffsohn (2018) stated in their study that extensive usage of screens strains the eye and can cause serious ocular disorders.

During this process we also checked the references used in the papers as an additional source of finding relevant publications (Snyder, 2019) As we read the papers we took notes of themes and ideas that we wanted to explore in our study and made evaluations of the main points and conclusions.

2.6 Data analysis

We analyzed the data by taking notes of the most relevant information we found in the publications. We then sorted the gathered data into categories, e.g. Dark Mode origin or Dark Mode popularity reasons, in order to organize our trains of thought and to efficiently being able to answer the research questions. Our aim was to provide a holistic view of the gathered data to provide an overview of the Dark Mode trend. Controversial statements can be found as we wanted to convey an objective view.

Because the collected data comprised of facts from different areas, the goal was to compare it and connect to each other, as the main goal of the study is to create a broad foundation for further studies to build upon. Information was grouped. We tried to use the holistic approach and answer the research questions from different viewpoints. Especially significant segments we collected data from were technology, sociology/psychology and design.

2.7 Validity and reliability

There are factors in conjunction with the chosen topic that have an influence on the validity of the study. Trends in digital design is the main field the study will focus on. While it is rather objective when it comes to advantages and disadvantages of a design choice that is recognized as a trend, the reasons for its introduction and its success can be considered more speculative and can be viewed differently by different experts. Furthermore, an important step of trend research is the prediction of its future behavior, which cannot be fully true, as there are far more factors that influence trend behavior that cannot be considered nor be predicted.

While choosing the integrative approach in literature review, a qualitative research method, provides greater depth to a subject, it generates data that is as valid as the source itself is. While this can be minimized by checking other sources for similar data to validate, it cannot be fully excluded as a validity issue. Especially in the field of design it is hard to trace trends to its origins and research inspiring factors or influential factors that played a role in the creation of a design trend. However, the field of digital monitor-based UI is new. This makes literature review an efficient way to get scientific data, as it clearly shows its development and the trend evolution over the years. Providing data in a balanced way, that encloses different standpoints contributes to its validity.

The integrative approach provides suitable data for critique and synthesis of facts; however, it poses a challenge as it is less systematic and deals with many different sources like books and other publications, each with a different degree of reliability. This has a direct influence on the validation process of the data from each source.

3 Theoretical framework

The chapter presents the theoretical foundation for the study.

3.1 Link between research questions and theory

To give a theoretical foundation for the three research questions stated above, it seemed important to include two theories. From a broad perspective user interface design, which Dark Mode is part of, is the most important aspect of the mainstream Human Computer Interaction. HCI research is the base for the technologies and design to build upon, as they all share the goal that is defined by HCI, namely effective and efficient interaction. The theory of “Thought Styles” in particular is seemingly applicable to the current evolution in UI. Furthermore, all three research questions deal with the nature of the Dark Mode, which is viewed not only from the technical perspective but as a combination with the trend phenomenon. Trends exist in different shapes and can be observed in very different aspects of our lives, however as with many other social actualities it is possible to understand their principles and similarities. One particularity of Dark Mode however is that it did not introduce anything groundbreakingly new in functionality nor did introduce disruptive changes in UI, instead it was established as an option. User could now choose between the light and the dark mode. The Decision Theory describes the social and psychological impact of having a choice, which is relevant for Dark Mode itself, but also relevant for the emergence of trends.

3.2 Decision Theory

The Stanford Encyclopedia of Philosophy states that the Decision Theory “is concerned with the reasoning underlying an agent’s choices, whether this is a mundane choice between taking the bus or getting a taxi, or a more far-reaching choice about whether to pursue a demanding political career. (Note that “agent” here stands for an entity, usually an individual person, that is capable of deliberation and action.)” (Steele, Stefánsson, 2016). The ultimate goal when making a specific choice, is the satisfaction of one’s desire. This leads to the assumption that the more choices a person has the higher is the probability of personal desire satisfaction, which indicates that having a choice at all already greatly improves that probability. Because humans strive to be in control of their life’s, giving them options improves their satisfaction, as having alternatives and the freedom to choose the most appealing ones creates even higher rates of satisfaction than if the same choices would have been not a choice but an obligation (Weinschenk, 2013). Trends themselves are to some extent the product of larger groups of humans making similar choices, but Dark Mode itself was implemented in the way that it created a choice, which based on the theory allowed users to be more in control of their devices and thus possibly increase their level of satisfaction.

