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SARA NAZERIHA

ADAM JONSSON
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Sara Nazeriha  
KTH, Royal Institute of Technology, Stockholm  
saranaz@kth.se

ABSTRACT
In a few seconds, after visiting a website for the first time, the users will get an overview of the website. Then, through subjective judgments, for example, on the website’s layout, usability, and color selection, the users will decide whether the website is trustworthy enough to remain on it. Therefore, it is crucial for websites and especially E-commerce websites, to create an excellent first impression in order for the customers to make a purchase. Recently, a new UX trend called Dark Mode has emerged in different web browsers and operating systems. When Dark Mode is implemented on a website, it uses a dark color palette for all screens, views, menus, and controls and uses more vibrancy to make foreground content stand out against darker backgrounds. This study aims to answer whether the customer’s initial trust will increase or decrease when Dark Mode is applied to an E-commerce website. This is achieved by using a model introduced by McKnight et al., that describes how initial trust is formed by categorizing initial trust into disposition of trust, institution-based trust, trusting belief, and trusting intention. The results of this study showed that the majority of the participants rated the graphic design of the light-themed version of the websites higher than the dark-themed version. This resulted in the participants having a lower trusting belief and trusting intention towards most of the dark-themed websites. No significant difference existed between participants that used Dark Mode daily and those who did not. The reason why the dark-themed version got a lower score on the graphic design could be because Dark Mode was implemented by software in this study. This direct implementation risks that the existing images and other design elements not being compatible with the dark-themed version of the websites. As a result, this study suggests that developers should implement Dark Mode from the beginning of the website’s development or redesign other elements on the website, rather than using a plug-in.

Sammanfattning

Keywords
E-commerce; UX design; Trust; Initial trust; Disposition of trust; Institution-based trust; Trusting belief; Trusting intention; Dark Mode; Dark Theme;

1. INTRODUCTION
Recently, a new User Experience (UX) trend called Dark Mode has emerged in different web browsers and operating systems [1, 2, 3, 4]. Dark Mode is a system that uses a darker color palette for all screens, views, menus, and controls and uses more vibrancy to make foreground content stand out against darker backgrounds [5]. This new trend has presumably changed the users’ preference for Dark Mode in the last two years. Also, using Dark Mode on OLED screens draws 40% less power compared when displaying a light-themed user interface [6]. This decrease in power consumption can be useful, especially for mobiles and laptops, to extend battery life. This can be beneficial from a sustainability and usability perspective. However, the preference for Dark Mode may not include all areas, thus making it hard for UX designers to hypothesize a user’s preference for a specific area such as webshops.

“E-commerce” is an abbreviation for “Electronic Commerce” and means that a company or a consumer buys, sells, or exchanges goods, services, or information over the Internet [7]. According to PostNord, Nordic consumers indicated spending SEK 112 billion online in the first six months of 2019. Swedes estimated spending a total of SEK 44.2 billion online, which corresponds with SEK 5,800 per person (Based on consumers’ estimates). In the first six months of 2019, on average, 62% of Nordic residents shopped online per month, which is an increase of two percentage points compared with last year [8]. Therefore, it is of interest to examine how UX design can affect customers’ trust towards E-commerce websites.

In a few seconds, after visiting a website for the first time, users will get an overview of the website. Then, through subjective judgments, for example, on the layout, usability, and color selection of the website, the users will decide whether the website is
trustworthy enough to remain on it or not [9]. Therefore, it is crucial for websites and especially E-commerce sites to create an excellent first impression in order for the customers to make a purchase.

This study aims to focus on B2C (business to customers) and answer whether a customer’s initial trust, the trust between parties when they first meet or interact, towards E-commerce websites will increase or decrease after Dark Mode is applied on a website.

1.1 Definition of concepts
The main concepts used in this study are defined and explained in this part to give the reader a better understanding of the content. Note that some of these definitions which are marked with (*) are stipulated by the authors of this study.

1.1.1 Trust
Trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform on a particular action essential to the trustee [10].

1.1.2 Initial trust
Initial trust is the trust between parties when they first meet or interact [11]. According to McKnight et al., “Initial trust refers to trust in an unfamiliar trustee, a relationship in which the actors do not yet have credible, meaningful information about, or affective bonds with, each other [10].”

1.1.3 UX (User Experience)
“User Experience design is the discipline of creating a useful and usable Web site or application—one that’s easily navigated and meets the needs of both the site owner and its users [12].”

1.1.4 Dark Mode & Dark Theme
Dark Mode is a system that uses a darker color palette for all screens, views, menus, and controls and uses more vibrancy to make foreground content stand out against darker backgrounds [5]. In this study, when Dark Mode is enabled on a website, the theme will be called Dark Theme.

1.1.5 Light Mode & Light Theme
In this study, Light Mode is a system that uses a lighter color palette for all screens, views, menus, and controls and uses more vibrancy to make foreground content stand out against light backgrounds (*). The original theme for all websites in this study was Light Theme.

1.1.6 Dark Mode users & Light Mode users (*)
In this study, a “Dark Mode user” uses Dark Mode on an application, website, or operating system, daily. Vice versa, a “Light Mode user,” does not use any application, website, or operative system while having Dark Mode enabled on them, daily.

1.2 Previous studies
Through our knowledge, no research has directly examined how Dark Mode affects the user’s trust on E-commerce websites. However, the color used in a website and its impact on trust have not yet have credible, meaningful information about, or affective bonds with, each other [10].

