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EFFECTS OF VISUAL AESTHETICS ON PERCEIVED COGNITIVE ACCESSIBILITY

Master thesis

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ABSTRACT

The purpose of this study was to understand how visual aesthetics and perceived cognitive accessibility interplay and what effect elements of visual aesthetics have on perceived cognitive accessibility. Current research suggests that user experience relating to visual aesthetics has a major impact on multiple user behaviours, including customer loyalty, satisfaction, perceived usability, fun, joy, etc. Meanwhile, with the current changes in the legislation, accessibility has become a major item on many agendas. While there is a growing body of research to suggest that some aspects of visual aesthetics have a positive effect on accessibility, yet a lot of that research is concerning visual impairment. Therefore there still is a need to investigate how visual aesthetics and perceived cognitive accessibility interpay. While good accessibility can have a positive impact on the experience of every user, it can particularly benefit those with learning disabilities who are one of the most excluded groups. This was a mixed methods study - the first part used Tratcincky's qestionaire to assess the perceived visual aesthetics of 6 prototypes and to help to choose two prototypes (with the highest and the lowest average aesthetic scores) for the second part of the study. The second part of the research was a qualitative study that investigated the interplay between the two phenomena - perceived visual aesthetics and perceived cognitive accessibility; it involved people with mild learning disabilities. The results of the interviews suggest that certain aspects of classical aesthetics can positively impact perceived cognitive accessibility. The facets of visual aesthetics that had a positive impact on perceived cognitive accessibility were 'clear', clean' and 'aesthetic'. Once the results were interpreted, a list of recommendations was created. And this, alongside a good

understanding of the negative impact digital exclusion can have, can hopefully ensure that ‘no one is left behind’ (Scottish Government, 2021).

Keywords: perceived, visual aesthetics, cognitive accessibility, digital inclusion.

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LIST OF ABBREVIATIONS

UX - User Experience

ADHD - Attention Deficit Hyperactivity Disorder

ICT - Information and Communications Technology

CRPD - Convention on the Rights of Persons with Disabilities

WC3 - World Wide Web Consortium

EBP - Evidence Based Practice

1. INTRODUCTION

Visual aesthetics is known to have significant influence on user behaviour when interacting with interfaces (Mbipom, 2009; Alsudani and Casey, 2009; Peng et al. 2017); the research has shown that we can discontinue our interaction with a website that we deem to be unattractive as quickly as within 50 milliseconds (Lindgaard et al, 2006); (almost 50% of users leave a website as soon as they judge the website not to be attractive - all of this suggest that high aesthetic value is key for the websites that rely on user involvement (Bonnardel, et al., 2011). In the meantime, complying with web accessibility standards has become an expectation that most designers and service providers have to address (Mbipom, 2009; Peter and Bradbard, 2009). However, accessibility still very often concerns access for those with visual impairment only (Mbipom and Harper, 2011; Aizpurua et al., 2016) - cognitive accessibility seems to be missed and therefore excludes a wide range of users. Making interfaces easier to understand and navigate would not only include users with learning (cognitive) disabilities (W3C, 2015), it could also benefit the rest of the population (Miesenberger et al., 2019) and could lead to a better success of a service or business (Horton and Sloan, 2016).

This study will investigate the relationship between visual web aesthetics and cognitive accessibility in order to gain the insight of what impact good visual aesthetics has on cognitive accessibility; it will try to understand if a visually pleasing web design be also easy to access and what are the challenges those with mild learning (cognitive) disabilities face when navigating interfaces with high aesthetic value.