3.3 Thought Styles

Thought Styles is a theory proposed by the philosopher Ludwik Fleck. He stated that “cognition is a collective activity, since it is only possible on the basis of a certain body of knowledge acquired from other people” (Fleck, 1979). This means that exchanging ideas and thoughts between different people creates a thought collective, “bonded by a specific mood”, which leads to the development of “thought styles”. These thought styles effectively shape our collective understanding of the world. Wiberg and Stolterman (2019) argue that understanding these “collective efforts” is important to be able to better connect concepts and design thinking in Human-Computer Interaction. In this sense Thought Styles are the connection between philosophy, sociology, and interaction design. Janlert and Stolterman (1997) suggested that interaction design elements could not only be viewed having the understanding of the design’s functionality, but also be described “in terms of the dynamic gestalt or character”, they also proposed that this character itself is “the digital manifestation of a particular ‘thought style’ behind a particular form of an interactive system”. Thought Styles influence user’s perception of user interfaces and how they should be used based on collectives as a whole and not just single users. Thus, the understanding how an interface is and has been changing over decades through changing views, application fields and changing technologies, but these changes are never radical, rather including aspects and characteristics from predecessors. As Fleck noted, “every thought style contains vestiges of the historical, evolutionary development of various elements from another style” (Wiberg, Stolterman, 2019). This makes user interface design and thought styles deeply rooted to each other.

4 Empirical data

The chapter provides an overview of the empirical domain which forms the basis of this study. Further, a description is given of the empirical data that has been collected to answer the research questions.

To try to answer the first research question “What are possible reasons, based on the scientific and social aspects, for the emerging popularity of the Dark Mode trend in User Interface Design?”, data in the following areas is collected: Definition of a trend, Definition of Dark Mode and Scientific Research on Dark Mode. The trend definition is covered because it is crucial to understand and define what a trend is to be able to identify reasons for its development and behavior. As the term Dark Mode is not descriptive enough, it was necessary to clearly define what dark mode is and explain its naming. The scientific research on dark mode is covered because it provides facts and figures from previous studies that will help state reasons for its popularity and also the delimitations of dark mode.

To answer the second research question “What are differences and similarities between Dark Mode and the User Interfaces with dark color schemes in the 80s?”, data in the following areas is collected: Early Computer Monitor Development and the Retro trend definition. The retro trend definition is included to define what a retro trend is and what a recent trend should have to be considered a retro trend. This information is crucial to be able to answer the research question. The early computer monitor development is needed to understand and categorize earlier developments that involved similar design choices as the ones currently known and generalized as Dark Mode. It is also important to understand why these design choices have been used to be able to spot trend correlations, or in this case the trend-retro trend relationship, if there is one.

To answer the third research question “What is the possible future of Dark Mode based on observation of similar trends and the behavior of the industry?”, data in the following areas is collected: Examples of trends, and other parts that are stated above. As this question is more general, it is important to present data from other trends and their development cycles. Due to the rather abstract nature of the research question, all the theoretical information that was collected to answer the first two research questions will be of use.

4.1 Design Trends

4.1.1 Trend Definition

X The Cambridge Dictionary defines trend as a general development or change. Trends usually start as a phenomenon and go through a specific pattern. They dominate the market for a length of time until new trends arise, later they might return as a retro trend. The specifics of retro trends are explained in the following chapter. Analyzing previous trends is a method of forecasting the future direction design will take. Trend forecasting can be also based on how individuals or companies develop. (Kongsholm, Frederiksen, 2018).

Great influence, on how styles shift within user interface design, have experience designers. The designer sits at the core and decides how users will have their best experience with a device (Schwartz, 2017).