In 2015, before popular applications introduced Dark Mode, another study [6] examined how user’s acceptance changed when seven different websites were transformed from having a Light Theme to having a Dark Theme. The results confirmed that attractiveness decreased, on average, 17% and readability decreased, on average, 14%. However, a flaw in the transformation algorithm was pointed out in the study. “Transformed images, in general, were not as clear or readable as their original versions. In future work, we plan to explore improved image processing techniques for transforming image colors [6].” The study discussed that this flaw could be one possible explanation of why participants thought Dark Mode websites looked less attractive compared to the original theme (Light Mode) of the websites.

2. PROBLEM DEFINITION
This study aims to answer the following question:
“Does initial trust towards E-commerce websites increase or decrease when Dark Mode is enabled on the websites?”

Because Dark Mode has risen in popularity in the last two years [1, 2, 3, 4], there are potential groups of people that have used Dark Mode and also groups that have not. Therefore, both groups were recruited for this study to see whether the results differ between the groups.

2.1 Questions and hypothesis
A hypothesis is that similar designs to other known brands may influence what users perceive as a legitimate E-commerce website. As a result, a pattern of a user interface design that follows current design trends, standards, or has a similar design to other known brands, could most likely be the most trusted webshops by the users. It is hypothesized that because Dark Mode has risen in popularity, webshops using it may be perceived as modern by the users, presumably increasing the user’s trust towards the webshop.

2.2 Limitations
This study recruited students from The Royal Institute of Technology as participants. Therefore, the results cannot represent all E-commerce customers. Moreover, how Dark Mode affects trust will only be examined on E-commerce websites that primarily sell clothes.

The trust which is measured in this study is limited to initial trust, the trust between parties when they first meet or interact.

Because Dark Mode had to be implemented on the sites, websites using a Light Theme (Light Mode) as its original theme was chosen for this study.

3. THEORY
The theory used in this study for Dark Mode and trust towards E-commerce websites will be presented in this part.

3.1 Dark Mode
Numerous definitions exist regarding using a Dark Theme on user interfaces. The guidelines of Material Design define it as: “A Dark Theme is a low-light user interface that displays mostly dark surfaces [14].” Dark Mode can be used to indicate a mode that changes the existing theme of an application to a Dark Theme. Apple defines Dark Mode as follow: “In Dark Mode, the system uses a darker color palette for all screens, views, menus, and controls, and it uses more vibrancy to make foreground content stand out against the darker background [5].” Both Apple’s and Material design’s definition includes changing the background and surface to dark colors. However, neither specifies a definition of a dark color and what ratio between light and dark colors needs to exist in order to called it Dark Mode. Material design’s recommendation is to use a hex value of #121212 when implementing a Dark Theme, which is a dark grey color.

Through our experience, most E-commerce websites that sell clothes use a Light Theme. A Light Theme is the opposite of a Dark Theme, using light surfaces on a user interface.

3.2 Trust
The definition of trust used in this study comes from Schoorman et al. [15] that defined trust as “The willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other part.”


3.2.1 Initial trust

According to McKnight et al.’s study, trust can be divided into initial trust and knowledge-based trust. Initial trust is the trust between parties when they first meet or interact, and knowledge-based trust is based on previous experiences with the trustee, such as previous purchases [11]. This study is focusing on initial trust of unknown E-commerce websites. This is because initial trust is more likely to be affected by the website’s visual appearance compared to knowledge-based trust [10].

3.2.2 Formation of initial trust

In order to analyze initial trust, this study is using a model introduced in McKnight et al. [10] study that describes how initial trust is formed. This model is chosen because of two reasons: (1) The model was created and tested in an E-commerce context; (2) It distinguishes different dimensions of trust, which allows for more systematic measurement of trust and more reliable comparison between research. The different dimensions of trust introduced in the model are: (1) Disposition of trust, (2) Institution-based trust, (3) Trusting belief, and (4) Trusting intention.

The study defines disposition of trust as a person’s overall tendency to trust another. It decomposes disposition of trust into two dimensions. The first dimension is to generally believe others to be benevolent, competent, or honest (integrity). The second dimension is trusting stance, which means that, regardless of what one believes about people’s attributes, one assumes better outcomes from dealing with people. In McKnight et al.’s study, a person’s disposition of trust affects the person’s institution-based trust, trusting beliefs, and trusting intentions.

The study defines institution-based trust as a person’s trust in the situation and environment. Like disposition of trust, institution-based trust can be decomposed into two dimensions: structural assurance and situational normality. Structural assurance is to believe that the structure in a given environment would decrease one’s vulnerability, for example, on E-commerce websites. Situational normality is to believe that vendors in an environment are benevolent, competent, and honest (integrity). McKnight et al. also gives a fourth category called general situational-normality that cannot be categorized into benevolent, competent, or integrity. A high structural assurance or high situational normality in a given environment would increase a person’s trusting belief and trusting intention towards others in that environment.

Lastly, trusting belief is to believe that someone is competent, benevolent, and honest. These beliefs affect trusting intention, which is defined as the willingness to depend on someone. A person with a high trusting belief towards other people will most likely also have a high trusting intention towards others.