1.1. PROBLEM STATEMENT

Visual aesthetics is proved to be key in the overall experience of web users and greater accessibility is becoming a new standard required by the law; however, there is a lack of understanding of how good visual aesthetics impact perceived cognitive accessibility. This study will therefore investigate the effect that visually highly rated websites have on the users' cognitive access. Currently researchers agree that aesthetics augment the overall interactive experience and increasing aesthetic value is greatly desirable; user engagement with interfaces often rely on the aesthetic appeal of an interface (Alsudani and Casey, 2009; Robins and Holmes, 2008). Meanwhile, current changes in the law also require websites and applications to meet a certain standard of accessibility (Peter and Bradbard, 2009). There is a growing body of studies that look at what impact visual aesthetics has on accessibility, but most of them address the issue of visual accessibility (Mbipom and Harper, 2011; Aizpurua et al., 2016); however, there is limited understanding of how visual aesthetics affect cognitive accessibility of websites (Harper et al., 2011; Burmeister, 2010; Bonnardel et al., 2011). According to the statistics, there are 1.5 million people with learning disabilities in the UK, populations are ageing, anyone at any given moment can acquire a permanent or temporary disability that can impair one's ability to function. Researchers suggest that due to the lack of accessible design and creative thinking, people with learning disabilities are at risk of being left out (Zhang et al., 2016). Researchers suggest that most UX attributes significantly correlate with accessibility (Aizpurua et al., 2016) and cognitive accessibility shows high impact on usability and therefore can improve the overall user experience (Miesenberger et al., 2019). Besides, development in accessibility brings benefits to all users and therefore

should not be ignored (Henry et al., 2014) and for this reason a better understanding of interplay between visual aesthetics and cognitive accessibility is needed (Bonnardel et al., 2011). One of the reasons why there is still such limited understanding of the relationship between cognitive accessibility and visual aesthetics is due to the fact that accessibility is still seen as an issue relating to people with disabilities and the elderly and poor accessibility often narrowed down to visual problems. Besides, the concept of universal design is yet to be embraced by the design teams. Bormeister (2010) suggests that the researchers have placed too much emphasis on perceptual access and with cognitive access being left out. It is also suggested that visual aesthetics is still often considered the aim rather than the tool (Peters and Bradbard, 2007). Moreover, web sites are often designed without considering human diversity (Aizpurua et al., 2016).

1.2. RESEARCH GOALS

Having an understanding of the relationship between good web aesthetics and cognitive accessibility would enable a better inclusion of a more diverse population and could lead to a better understanding of how cognitive accessibility works in the real world. Having an understanding of the interplay between good aesthetics and accessibility and the challenges those with cognitive difficulties face could also lead the way to a more universal interface design through better inclusion.

1.3. RESEARCH QUESTIONS

The study will aim to answer the following questions:

RQ1 - What are the challenges that those with mild learning disabilities face when navigating interfaces? And what is the impact of it?

RQ2 - How perceived visual aesthetics and perceived cognitive accessibility interrelate? What is the experience of people with learning disabilities when navigating interfaces with high and low aesthetic value? What are the values of users with disabilities?

1.4. EXPECTED OUTCOMES

The study is expected to help to produce a list of guidelines that could be considered by those designing interfaces with cognitive accessibility in mind. The study will broaden our understanding of the relationship between visual aesthetics and cognitive accessibility and will provide an insight into the cognitive challenges that people with learning disabilities face when navigating the interfaces of different aesthetic value. With universal design being beneficial for everyone, not only to those with disabilities, this study will contribute to a better understanding of the impact visual aesthetics has and how it can benefit the experience of every user. The finding of this study would also be valuable to those who promote better inclusion and accessibility as well as those who design interfaces specifically for people with learning disabilities.

1.5. RESEARCH APPROACH

Table below illustrates the above described research.

PHASE	RESEARCH OBJECTIVE	METHODOLOGY
Theoretical understanding of the topic	The aim of this phase is to gather the relevant knowledge and to gain a better understanding of the issues, approaches and challenges.	Literature review: review the literature relating to visual aesthetics and cognitive accessibility. Include academic, professional and current media sources.
Preparation of prototypes	To find out what are the current trends in web design, particularly in relation to visual aesthetics.	Online survey of the most current articles and blogs

The study	The study was divided into three stages: 1. Researching online articles relating the current trend in visual aesthetics and creating prototypes 2. Quantitative study to help decide on the stimuli for the qualitative part of the study through the assessment of the perceived value of each prototype. 3. Qualitative study - to help to understand how visual aesthetics and cognitive accessibility relate, what impact they have in the lives of those who live with learning disabilities.	1. Design an online questionnaire to collect data on the perceived aesthetic values of each prototype, recruit participants only, 2. Conduct qualitative interviews to gain deeper understanding of visual aesthetics and cognitive accessibility.