4.1.2 Retro Trends

The term retro trend refers to cultural styles from the recent past, that are gaining popularity in the present. According to cognitive theorists (Almeida, Xue, 2011) emotions have substantial influence on how humans behave. People are drawn to objects that evoke positive emotions in them and avoid the ones which they react negatively to. Nostalgia is a mixed but mostly positive toned emotion, “a wistful pleasure, a joy tinged with sadness” (Werman, 1977) for a past time. The complex emotions evoked by nostalgia could be a reason why people are drawn towards retro objects, music or design. Retro trends are popular within the groups who already experienced the trend as well as with groups who experience the style for the first time.

Even though technology is in a constant revolution, attraction in retro technology, fashion, music, and design increased dramatically during the last decade. History always found its way into present styles (Sasso, 2011), society is fascinated with reinterpreting past styles (Dermody, Breathnach, 2010).

4.1.3 Trend Cycles

Trends in pop culture recur in cycling movements, the time frame in which they recur however is discussed by trend forecasters. Gopnik (2012) believes in “the Golden 40-year Rule”. In his opinion current trends are influenced by the styles that were in vogue 40 to 50 years ago. Gopnik explains his stance for example by stating that bands like Arctic Monkeys had gained fame during the 2010s and were obviously influenced by 1960s rock. His examples might be indeed right, however other trends in pop culture that gained popularity during the 2010s were manifestly influenced by different decades. Wilson (2011) states that trends repeat in a cycle of 20 years. The 20-year rule is a popular concept within the fashion industry. Gordon (2017) however argues that the 20-year rule concept is a “useless measure of trends” since social media has the power to promote styles from all around the world for every average person to be inspired from. She also states that trends today do not depend on any specific decade, they are rather inspired by “standalone items”. In her opinion the life cycle of a trend is much shorter than a decade before, due to the speed on how fast trends reach potential customers because on the internet. Ruth Chapple, head of content at Stylus Fashion states that social media has the power to make trends stick longer, while also on the other hand overexpose trends. Anne Lise Kjaer, founder of trend management consultancy Kjaer Global, states that trends that explore a certain lifestyle are prone to last longer than trends with noticeable consumption. Generally, nostalgia trends in pop culture do occur in waves, but there is no scientific methodology in forecasting them and no way to tell how long they will last (Wickman, 2012)

However, there are methods to simplify trend life cycles in order to categorize in which stage the trend is currently in. In a usually bell formed curve the five stages of a trend: introduction, rise in popularity, peak of popularity, decline in popularity, and rejection are described. In the introductory phase the trend enters the market, the products are usually high priced and limited to a few. During the second stage, increase in popularity, the trend gains wider popularity. The trend is usually modified to appeal to a bigger range of customers and is sold in mid to high priced stores. In the third stage the trend can be found in its peaking point. In this stage the trend is accepted in the mainstream culture. Many other manufacturers try to copy the trend from its original and sell it to a cheaper price. In the fourth stage a trend declines in popularity. Society gets tired of the trend, since it has been mass produced and consumed by almost everyone. The products get sold for sale. During the last phase society already turned to a new trend and the previous one seems out fashioned and gets abandoned.

4.2 Dark Mode

4.2.1 Origins

Dark Mode alongside with dark theme and night mode is a popularized term for the light-on-dark color scheme. As defined by the Tech Terms Computer Dictionary, Dark Mode is a software option that is used to make the user interface darker. While the background colors are changed to darker ones, the text color changes from dark to light.

The light-on-dark color scheme does not have a specifically defined color palette, instead it is up to the designers to decide which colors to implement with the goal to have best possible readability and color compatibility. The choices vary from dark gray to solid black or even sometimes, also hues like slate and dark blue are used (Christensson, 2019).

4.2.2 Popularity Reasons

This chapter deals objectively with advantages and disadvantages of the light-on-dark color scheme, aka Dark Mode.

A study from 2003 found that when text was displayed in positive polarity, thus using a dark-on-light color scheme, participants were able to read and comprehend text faster than if it was displayed in negative polarity, using the light-on-dark color scheme. This suggests that dark text on white background is more appropriate for everyday tasks, especially those that involve typing or reading large amounts of text, as it allows humans to process the written content faster (An-Hsiang, Jia-Jen, Cheng-Hsun, 2003).