3.2.3 Initial trust in an E-commerce context

Initial trust towards an E-commerce website occurs when a customer first interacts with the website and has no previous experience with the E-commerce company. The different dimensions of initial trust are essential to study because they all affect the customer’s tendency to engage in trust-related behaviors, that is, behaviors making oneself vulnerable to a vendor. In an E-commerce context, this behavior is mainly making a purchase [16]. When a purchase is made on a website, it obtains sensitive data, making the customer vulnerable because the website can misuse the information or not deliver what was promised [17].

Disposition of trust is defined as one’s tendency to trust other people. This means that disposition of trust does have its most significant impact on initial trust when no previous interaction exists between the E-commerce customer and the E-commerce website [10]. A person that has a high disposition of trust is more likely to trust a newly introduced E-commerce store compared to a person with a low disposition of trust.

In the model, institutional-based trust is based upon the situational-normality belief and structural-assurance belief. In an E-commerce context, situational normality is how people believe that the internet and E-commerce stores, in general, are competent, benevolent, or honest. Structural-assurance affects user’s trust depending on safety nets, guarantee, or laws, protecting the users from being vulnerable. In an E-commerce context, this can include known third party payment and delivery providers, privacy laws, and guarantees [17, 18].

Trusting belief towards E-commerce websites is believing that a specific E-commerce website is benevolent, honest, and competent. Trusting intentions is the willingness to make a purchase or give sensitive data that makes one vulnerable to the website [10].

Two studies found that trusting belief is affected by the quality of the website [10, 19]. In McKnight et al. [10] study, the perceived quality of the website was measured by asking the participants how well it worked technically, how it looked visually, how simple it was to navigate through the website, and lastly, how easily it was to contact the owner of the website. The result indicated that the quality of the website affected the participant’s trusting belief of integrity, competence, and benevolence.

4. METHOD

The method included three distinctive parts. In the first part, trust references were created by measuring the participants’ disposition of trust and institution-based trust. This was to measure the participants’ overall tendency to trust another and the participants’ overall trust towards the web and E-commerce websites. After creating trust references, the participants’ initial trust towards four different E-commerce websites was measured. For each participant, half of the websites were presented in the original version (Light Mode), and the other half were presented after Dark Mode was implemented on the websites. This was in order to measure whether initial trust differs between websites with a dark theme and a light theme.

In the last part, by providing direct questions, the participants were asked whether they prefer the original version (Light Mode) or the Dark Mode version of five different websites. Also, they were asked why they use or do not use Dark Mode on their devices daily.

Eighteen students participated in this study, where five women and thirteen men were included. Their age was between twenty and thirty, and among them, thirteen of eighteen were Dark Mode users. The rest of them were not using Dark Mode on their devices daily, named Light Mode users.

Note that during this study, Sweden was facing the Coronavirus pandemic. Therefore, students studying at The Royal Institute of Technology were not allowed to use the university’s facilities. Therefore, we had to come up with online solutions to be able to accomplish this study.

4.1 Prerequisites

The participants had to put about an hour of their time to submit three surveys through this study, choosing a time between 9:00 and 16:00.

“Google Hangouts” was used in order to communicate with the participants. The participants were required to install “Team Viewer” to remote control the experiment leader’s computer. They had to sit in a lit room and set the brightness of their computer screen to the highest possible level. Also, they were required to turn off “Night shift” on their computer. These requirements were made to minimize variation in ambient lighting and screen lighting.

All participants were informed that all data obtained from this study would be used for no other purpose rather than the Media Technology students' bachelor exam. It is also worth mentioning...
that participating in this study was mandatory for the participants in order to pass one of their courses within the Media technology bachelor.

4.2 Selection of participants
Students from a course within the Media Technology Bachelor at The Royal Institute of Technology were recruited for this study. Before their participation, they were required to submit a survey, answering the following questions:

1. Have you ever done online shopping before?
2. Do you use “Dark Mode” on your computer, mobile phone, browser, or any program/application that you use daily? Please note that code editor programs do not apply!

Note that code editor programs usually have Dark Mode as their original theme, and as the participants all had experiences with programming, code editor programs were excluded.

Having previous experience of doing online shopping was a requirement to make sure that the participants can easily understand the questions regarding trust towards E-commerce websites. Furthermore, in order to examine whether a previous experience of using Dark Mode affects the results of this study, both Dark Mode users and Light Mode users were recruited.

The participants did not get any information about this study until the end of their participation. The only information provided was that this study is focusing on improving UX design in general. Note that questions regarding their usage of Dark Mode and their previous experience of doing online shopping were among many other questions that other students working on their bachelor exam had provided.

4.3 Grouping the participants
The participants were grouped in such a way that they did not answer questions regarding initial trust towards both the Dark Mode and the Light Mode version of a website. This was because questions regarding initial trust were not tied to the graphic design but rather the E-commerce store in general, such as the following Likert scale question: “Overall, the website is a capable and proficient E-commerce store.” As a result, if a participant had to answer such questions for the light-themed and dark-themed version of the same E-commerce website, the participant may give the same answer, even if different impressions were perceived. Because of this, all participants were divided evenly into two groups, group A and group B. Both group A and group B evaluated all the websites but with different themes (see table 1).

To measure if Dark Mode users and light mode users trust Dark Mode and Light Mode websites differently, the users were distributed as evenly as possible among group A and group B. Group A included six Dark Mode users and three light mode users, and group B included seven Dark Mode users and two light mode users.

In order to create a similar experience between group A and group B, the two groups evaluated the same amount of Dark Mode websites as Light Mode websites (see table 1).