Data Analysis	1. Analyze qualitative data and establish the prototypes with the highest and the lowest aesthetic values 2. Analyze qualitative data in order to understand how visual aesthetics and perceived cognitive accessibility interrelate, to look for themes.	1. Calculate the average scores and confidence intervals for each prototype. 2. Transcribe the interviews, conduct in vivo coding. Analyze the videos to further understand behaviours and to define the themes.
List of recommendations	To produce a list of recommendations for designing interfaces that have a higher aesthetic value and better perceived cognitive accessibility.	Through the reflection on the findings, a list of recommendations will be made.

Table 1: Overview of research objective and methods

1.6. STRUCTURE OF THE THESIS

The thesis is divided into six parts. The first part is the introduction to the concepts that will be discussed and researched in the thesis. It also provides the following details

about the research - the problem statement, the goal, the research questions, expected outcomes and the research approach.

The second part is the literature review which provides theoretical background to the research - it explains issues relating to perceived visual aesthetics and perceived accessibility. It also aims to answer the first research question.

Part 3 of this thesis describes the research methodology in detail - the design of the study, the participants, instruments, stimuli and the procedure.

The Results section (part 4) describes the finding of both qualitative and quantitative studies.

Part 5 is discussion of the results, it also provides a list design guidelines that were based on the findings of the qualitative interviews.

Part 6 provides a conclusion which gives an overview of the thesis and the most important findings. It also provides a list of limitations related to the study as well as proposals for further research.

The list of references and appendix are also provided at the end of the thesis.

2. LITERATURE REVIEW

2.1. VISUAL AESTHETICS

While visual aesthetics is quite a broad concept that fascinated thinkers and scientists throughout the history of humanity (Lavie and Tractinsky, 2004), the importance of beauty in almost every aspect of life has been recognised since ancient times and has

been backed by the more recent studies in social science (Lavie and Tractinsky, 2004). What is visual aesthetics? Virginia Postrel (2004) describes it as ‘fundamentally the art of using line, form, tone, colour, and texture to arouse an emotional reaction in the beholder. Very often aesthetics is used as a synonym to beauty. Moshagen and Thielsch (2010) suggests three approaches to understanding it - objectivist, subjectivist and interactionist views. It is the interactionist approach that merges the views of the other two and gives the most wholesome explanation - beauty (aesthetics) is seen as ‘a function of both, properties of an object and characteristics of the perceiver, that is, beauty emerges from patterns in the way perceivers and objects relate’. Therefore beauty is seen as value positive, intrinsic, and objectified (Moshagen and Thielsch, 2010).

Numerous researchers agree that there are two dimensions to aesthetics: classical and expressive (Bonnardel et al., 2008). Classical dimension refers to orderly and clean design, design rules; meanwhile, expressive aesthetics is about the designers’ creativity and originality (Bonnardel et al., 2011; Cai et al., 2008). Lavie and Tractinsky (2004) point out that features of classical aesthetics are linked to usability. The other features of aesthetics that will fall into either of the two dimensions are: simplicity, diversity, colourfulness, and craftsmanship (Moshagen and Thielsch, 2010).

Moreover, visual aesthetics is seen as a way to communicate a message through the selection of elements and techniques (Hoffmann and Krauss, 2004). It also is understood to alter the psychological state and interact with cognition of the viewer (Avery, 2005).

2.2. AESTHETICS IN WEB DESIGN

When human-computer interaction was first researched it was usability that scientists were primarily concerned with (Cai and Xu, 2011; Hoffmann and Krauss, 2004). More recently though, aesthetics has gained significance in the product and web development (Xenakis and Arnellos, 2013; Lavie and Tractinsky, 2004). At present, there is no doubt about the positive relationship between the appearance of a website and user behaviour (Lavie and Tractinsky, 2004, Cai et al., 2008).