However, it is scientifically proven that Dark Mode allows to greatly reduce power consumption under certain circumstances. Devices that use mini LED, micro LED, OLED and AMOLED display technology are able to benefit from the Dark Mode, as due to the technologies used, black areas of the screen consume no electricity and darker areas consume less, allowing longer battery times on portable devices like phones, tablets and laptops (Deguang, et al., 2016). The bigger picture of the Dark Mode impact is that it is more sustainable, especially if the number of devices with these monitors will grow further.

Another aspect of Dark Mode usage is eye strain. There have been several studies conducted on the relationship between the two. Erickson et al. (2020) argue that enabling dark mode lessens eye strain, particularly in environments with no or little light. It is worth mentioning that many editors and other software used by developers and coders are designed in Dark Mode or have at least such an option. This is true for Sublime, Atom and Visual Studio amongst others. This leads to the conclusion that coders prefer Dark Mode. Due to the nature of their job they are required to spend many working hours looking at the screen, which could lead to eye strain. When looking at screens in darker environments, Dark Mode not only reduces eye strain significantly, but also feels more natural as it is mimicking the lighting conditions of the environment itself.

4.3 Technical Innovation

4.3.1 CRT Monitors

In early computing machines cathode ray tube (CRT) monitors were used to display interface (Aaron, 2015). CRT is a type of vacuum tube in a monitor that moves across inside the glass screen hitting phosphor dots. Once the phosphor dots are hit by electron guns they glow for a short amount of time. Due to this reason the process repeats until each line on the screen is drawn. The earliest home computers, like Commodore PET, only displayed monochrome CRT. Graphical elements appeared green or amber on dark background due to the very dark colored phosphor (Wheeler, Clark, 1992). With Apple II and Atari 800, both released in the late 70s, computers became capable to display color. During this time TV monitors were connected to the computer to display information in better color quality and resolution. IBM replaced monochrome visuals in 1981 with the introduction of Color Graphics Adapter (CGA), the first color graphics card. CGA displays were able to show 16 colors, that could only be shifted by intensity, with a resolution of 320x200. According to James Alan Farrell (1994) the bad visualization of colors was not caused by bad monitor technology of the 80s, it was due to the high-priced random-access memory (RAM), that had to be used sparingly to reduce cost. CRT monitors that were capable to show 1024x768 pixels were less exclusive and reduced in price during the following decades. They were widely available as computer screens until the beginning of the 2000s but got exceeded by Liquid Crystal Displays (LCD) (Smith, 2017).

4.3.2 Graphical User Interface

A graphical user interface (GUI) allows users to interact with electronic devices, by showing visual objects that users obtain information and can act from. In 1973 Xerox and Texas Instruments released the first computer, called Xerox Alto, that supported an operating system which was able to show a graphical user interface. The computer was mainly intended for research at universities, but a decade later GUI became widely introduced to home computers. Xerox 8010 Star, released in 1981, was the first commercially successful home computer with GUI. With the release of Xerox 8010 Star the concept “What you see is what you get” (WYSIWYG) was introduced, in which users could interact directly with the content on screen without typing in commands. Galitz (2007) states that the best user interface is the one that is not noticeable by the user and permits immersion into the task instead on the commands used to perform it. With the commercialization of GUI, general users of word processing applications had the opportunity to work with a digital layout that was similar to real ink on paper, as it displayed dark colored text on white background (Galitz, 2017).

4.3.3 Screen Types

There are several display technologies that are currently in use. LED, mini-LED, micro-LED, OLED, QLED and AMOLED are the most used in monitors and portable gadgets as of today. These display technologies can be generally divided in two groups. Displays that are using back lighting (light emitting diodes are the common choice) as the light source to illuminate the liquid crystal layer, where the pixels are located, to display an image, and displays that have an active matrix that already emits light on its own and doesn't require a back light layer.