4.4 Implementing Dark Mode by Dark Reader on websites
“Dark Reader” is a software that enables Dark Mode by creating a Dark Theme for websites on the fly [20]. Dark Reader accomplishes this by lowering the saturation of light surfaces in order to make them dark. Additionally, the saturation of foreground content such as the text and vector icons increase in order to keep the original contrast between background and foreground (see figure 1). A previous study pointed out that transformed images can negatively affect the website’s appearance if not applied correctly [6]. Therefore, Dark Reader was used in this study as it did not transform images on websites. However, if a website used images for displaying icons, buttons, or other user interface elements, it could risk that the saturation of these elements stayed the same, creating a too high or too low contrast between the background and the elements. To fix errors such as these, a function called “Developer tools” was used to change specific user interface elements on the websites manually. By using Dark Reader, initial trust between a dark-themed and light-themed website was compared.

![Figure 1. Comparison of HTML elements when Dark Mode is disabled and enabled by Dark Reader.](image)

4.5 Selection of websites
Existing E-commerce websites were used in this study. The E-commerce websites were chosen based on whether the websites provided clothes for both men and women. This to make sure that the websites would be of interest to all of the participants in this study. Our observation was that it is unusual to have Dark Mode on E-commerce websites that sell clothes compared to sites that, as an example, sell electronic devices. These are the reasons why this category of E-commerce websites was chosen.

In order to measure initial trust, the participants should not have done online shopping on the provided websites. Neither should they be familiar with any of the provided brands. Therefore, websites that were not popular and known by people in Sweden chosen for this study. The participants were also asked whether they knew any of the provided websites before doing the evaluation. If that was the case, other E-commerce websites were replaced by the experiment leader. This was also to make sure that the participants do not recognize that the websites have been modified. Note that none of the brands of the E-commerce websites were from Sweden, and none of the chosen websites had a dark-themed user interface implemented as default.

Dark Reader was applied to all of the websites, creating a light-themed and a dark-themed version for each website. Dark Reader did not always work well on all of the websites. Some texts and pictures disappeared when enabling Dark Mode by Dark Reader. Therefore, the websites were chosen based on whether Dark Mode could easily be implemented with minimum errors on the websites.

The two versions of each site were split between the groups and presented in the following order (see table 1).

See appendix (1.5), for viewing screenshots of each website.
Table 1. How the websites were distributed between group A and B.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Connection (Light Mode)</td>
<td>French Connection (Dark Mode)</td>
</tr>
<tr>
<td>Matalan (Dark Mode)</td>
<td>Matalan (Light Mode)</td>
</tr>
<tr>
<td>Bassike (Light Mode)</td>
<td>Bassike (Dark Mode)</td>
</tr>
<tr>
<td>Matchesfashion (Dark Mode)</td>
<td>Matchesfashion (Light Mode)</td>
</tr>
<tr>
<td>Saba (Light Mode)</td>
<td>Saba (Dark Mode)</td>
</tr>
<tr>
<td>Myntra (Dark Mode)</td>
<td>Myntra (Light Mode)</td>
</tr>
</tbody>
</table>

Note that in part 4.8, “Measurement of trust,” Saba and Myntra were used in case any of the participants were familiar with any of the other provided websites. In this study, three participants had previous experience of doing online shopping on French Connection, and therefore Saba was used instead. In part 4.9, “Direct comparison between Dark Mode and Light Mode,” there were no reserved websites, and all websites except Myntra were used. Also note that Myntra was not used in any part of this study.

4.6 Preventing unexpected update
Existing E-commerce websites may get updated regularly with new content such as products and deals. This risks an inconsistent appearance of the homepage of a website in a given time interval. Because the data collection of this study spanned two weeks, a chance of change was estimated to be likely. For this reason, a service called “Wayback Machine” was used to access the archived version of the used websites [21].

4.7 Evaluation of the websites
The participants had to submit three Google Forms through this study. The first one included questions regarding disposition of trust and institution-based trust. An agreement regarding usage of the participant’s data, as well as how they should get prepared for the next task, was also included in this form (see appendix, 1).1). The second form was used to evaluate initial trust and the graphic design towards the websites. Four different websites were provided, half of them with Dark Mode implemented on the websites, and the other half without Dark Mode. The participants had to submit this form for each website they evaluated. The last form included a direct comparison between the dark-themed version and the original version (Light Mode) of five different websites as well as the participants’ motivation of why they use or do not use Dark Mode daily.

By using Team Viewer, the participants could easily scroll through the E-commerce websites on the experiment leader’s computer. The same computer was used for all participants. The participants were required to remain on the start page of the websites. By limiting the participants to the start page, all of them got the same experience while evaluating the websites, and other factors such as web usability, which could affect trust, were limited.

4.8 Measurement for trust
Same questions, as in McKnight et al.’s study [10], with some adjustments, were used to measure disposition of trust, institution-based trust, trusting belief, and trusting intuition. Disposition of trust and institution-based trust measured each participant’s tendency to trust others and how they generally trust the web. Trusting belief and trusting intuition measured each participant’s initial trust towards the websites shown in this study. All subcategories of disposition of trust, institution-based trust, trusting belief, and trusting intention were measured in order to get a better understanding of how Dark Mode affects trust. All Likert scale questions were answered by choosing between an interval from 1 “I do not agree” to 5 “I fully agree” to a given statement about trust (see appendix, 1.2).