In terms of understanding the aesthetics of web design, Cai et al. (2008) suggest that it is a balance between design elements (e.g., line, colour, etc) and principles (e.g., unity, contrast, balance, proportion, etc) - which is also in line with the earlier mentioned dimensions of aesthetics.

Moreover, interface design is connected to attention and understanding (Cai et al., 2008) and therefore requires both cognitive and affective evaluations (Cai et al., 2008). Further, Cai et al. (2008) suggest using cognitive affective framework to explain web aesthetics. It is a two dimensional model that suggests two components of web aesthetics - cognitive and effective (Cai et al., 2008). Cognitive component refers to the organisation of a website (order, coherence, legibility, clarity, etc), whereas affective component would include features relating to visual appeal (complexity and diversity, beauty, meaningfulness, creativity, richness of design) (Cai et al., 2008) The framework overlaps with the classical and expressive dimensions of aesthetics.

Cai and Xu (2011) suggest that various aesthetic qualities of an interface design can improve the user experience. For instance, Cai and Xu (2011) found that ‘the sensory

experience is determinant of users' shopping and returning behaviour'. Numerous other studies have found that user engagement with interfaces often relies on the aesthetic appeal of an interface (Robins and Holmes, 2008; Avery 2005; Garett et al., 2016). Moshagen et al (2009) found that good aesthetics can improve user performance.

Moshagen and Thielsch (2010) suggests that aesthetics has been found to positively influence human behaviour in the following areas:

- perceptions of a system
- perceived usability
- credibility and trustworthiness
- satisfaction
- preference
- urge to buy impulsively
- customer loyalty
- intention to revisit
- fun, joy, and pleasure.

And therefore, there is no longer any doubt as to whether visual aesthetics is instrumental in the success of a website.

2.3. COGNITION AND AESTHETICS

Cognition can be defined as an information processing system - it ‘allows us to interpret the world and make sense of it’ (Bonnardel et al., 2011). Russell (2004) suggests there being 3 levels of human processing - visceral, behavioural and reflective. Norman (2002) describes visceral level as a fast level where we make quick decisions about what is good or bad, it a start of affective processing; at behavioural level our behaviour is controlled, this not a conscious level; and at the reflective level that we use conscious attention and thinking.

When trying to explain our perception of a product, Bonnardel et al. (2011) argue that visceral level is used to relate to product attractiveness, behavioural level refers to function and usability and at reflective level we relate to the ‘prestige’ of a product. This is what Don Norman referred to as Three Level of Design (2002).

However, while it is our cognition that allows us to interpret what we see, emotions seem to play an important part in the process as they allow us to assign valence to objects and therefore have an effect on cognition (Bonnardel et al., 2011).

2.4. COGNITIVE DISABILITY

The World Health Organisation views disability as part of human condition - they argue that most people will experience disability at some point in their life (WHO, 2020) . They also emphasize the fact that disability happens at a point of interaction - between the person that has a certain health condition and personal and environmental factors. A lot of the time it is the lack of access, negative attitudes, limited support that created

barriers. Centres for Disease Control and Prevention define disability as a three dimensional phenomenon - an impairment of body or mind that makes it hard for a person to carry out certain activities and to interact with the world around them (CDC, 2020).

People with disabilities encounter stigma and experience exclusion, which involve ‘inaccessible education systems, working environments, inadequate disability benefits, discriminatory health and social support services, inaccessible transport, houses and public buildings and amenities, and the devaluing of disabled people through negative images in the media — films, television and newspapers (Oliver, 2004).

People with disabilities are often referred to as one group, meanwhile it is important to acknowledge the diversity of the group in order to understand and respond to the needs of each group appropriately. There is no one agreed way to classify different disabilities, Courtne-Long et al (2013) suggest that disabilities fall into the following categories, based on the function and the challenge: vision, cognition, mobility, self-care, and independent living.

Cognition can be defined as the mental processes involved in acquiring and processing information that are necessary for everyday living (Magni and Bilotta, 2016). Small et al (2005) proposed two types of cognition: mechanical (relating to information processing and learning) and pragmatic (relating to social interaction and communication).