The most common technology, as it is currently the most affordable, that is used in phones, tablets, laptops, and similar portable devices, are LED Displays. These displays have LED backlighting, while the panel itself can be either IPS or TN. While the panel technology is

irrelevant for the research topic, it is worth mentioning that the pixels are not emitting light. Instead, consisting out of RGB elements, each pixel dims the red, green, and blue colours to reproduce the desired colour of the whole pixel. To be able to see these colours, a light source is needed, which in this case is a light emitting diode. These illuminate the whole area behind the panel, while the panel acts as a gate, that controls how much light and of which wavelength will be led through to produce an image. While it is the most affordable technology, there are disadvantages to it. The pixels that are inactive and thus dark, cannot block the backlight to full extent, which means that the blacks produced by displays with this technology are not true blacks. Furthermore, the light emitting diode must be powerful enough to illuminate evenly the whole area of the panel and must stay always on, which leads to inefficient energy consumption. Also due to its nature it is prone to “bleeding”- uneven backlighting, which is especially visible when the screen is dark. While the QLED technology in its current form improves colour accuracy compared to LED Displays by adding a quantum dot layer, it still relies on LED backlighting, making it less energy efficient than other options, as it is the case with normal LED Displays as well (Christensson, 2017).

More recent technologies include OLED and AMOLED but are only found in top tier devices as displays with these technologies are more expensive to manufacture. OLED stands for “Organic Light Emitting Diode”, AMOLED for “Active Matrix Organic Light Emitting Diode” while these technologies have some differences in layer composition, they have the main functional feature in common. The RGB pixel layer consists of organic emitters, making essentially each RGB element in a pixel an independent light source. This brings several advantages. Energy consumption is lowered significantly, as the dark regions consume less energy and black, or turned off regions are not consuming energy at all. Furthermore, the blacks that are produced by these displays are true blacks, as they are not emitting any light, which in turn greatly improves the contrast (Christensson, 2014). It is worth mentioning that Windows Phone 7 was the first OS to introduce a global Dark Mode design, just to improve battery time on devices that were equipped with OLED screens. The operating system was officially released in 2010 (Rubenstein, 2010).

While OLED and AMOLED are expensive technologies, the industry is focusing on creating potentially cheaper technologies but also alternatives with similar or better characteristics. These are the mini and micro LED displays. Mini-LED displays are an economically more sustainable option with similar advantages as OLEDs. Technically these displays do have a backlight layer, which however consists of an array of very small LEDs, that are connected into zones. These zones operate independently and can be dimmed and activated locally when needed. By using this technology, the energy consumption is significantly lowered, as zones where the displayed image is dark are dimmed. This also produces near true blacks. The most recent development are the micro-LED displays, where the diodes are even smaller- on an on-pixel size level and thus are essentially parts of the pixel, that can light and dim each pixel individually. Hereby true blacks are produced, and power efficiency is increased even further. However due to the technology being just developed, it still is expensive and will for now only find its way into more expensive devices (Wu et al, 2018).

5 Analysis

The chapter answers the research questions by processing the collected empirical data and the theoretical framework.

5.1 What are possible reasons, based on the scientific and social aspects, for the emerging popularity of the Dark Mode trend in User Interface Design?

The literature review showed that there are several reasons, that could have potentially helped Dark Mode become a global trend. The light-on-dark color scheme was for decades popular throughout the developer community, with coders preferring the use of dark backgrounds in code editors. As shown in the survey conducted by the user Sarath (2016) on the hashnode platform, 92% of 214 coders preferred the use of a dark theme while coding. When inspecting closer the base operating systems Linux, MacOS and Windows one can find the so-called command line interface, which is using the light-on-dark color scheme by default since it was introduced as the main user interface half a century ago. Due to the recent revival and adaptation of 70s to 90s styles, Dark Mode is experiencing strong interest from the public Wickman (2012).

“One of my clients is a pretty major cyber security company. There [dark mode] is used by people who often work in control centers. Because they are looking at very large monitors, a very white bright interface would basically light up the roof.”

Andy Clarke
founder of the web design studio
Stuff & Nonsense

When it was first introduced on a modern OS- the Windows Phone 7 back in 2010, it did not attract much interest. Mostly due to the lack of popularity of the Windows Phone, its interface, and a niche existence in the phone market not many app developers actually paid attention and the Dark Mode never jumped over to other platforms. However, the reason it was introduced, is today more relevant than ever. The main idea was to save power and extend the battery life of devices with OLED screens, as pointed out by Rubenstein (2010). Back in 2010 this display technology was new on the consumer market, it was expensive and was used in more expensive, high-spec phones only. Due to these circumstances only a very small fraction of phone users experienced the efficiency that came with Dark Mode. Today, when OLED displays became more affordable, and are common even in mid-range devices, developers and companies once again started designing with focus on sustainability, having the same goal in mind- to save more power and extend the battery life.