4.8.1 Creating trust references
Disposition of trust and institution-based trust was measured because they could differ between the participants and affect the results of this study. Based on McKnight et al.’s study, a participant whose disposition of trust or institution-based trust is higher compared to another participant is more likely to trust websites more, even if both of them got the same impression. If participants evaluating the dark-themed version had an overall higher or lower disposition of trust compared to the participants evaluating the original version of the site, it would risk a deviation in the final results. The difference in institution-based trust between participants would also create a similar deviation. Rather than removing this deviation by quantity, a more qualitative approach was taken by measuring disposition of trust and the participant’s institution-based trust towards the web. The gathered data was then used as a reference when comparing trusting belief and trusting intention, minimizing the risk of a deviated result.

Questions regarding disposition of trust had statements about how the respondent generally trust others to be benevolent, competent, honorable, and also about their trusting stance. Institution-based trust had statements about structural normality for the web as well as structural assurance for the web in general.

4.8.2 Trust towards websites
Because McKnight et al.’s study measured trust towards a website that offered legal advice, some questions could not directly be used in this study with an E-commerce context (see changed question marked in the appendix, 1.2). Therefore, several questions regarding trusting belief and trusting intuition needed to be adjusted or removed.

Questions regarding trusting belief had statements about how the participants believed that the presented website is benevolent, competent, and honorable. Trusting institution had statements about how willing they were to become vulnerable to the presented website.

4.8.3 Perceived quality of the websites
The perceived quality of the websites was also measured because McKnight et al.’s study found that the perceived website quality highly correlates to trusting belief. Perceived website quality was measured by the participants ranking each website from 1 to 5, answering the following question: “On a scale from 1 to 5, what was your opinion about the graphic design of the website?” Questions in McKnight et al.’s study that were used to measure the perceived quality, such as how easy it was to navigate through the website, find contact information and how well it worked technically, were not used in this study. This was because the user was limited to the start page of each website and that the only difference between a website using Dark Mode and Light Mode was the graphic design.

4.8.4 Comparing trust and perceived quality between participants
In order to compare trust and the perceived quality between different groups, the average value of the participants’ responses was taken. It can be discussed that the median is a better alternative as it does not need the assumption that the Likert scale questions have an equal length between the options, so-called an interval scale. However, the median creates an issue as it does not reflect the data we want to compare. An example would be to have the following data regarding trust towards a website:

Group X: 1, 1, 2, 2, 2
Group Y: 1, 2, 2, 4, 5
Using the median, group X and group Y will get a value of 2, meaning that both groups trust the website equally. We argue that this should not be the case as three participants in group Y rated the site higher than group X. The average value is, however, reflecting this with group X having an average value of 1.6 and group Y an average value of 2.8. For this reason, the average value was taken and presented in the result.

4.9  Direct comparison between Dark Mode and Light Mode
To evidence the results from McKnight et al.’s study regarding initial trust, the participants had to make a direct comparison of the Dark Mode and the original version (Light Mode) of the provided websites. The participants had to answer the following question for each site: “Which website do you prefer?”

To show the dark-themed version and the original version (Light Mode) of the provided websites side by side, the “Split show” function on macOS was used.

For this part, five E-commerce websites were chosen and presented as below:
1. French Connection
2. Bassike
3. Matalan
4. Saba
5. Matchesfashion

See appendix (1.5), for viewing screenshots of each website.

For implementing Dark Mode on these websites, “Dark Reader” was used. The original version of the sites was named A, which was on the left side, and the Dark Mode version of the websites were on the right side, named B (see figure 2).

![Figure 2. How the Dark Mode version and the Light Mode version of a website was compared.](image)

4.10  Question regarding usage of Dark Mode
As the last question, the participants were asked why they use or do not use Dark Mode on their devices daily.

The question was as below:

“Explain why you use or do not use “Dark Mode” on your computer, mobile phone, browser, or any program/application that you use daily?”

This question was provided to get a better understanding of why users prefer or do not prefer Dark Mode.

5.  RESULT
The results of this study will be presented in this part, beginning with measurement of trust reference between the groups. After that, trust towards the provided websites will be presented as well as the result of the direct comparison between Dark Mode and Light Mode websites. Lastly, the answer to why the participants used Dark Mode or Light Mode will be presented.

5.1  Trust measurement
For each trust category, the answers provided on the Likert scale questions were averaged in order to compare trust and the perceived quality towards the websites between group A and group B.

5.1.1  Trust references between the groups
Disposition of trust and institution-based trust was compared between group A and group B for Dark Mode users and Light Mode users separately, to see if there was a significant difference between the groups.

Note that SN stands for Situational Normality, and SA stands for Structural Assurance.

More details can be found in the appendix (see appendix, 1.4).

Regarding disposition of trust, the difference between Dark Mode users in group A (six participants) and group B (seven participants) was as figure 3:

![Figure 3. Comparison between Dark Mode users in group A and group B, regarding disposition of trust.](image)

Regarding disposition of trust, the difference between Light Mode users in group A (three participants) and group B (two participants) was as figure 4:

![Figure 4. Comparison between Light Mode users in group A and group B, regarding disposition of trust.](image)

Regarding institution-based trust, the difference between Dark Mode users in group A (six participants) and group B (seven participants) was as figure 5:

![Figure 5.](image)
5.1.2 Trust towards the websites
The participants’ initial trust towards both Dark Mode and Light Mode versions of the E-commerce websites was measured based on McKnight et al.’s theory. The results of Light Mode users’ and Dark Mode users’ trust towards the four E-commerce websites were as following:

Note that only three participants did evaluate the reserved website, which was Saba (see appendix, 1.5). Because of the low number of participants on that website, the results will not be presented.