Courney - Long (2013) fond that mobility and cognition related disabilities were the most common.This has been confirmed by Böcker et al (2016) who have also found that

Cognitive impairments are relatively common, affecting between 1–2.5 % of the general population in the Western world.

In terms of terminology, there is not clear agreement which term - cognitive or learning disability - is currently considered to be the most person centred, politically correct and respectful. In the UK, 'learning disability' is the most commonly used term to refer to people who might struggle to understand and process new information, learn new skills and function independently (Office For Disability Issues, 2021). A lot of literature quoted in this thesis used the term 'cognitive disabilities' to refer to the same group of people. Both terms are used interchangeably in this document. Other terms that currently are considered to be offensive and outdated have been omitted.

Braddock et al (2004) define cognitive disabilities as "a substantial limitation in one's capacity to think, including conceptualizing, planning, and sequencing thoughts and actions, remembering, interpreting subtle social cues, and understanding numbers and symbols". Moreover, cognitive disabilities take many forms and these include clinical diagnoses of Autism, Down's syndrome, ADHD, dementia, a list of mental health disorders, various learning difficulties (Firth, 2019; Burmeister, 2010). Steel and Janeslätt (2017) argue that people with cognitive disabilities are some of the most marginalised groups in the society due to the limited access, particularly in the societies where technology is used to communicate, organize and negotiate work, social lives and recreation; this claim has also been supported by Firth (2019). Besides, Firth (2019) suggests that some cognitive impairments can be temporary and affect many more people; those temporary impairments include influence of alcohol and drugs, going through traumatic life events, sleep deprivation.

2.5 WEB ACCESSIBILITY

The Web Accessibility Initiative (n.d.) describes web accessibility as websites that are designed in a way that people with disabilities can use them. An inclusive design toolkit produced by Microsoft suggests that ‘disability happens at a point of interaction’ (Microsoft Design, n.d.). That is the idea behind the social model of disability - disability is a social construct that is supported by the inaccessible environment we have created. Aizpurua et al. (2016) point out that even though the web was designed to be universally accessible, that is not the case in practice (Shinohara et al., 2016). The reason being - lack of consideration for the diversity of human condition, failures to include people with disabilities in the design process (Shinohara, et al., 2016; Aizpurua et al., 2016; Shinohara, et al., 2018). Meanwhile, it was suggested that there are four major categories of impairments that are related to problems in using websites: (a) Visual impairments, (b) hearing impairments, (c) cognitive impairments, and (d) motor impairments (Thatcher et al., 2006; Vu & Proctor, 2011).

Persson et al. (2014) suggest that the concept of disability is quite exclusive and singles out those that have the label or a diagnosis, meanwhile everyone has a differing levels of abilities, some disabilities are permanents, others are temporary and situational. Therefore, understanding various aspects of accessibility and designing for better access is in the best interest of everyone (Miesenberger et al., 2019; W3C, 2015), not only those who have the diagnosis of a disability.

Besides, Borg et al (2014) argue that accessibility to information and communication as well as full participation is now viewed as part of human rights defined by the convention of the rights of persons with disabilities.

Besides, Aizpurua et al. (2013) found that compliance with the accessibility guidelines does not automatically guarantee accessibility for users which means that accessibility is quite a complex phenomenon. Meanwhile other studies (e.g. Schmutz, 2017) found that that websites' higher level of accessibility had higher user ratings (i.e. perceived usability, aesthetics, workload and trustworthiness).

2.6. COGNITIVE ACCESSIBILITY

With accessibility being seen as a way to include users with various disabilities, cognitive accessibility refers to the ‘accessibility considerations for people with cognitive and learning disabilities’ (Zentel, Opfermann, and Krewinkel, 2007). Moreover, cognitive accessibility refers to the modification of the environment so that people with cognitive disabilities can fully participate and function in it (Yalon- Chamovitz et al., 2015). Kulkarni (2019) suggests that good cognitive accessibility simply implies making perception, comprehension navigation and contribution to the web easier for those who have cognitive disabilities. Improving cognitive accessibility contributes to a more general improvement of usability in terms of “the extent to which a product can be used by specified users to achieve their goals with effectiveness, efficiency, and satisfaction in a specified context of use” by supporting learnability, memorability, error prevention and handling, trust, and satisfaction (Miesenberger, 2019).