From the standpoint of usability, Dark Mode is scientifically proven to reduce eye strain. Due to less light being emitted while the user is watching the screen, it takes longer for the eyes to become overtired. Especially in darker surroundings and at night the usage of Dark Mode is far more enjoyable as stated by Erickson et al (2020).

While it is proven that reading white text on a dark background is harder and requires more time than with conventional dark letters on white background, according to the study by An-Hsiang, Jia-Jen, Cheng-Hsun (2003), it is worth mentioning that there is a low amount of text in user interfaces and operating systems that has to be read.

Media plays an important role in creating trends and thought styles, so due to the focus on Windows' and Apple's new OS versions, the introduction of a new function as Dark Mode is

spread very fast. Functionality of new OS versions is always known to create a hype and desire among users to try it out, especially changes that are visible for normal users. But introduction of Dark Mode also created a chain reaction, where developers rushed to implement the new design guidelines of their target operating systems, which again did not allow Dark Mode to be forgotten.

Dark Mode also managed to create an option for users, i.e. decide whether the interface should be in Light Mode (dark-on-light color scheme) or Dark Mode (light-on-dark color scheme). Psychologically users prefer to have choices and be in control of the device they own according to the Decision Theory, as described in 3.2. As this is a serious change, that affects the whole interface, it is also a strong customization feature. Giving users options increases the probability of their desires being more likely fulfilled, which adds to personal satisfaction when using the devices or apps.

In conclusion, all above makes Dark Mode a great new addition to the functionality of a user interface with technical, social, and psychological aspects speaking for it. However, there are clearly two main factors that played a key role in helping the trend become a global phenomenon. From the perspective of the trendsetters and creators, that are often large companies, Dark Mode is a simple, cheap, and future proof feature that allows the increase of battery time without modifying the hardware itself. As described in the display technologies chapter, newer display types that have newer types of light sources like OLED and Mini-/Micro-LEDs consume less energy when dark. From the user's point of view Dark Mode increases comfort in conditions with low lighting. Especially today, in times when people spending large amount of time in front of screens (CooperVision, 2018), Dark Mode is seen as miracle cure for the eyes, that looks good as well at the same time (Erickson et al, 2020). It is safe to say that the usage of newer screen types allowed both consumers as well as manufacturers to benefit greatly from Dark Mode. With displays that are capable to produce true blacks Dark Mode is not only helping with eye strain, but also looks good and extends the battery life without further physical changes to the device.

5.2 What are differences and similarities between Dark Mode and the User Interfaces with dark color schemes in the 70s?

Industry experts agree that the present Dark Mode trend is inspired by dark themed user interfaces of computing machines from the 70s, however the current interfaces designed in Dark Mode are not only displaying white or green on black but can invert the light-colored versions in their entirety. Due to the vast screen development of the past forty years Dark Mode can be now displayed with softer and more soothing color hues and tones compared to CRT monitors. Using Dark Mode is a choice and not a default setting. The option to choose whether to use Light or Dark Mode has an influential effect on the overall satisfaction of the user. Based on the decision theory the choice allows the user to be more in control of their digital devices, which leads to an increased level of satisfaction with the product. As computing machines of the 70s were not able to display a dark-on-white interface, in e.g. word processing applications, the concept of WYSIWYG to make user interfaces more intuitive could not be realized. As we humans use computing machines for decades now, we got more intuitive in the usage of them. Interfaces do not have to imitate reality anymore as we got used to the abstraction.

Dark Mode is inspired by dark themed user interfaces of the 70s, but advanced in style to meet contemporary society's needs. Currently emerging design trends, e.g. Brutalism and Neomorphism, are inspirations of past trends, as for they are called retro trends, as Brage (2019) stated. Dark Mode did not emerge as the only way to design a user interface, but as a need, a demand from society. Before Dark Mode was officially published for Windows Phone in 2010, followed by operating system updates from Apple and Android, Dark Mode was already used in e.g. Adobe Suit and for most coding software. Users of editing and coding software spend long continues hours working in front of screens and as dark interfaces produce less light, they are more pleasant for most users to use, especially in dark environment. Before Wikipedia,

Reddit and other websites and apps released official Dark Mode updates, users of these websites unsatisfied with Light Mode modified into dark themed interfaces themselves.