Website 1 – French Connection:
One Light Mode user in group A evaluated the Dark Mode version, and two Light Mode users in group B evaluated the Light Mode version of French Connection. The reason behind the low number of participants was that three of the participants from group A (two Light Mode users and one Dark Mode user) had previous experience of doing online shopping on French Connection (see figure 7).

Website 2 - Matalan:
For Light Mode users, three participants from group A evaluated the Dark Mode version of the site, and two participants from Group B evaluated the Light Mode version (see figure 9).
Website 3 - Bassike:
For Light Mode users, three participants from group A evaluated the Dark Mode version of the site, and two participants from group B evaluated the Light Mode version (see figure 11).

Website 4 - Matchesfashion:
For Light Mode users, three participants from group A evaluated the Dark Mode version of the site, and two participants from group B evaluated the Light Mode version (see figure 13).

Figure 10. Comparison of how Dark Mode users rated Matalan with Dark Mode and Light Mode.

Figure 11. Comparison of how Light Mode users rated Bassike with Dark Mode and Light Mode.

Figure 12. Comparison of how Dark Mode users rated Bassike with Dark Mode and Light Mode.

Figure 13. Comparison of how Light Mode users rated Matchesfashion with Dark Mode and Light Mode.

Figure 14. Comparison of how Dark Mode users rated Matchesfashion with Dark Mode and Light Mode.

For Dark Mode users, six participants from group A evaluated the Dark Mode version, and seven participants from group B evaluated the Light Mode version of the site (see figure 14).

For Dark Mode users, six participants from group A evaluated the Dark Mode version, and seven participants from group B evaluated the Light Mode version of the site (see figure 12).

5.2 Direct comparison of Light Mode and Dark Mode
In this part, the results indicated that most users prefer the Light Mode version of the websites. Four out of thirteen Dark Mode users preferred the Dark Mode version, and the rest preferred the Light Mode version. Among Light Mode users (five participants) all preferred the Light Mode version of the websites.

In figure 15, all eighteen participants are included.

All participants

Figure 15. Direct comparison of Light Mode and Dark Mode.

5.3 Question regarding usage of Dark Mode
As the final task, the participants had to answer the following question:

“Explain why you use or do not use Dark Mode on your computer, mobile phone, browser, or any program/application that you use daily?”

Here comes a summary of the answers provided by the participants:
Eight out of thirteen Dark Mode users (61.5%) indicated that it is easier for the eyes to use Dark Mode.

Five out of thirteen Dark Mode users (38.5%) indicated that the quality of Dark Mode varies between different devices, applications, and websites. Therefore, they do not use Dark Mode on all websites or applications.

Four out of thirteen Dark Mode users (30.8%) used Dark Mode in the evenings and while sitting in a dark environment.

Three out of thirteen Dark Mode users (23.1%) used Dark Mode because it looks modern and professional. Two out of five Light Mode users (40%) indicated that the design seems to be more pleasant and professional when Light Mode is enabled.

Four out of eighteen participants indicated that it is more difficult to navigate on a computer or phone when Dark Mode is enabled. Two of them were Dark Mode users, and the other two were Light Mode users.

Note that the participants were free to write their own statements. Also, note that thirteen out of eighteen participants were Dark Mode users, and five out of eighteen participants were Light Mode users in this study.

6. DISCUSSION

The results will be analyzed and discussed in this part.

6.1 Disposition of trust and institution-based trust between the groups

For Dark Mode users, group B had, on average, a higher disposition of trust and institution-based trust compared to group A. This was observed for all subcategories except general situational-normality and benevolence situational-normality. According to McKnight et al.’s study, this will make group B trust a website slightly more than group A, even if the initial impression towards the webshop is the same for group A and group B.

For Light Mode users, group B had, on average, a higher disposition of trust but a lower institution-based trust compared to group A. Disposition of trust and institution-based trust may not equally affect trusting belief and trusting intention. It can, therefore, be hard to predict how this will affect the results. One argument can be that institution-based trust has a more significant impact than disposition of trust as it measures the general trust towards the web and E-commerce websites. If this is the case, group A would have higher initial trust towards the websites than group B.

However, the impressions of the evaluated sites were not the same between group A and group B, as presented in 6.2. As a result, the trust towards the websites did not correlate with disposition of trust and institution-based trust, but rather the quality of the websites. One explanation can be that disposition of trust, and institution-based trust affects trusting belief and trusting intentions less than the perceived quality of the website’s graphic design.

6.2 Trust towards websites

As expected from McKnight et al.’s study, the website version that got higher votes on the graphic design was trusted more by the participants. This result corresponds to all websites evaluated by the participants.

According to the results in 5.3, 38.5% of Dark Mode users indicated that the quality of Dark Mode varies between different devices, applications, and websites. It may, therefore, be discussed that the quality of Dark Mode implemented by Dark Reader varied between the websites. Because Dark Reader is only inverting the colors of surfaces and the content inside, other elements on the site such as images may not suit the dark-themed version. French Connection had, for example, very bright images, which created a higher contrast in the Dark Mode version compared to the Light Mode version (see figure 16). This can explain why the three first websites had a low score on the graphic design for the Dark Mode version compared to the Light mode version.

![Figure 16. Light Mode version of French Connection on the left and Dark Mode version on the right.](image)

Dark Mode users may have higher expectations from a website or application using Dark Mode compared to Light Mode users. This can be one explanation of why Light Mode users preferred the Dark Mode version of Matchesfashion more than the Dark Mode users. On French Connection and Matalan, the results were as expected. Light mode users preferred the original version of the websites more than the Dark Mode users.

It could also be discussed that a low number of Light Mode users (five participants) were recruited for this study, and therefore, the results may have been affected.

In a real-world situation, dark-themed website design is most likely to be created with a dark-themed version from the start. The design will probably, therefore, be perceived as better looking as images and other elements have been taken into account.

6.3 Direct comparison of Light Mode and Dark Mode

Both Dark Mode users and Light Mode users preferred the Light Mode version of all the websites. However, compared to other websites, the Dark Mode version of Matchesfashion got higher votes. Eight participants voted for the Dark Mode version, and ten participants voted for the Light Mode version of the website.

Why Matchesfashion got a high number of votes is unclear, but it may be discussed that Dark Mode was better implemented on this website compared to others.

Analyzing the results of 5.3, Question regarding usage of Dark Mode, 61.5% of Dark Mode users indicated that they use Dark Mode because it is easier for the eyes, and 30.8% of Dark Mode users indicated that they use Dark Mode when sitting in an unlit room. The participants had to accomplish this task at a time between 9:00 and 16:00. As the participants evaluated the websites during the day and while they were sitting in an illuminated room, this may be the reason why the participants preferred the Light Mode version of the websites. It can be discussed that if the participants were sitting in an unlit room, they would prefer Dark Mode instead.

Furthermore, 38.5% of Dark Mode users indicated that the quality of Dark Mode varies between different devices, websites, and applications. By analyzing this statement, it may be discussed that the direct implementation of Dark Mode by Dark Reader risks that the existing images and other design elements will not be compatible with the dark-themed version of the websites. Therefore, this may be the reason why the participants preferred the original version (Light Mode) of the websites instead.
6.4 Limitations

During this study, Sweden was facing the Coronavirus pandemic. As we had to come up with online solutions such as using “Team Viewer,” the resolution and screen size of the participant’s computer may have affected how the quality of the websites was perceived. This because the details of the websites can be hidden depending on the screen size or resolution, making the site look better or worse.

Questions regarding trust were replicated from McKnight et al.’s study, which had been studied to measure different categories of trust. However, in order to use McKnight et al.’s questionnaire, some questions needed to be modified to fit an E-commerce context. Some questions used in this study concerning trusting intention have not been used and proven before and can, therefore, be a potential source of error.

While the first page of the websites was only shown to the participants and clothes for both men and women were provided on all the sites, layout, product, and the offers provided on the first page may have affected the participants’ trust, as this is a matter of taste.

How the participants were selected may also affect the results. For this study, eighteen students within the Media technology bachelor were recruited from The Royal Institute of Technology. It can be discussed that a low number of students were recruited, and all of them had some experience with UX design because of their educational field, Media technology.

No statistical methods were used to check whether there existed a significant connection between trust and perceived quality. This was because we had a low sample size in our groups. A significance test could therefore not give any valuable data to our study.

Furthermore, men and women and Dark Mode and Light Mode users were not equally recruited for this study and therefore, the results may not represent both genders and both types of users. Neither was any requirements made for the temperature of the ambient light because it was assessed to be challenging to do it remotely.

Because it was mandatory for all students to participate in this study, a lack of motivation could exist and affect the final results as well.

6.5 Suggestions for future studies

For future studies, it would be of interest to analyze whether the results of this study would differ if the participants had to evaluate the websites at night and while sitting in a dark environment. Also, as 61.5% of Dark Mode users indicated that using Dark Mode is more comfortable for the eyes, for future studies, it would be of interest to see whether using Dark Mode can keep users on a website for a longer time compared to a website without Dark Mode.

Moreover, as Dark Mode implemented by Dark Reader may have affected the perceived quality of the graphic design negatively, the same study could be done while Dark Mode is implemented with other software or while designed with a dark-themed version from the start.

As images were not inverted in this study and may not have suited the background theme, for future studies, it would also be of interest to explore how improved image processing techniques can improve the implementation of Dark Mode.

6.6 Conclusion

The results of this study showed that the majority of the participants rated the graphic design of the light-themed version of the websites higher than the dark-themed version. This resulted in the participants having a lower trusting belief and trusting intention towards the majority of the dark-themed websites. No significant difference existed in initial trust between Light Mode users and Dark Mode users. A possible explanation for this could be that Dark Mode was implemented by a software program on an existing design. This direct implementation risks that the existing images and other design elements not being compatible with the dark-themed version of the websites. This study suggests that developers should implement Dark Mode from the beginning of the website’s development or redesign other elements on the website rather than using a plugin.

7. REFERENCES


https://material.io/design/color/dark-theme.html#usage  
[Retrieved 29 Mars 2020]


1. APPENDIX

1.1 Agreement and preparation

Agreement for participation:
The data is only going to be presented, such as it cannot be connected to the participants of this study. This means that your email addresses are going to be deleted after this study is completed.