5.3 What is the possible future of Dark Mode based on observation of similar trends and the behavior of the industry?

As Sheppard and Wolffsohn (2018) stated in their study, the time people are using screens in their daily routines increased during the past decade. As technology underwent a vast evolution, digital devices got more portable and more accessible for all sections of society worldwide. Various studies show that human eyes are not adapted to the number of hours people spend on average per day staring at screens. People experience a variety of ocular symptoms, e.g. eyestrain, tired eyes, and irritation, that are directly linked to the overuse of bright displays, especially in dark environments. Night shift and computer glasses are two examples invented to reduce eye related pain. They however are proved to cause sleeping disorders due to the reduction of blue light. Dark Mode is a newly emerging trend in operating systems, websites, and apps, used for many reasons, but mainly to reduce the brightness of screens in dark environment to cause less eye strain (Erickson et al., 2020). The Dark Mode trend became mainstream and is accessible for users of almost every digital device. There are no implications that people will stop using the option as they chose to use it for more comfort in their daily interaction with digital devices. Dark Mode will become less known as a trend, however the number of users will not decrease, as they chose Dark Mode for their benefit. If Dark Mode continues to grow as a standard option for websites and apps, brands and companies must adapt their overall UI and UX. Dark Mode will be part of making digital devices more sustainable, as true black screens save battery. As screens undergo further development and new types enter the mainstream market of digital devices in all sizes, Dark Mode can have great impact in saving energy and to make the usage of e.g. smartphones, smart-watches, and computers more sustainable.

6 Discussion and conclusion

This chapter summarizes the results of the study. Further, it describes the implications and limitations of the study. It also describes the conclusions and recommendations of the study. Suggestions for further research are given at the end of the chapter.

6.1 Findings

The results of our study indicate that various factors led to creation of the hyped trend, known as Dark Mode. It was first and foremost practicality of the light-on-dark color scheme that paved the way for Dark Mode. All operating systems, many apps, platforms and even websites incorporated it in their design. Being an optional feature, Dark Mode makes it more comfortable for users to use their devices outside the light hours or in environments with low lighting conditions.

With Dark Mode users get a far-reaching personalization tool, that visually changes essentially the whole OS or app. From a psychological point of view this improves user satisfaction, as humans naturally are seeking way to be in control. Being in control of own devices is undoubtedly an important aspect of it.

Besides that, Dark Mode houses potential to lower energy consumption of devices and provides users with longer battery times. This, however, only applies to devices with display technology like OLED, where backlighting is at least divided into zones, that can be turned off when not in use. Devices with conventional LED displays cannot benefit from lower energy consumption.

Additionally, trend value is added due to Dark Mode being a retro trend. Many trends from the last century currently experience a renaissance. Especially users that are interested in early days of personal computing machines find Dark Mode appealing, as it revives the light-on-dark color scheme, that was used to display the command line like user interface of early operating systems. However, it was a technical necessity due to not powerful enough components rather than a design choice. Nevertheless, the light-on-dark scheme has seemingly the appeal of tech savviness, as it is also a preferred choice for coders and other professionals that need to spend large amounts of time in front of monitors.

Since Dark Mode established itself as an option in operating systems and most apps, it is very likely to stay for years to come. The advantage of being just an option is clearly visible. As with many user interface styles, there are users that do not like Dark Mode for reasons like personal taste. But since it is possible to decide which color scheme should be used for the interface, allowing better personalization, more users are accounted for.

Also, giving users the right to be more in control of their devices adds more to the appeal of Dark Mode. While the hype around it will disappear, the practicality and the fact that users spend more and more time in front of screens will not let the Dark Mode disappear from the toolbox of user interface designers. Furthermore, it is expected that more and more devices will be shipped with new display technologies that will further improve battery life of portables, making Dark Mode a powerful tool to conserve battery power.

6.2 Implications

The study indicates that individuals use Dark Mode for a more satisfying user experience as they feel e.g. less eye strain with a dark themed user interface. Editing and coding software is mostly designed in a light-on-dark color scheme, as users often work for long continuous hours on screen, surrounded by dark environment. As screen time per individual increases, more people are experiencing ocular diseases. In counteraction, society demanded dark themed interfaces for operating systems, websites, and apps. As individuals were already using unofficial dark themes on different interfaces, tech companies started releasing system updates to make Dark Mode a choice. As Apple released their user interface update just in 2019, Dark Mode is still a relevant trend discussed in the industry and society. Experts indicate that Dark Mode is here to stay, as it satisfies preferences of many users and makes current OLED screens and future digital devices with appropriate display technology more sustainable.

6.3 Limitations

The scope and the timeframe of the thesis resulted in several limitations.

Due to limited time it was only possible to research aspects of the topic that were rather unambiguous, as research regarding trends often stretches over to subjects that are subjective since trends involve also taste and personal preferences. Instead we tried to cover scientific aspects, but also provide insights into the social aspect of Dark Mode.

Although the third research question is important, it is not possible to correctly predict the future. While facts and reasoning can lead to a correct prediction, there are still too many factors that cannot be accounted for. The influence of other trends and changes in society and other areas are less predictable but have a direct impact on trends like Dark Mode.

While searching for potential candidates for the interviews, we came to the realization that from all professionals in the field of design only some had actual experience in using and understanding Dark Mode.

Furthermore, the unpredictable situation with the current pandemic required high flexibility. While the original research method for the study was to conduct an interview, it turned out to be very difficult due to social distancing and work-from-home operation style of many agencies. Additionally, due to harder conditions on the job market and difficult financial situation for the agencies, many highly skilled professionals did not have the time for participating in interviews. As a result, it was not possible to conduct the interview in a sustainable timeframe. Instead literature review was selected as another appropriate method for answering the research questions. These changes resulted in loss of time and did not allow to research literature in even greater depth.

6.4 Conclusions and recommendations

The study explored the popular Dark Mode design, that developed as a trend into a global phenomenon. Origins of the trend were researched, as well as the reasons for its rapid spread to many devices and apps. Objectively, Dark Mode significantly improves the user experience under certain circumstances, especially in dark environments. It also has potential to save power and extend usage time between charges for devices with batteries.

Many factors suggest that Dark Mode indeed can be classified as a retro trend, having its roots in the early days of personal computing.

However, unlike then, Dark Mode is a personal choice rather than a technical necessity, meaning that users are free to decide whether they want to use it or not. Literature showed that especially users that must spend more time in front of screens are welcoming the implementation of Dark Mode. Although it is proven that Dark Mode makes it harder to read

text, this only matters in word processing applications or applications that contain or deal with running text. Most apps and operating system interfaces are not affected by this disadvantage. All the factors indicate that Dark Mode will stay for the foreseeable future as an option in operating systems and apps. However, this is only true for Dark Mode in digital media. Due to Dark Mode being a trend, it is possible for it to develop in new directions and areas of life that cannot be predicted.

6.5 Further research

The empirical data of this study comes from gathered publications in the field of Dark Mode, dark themed interfaces, and trends. A different perspective on Dark Mode would be provided if we interviewed designers and industry experts on their opinion of the emerging trend. They could have given us great insight into how brands and companies adapt to design trends, as well as the practical use of Dark Mode in e.g. branding of products.

Our research indicates that dark themes will rather stay an option than being a replacement of Light Mode, as Dark Mode has disadvantages in e.g. bright environments. Dark Mode is an option that is here to stay. Companies and brands might have to adjust their entire digital presence to the possibility that users want to see the content in Dark Mode. There is a relevance in testing how users perceive Dark Mode designs and which principles must be followed to make dark themed designs more effective while still conveying the same user experience as in Light Mode.

The decision theory indicates that humans are more satisfied when they get options to choose from. Dark Mode is an option to make the user interface more personalized, future studies can detect where personalization in user interfaces is likely to be beneficial for the overall experience. Furthermore, differences in perception of user interfaces due to gender, age and culture can be studied in greater depth.

Further studies of other newly emerging user interface design trends, e.g. Neomorphism, could help to indicate for which reasons digital design trends arise in contemporary society.

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