Environment:
During the meeting, you will need to have access to a room with high ambient light. With "High ambient light," we mean that you will have to be able to read a text on a paper comfortably.

Disable light filter:
You need to have all kinds of "Light filter" disabled before the booked meeting. See the instructions for Windows 10 and macOS at the end of this form. If you are using another operating system and you are not sure how to do it, you can send us an email. It may also be possible that you do not have any light filters on your computer.

Doodle:
Book an available time when you are free and have a computer with Team Viewer available.

Team Viewer:
On the online meeting, you are going to have access to our computer screen by using Team Viewer.

NOTE: We are NOT going to have any access to your computer!
You can install Team Viewer from the following links:
macOS: https://download.teamviewer.com/download/TeamViewer.dmg
Windows: https://download.teamviewer.com/download/TeamViewer_Setup.exe

1.2 Initial trust & Perceived Quality - Questionnaire

1.2.1 Disposition of trust
1.2.1.1 Benevolence
1. In general, people really do care about the well-being of others.
2. Usually, people are sincerely concerned about other people’s problems.
3. Most of the time, people care enough to try to be helpful, rather than just looking out for themselves.

1.2.1.2 Integrity (Honorable)
1. In general, most people keep their promises.
2. I think people generally try to back up their words with their actions.
3. Most people are honest in their dealings with others.

1.2.1.3 Competent
1. I believe that most professional people do a very great job at work.
2. Most professionals are very knowledgeable in their chosen field.
3. A large majority of professional people are competent in their area of expertise.

1.2.1.4 Trusting stance
1. I usually trust people until they give me a reason not to trust them.
2. Generally, I give people the benefit of the doubt when I first meet them.
3. My typical approach is to trust new acquaintances until they prove that I should not trust them.

1.2.2 Institution-based trust
1.2.2.1 Situational Normality - General
1. I feel good about how things go when I make a purchase or other activities on the Internet.
2. I am comfortable with making purchases on the Internet.

1.2.2.2 Situational Normality - Benevolence
1. I feel that most Internet vendors would act in a customer’s best interest.
2. If a customer required help, most Internet vendors would do their best to help.
3. Most Internet vendors are interested in customer’s well-being, not just their own well-being.

1.2.2.3 Situational Normality - Integrity
1. I am comfortable relying on Internet vendors to meet their obligations.
2. I feel fine doing business on the Internet since Internet vendors generally fulfill their agreements.
3. I always feel confident that I can rely on Internet vendors to do their part when I interact with them.

1.2.2.4 Situational Normality - Competence
1. In general, most Internet vendors are competent in serving their customers.
2. Most Internet vendors are capable of meeting customers’ needs.
3. I feel that most Internet vendors are good at what they do.

1.2.2.5 Structural Assurance
1. The Internet has enough safeguards to make me feel comfortable using it and to transact personal business.
2. I feel assured that legal and technological structures adequately protect me from problems on the Internet.
3. I feel confident that encryption and other technological advances on the Internet make it safe for me to do business there.
4. In general, the Internet is now a robust and safe environment in which to transact business.

1.2.3 Trusting belief
Some questions are added and modified from McKnight et al.’s study. Note that all answers provided on the questions were not used in this study.

1.2.3.1 Benevolence
1. I believe that the website would act in my best interest.
2. If I required help, the customer service of the website would do its best to help me.
3. The website is interested in my well-being, not just its own.

1.2.3.2 Integrity
1. The website is truthful in its dealings with me.
2. I would characterize the website as honest.
3. The website would keep its commitments.
4. The website is sincere and genuine.

1.2.3.3 Competence
1. Overall, the website is a capable and proficient E-commerce store.
2. In general, the website is very knowledgeable about what they do.

1.2.4 Trusting intentions
1. I would feel comfortable with making a purchase from this site. [Added question]
2. In a scale from 1 to 5, how likely is it for you to do online shopping on this website if the website had the product that you needed considering the fact that you are going to do online shopping and this website is not the only website that sells the product? [Added question]
3. I would feel secure by giving my email address if I wanted to get newsletters from this site. [Added question]

1.2.5 Personal Innovativeness
1. In general, when looking for a product, I am often using the same E-commerce website, which I used before, rather than looking for a new E-commerce site that offers the seeking product. [Not used]

1.2.6 Perceived Site Quality
1. On a scale from 1 to 5, what was your opinion about the graphic design of the website? [Added question]
2. Visually, this site reassembled other sites I think highly of. [Not used]
3. This site was pleasing to look at. [Not used]

1.3 Archived websites
Matalan: https://web.archive.org/web/20200325100949/https://www.matalan.co.uk/

1.4 Data

1.4.1 Disposition of trust - Dark Mode users

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<tr>
<th>Category of trust</th>
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1.4.2 Disposition of trust - Light Mode users

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1.4.3 Institution-based trust - Dark Mode users

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1.4.4 Institution-based trust - Light Mode users

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1.4.5 French Connection - Light Mode users

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**1.4.7** Matalan - Light Mode users

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**1.4.8** Matalan - Dark Mode users

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### 1.4.11 Matchesfashion - Light Mode users

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### 1.4.12 Matchesfashion - Dark Mode users

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### 1.5 Screenshot of the websites

Screenshots of the websites used in this study can be found below. Note that Myntra was one of the reserved websites and was not used at any part of this study.