Fieldman and Nelson-Bryen (2007) found that many individuals with cognitive disabilities experience difficulty in using the Web due to limited reading comprehension, complexity, slower learning, limited fine motor control, reduced spatial perception, lowered visual acuity, less hand/eye coordination and finger dexterity, and lowered information overload thresholds'.

While all the above issues present numerous challenges, Thompson (2018) argues that 'ICT and digital technologies have the potential to help marginalised groups, such as persons with disabilities overcome barriers to communication, interaction, and access to information' and therefore good accessibility should not be an option.

2.7. DISABILITY AND AESTHETICS

Traditionally, disability is viewed as a lack or insufficiency which results in technology experts aiming to solve the disability problem but forgetting to include the aesthetic needs of the individual (Wilde and Marti, 2018) - this often refers to aids created specially for people with disabilities (e.g. hearing aids, prosthetics, etc) and the result is often a product that is functional but often considered to be ugly. Wright (2019) argues that digital design for those who are less able is often described as ugly, lacking in style, primarily concerned with function.

2.8. VISUAL AESTHETICS AESTHETICS AND COGNITIVE ACCESSIBILITY

Currently, there are not many studies yet that attempt to understand the relationship between web aesthetics and accessibility, and those that do exist mostly focus on visual

accessibility (Friedman and Nelson-Bryen, 2007; Mbipom, 2009). Some of the findings relating to visual aesthetics and accessibility are quite positive; for instance, Mbipom (2009) found that good visual aesthetics is compatible with good visual access, namely visually clean websites did score higher on accessibility. Aizpurua et al. (2016) suggest that the aesthetics of a website correlates to perceived web accessibility which suggest that users could find a more beautiful website more accessible, but Mbipom (2009) suggests that more research is needed in order to understand that relationship. Fieldman and Nelson-Bryen's (2007) findings, on the other hand, suggest that some principles for good aesthetics and cognitive accessibility overlap, they also argue that more studies need to be carried to understand cognitive access and how it is impacted by the web aesthetics.

2.9. PERCEIVED ACCESSIBILITY

There are well established tools for measuring accessibility with the objective measures being the most commonly used; Lättman (2018) argues that perceived or subjecting accessibility is often excluded. Moreover, Van der Vlugt, et al (2019) suggest that using objective measures to assess accessibility does 'not reflect the perception of the users' which fails to provide an insight into the 'lived reality' of accessibility (Van der Vlugt, et al) and understand how accessibility affects the users who's quality of life is affected by lack of access.

Yesilida's et al (2015) study suggests that accessibility evaluation is more than just inspecting the source code - it needs to be grounded in user-centred practices. These include subjective perceptions and evaluations of accessibility, 'that are reliant on

individual attributes and characteristics (one's experiences, abilities, and beliefs) as well as situational attributes and characteristics, and their interaction'. (Lättman, 2018). It is crucial to understand the perceived accessibility as the individual's interpretation of accessibility has a significant impact on one's behaviour (Lättman, 2018).

Besides, Yesilida et al (2015) found that users think that accessibility and usability are related, with accessibility having greater impact on both usability and user experience than vice versa. Therefore, understanding accessibility is crucial. (Lättman, 2018) argues that in order to meet the access needs of as many users as possible, one needs to take into account the needs and expectations of the individuals, not solely rely on methodologies that are not related to individual experiences of accessibility.

2.10. CURRENT GUIDELINES FOR IMPROVING COGNITIVE ACCESSIBILITY

The Convention on the Rights of Persons with Disabilities (CRPD) requires that the State Parties put measures in place to ensure that people with disabilities have access on the same basis as everyone else (Borg, Lantz, and Gulliksen, 2015). The definition of access used by the CRPD includes access to information and communication. Meanwhile, WC3 (2021) suggest that people with learning disabilities are most likely to struggle with the following:

- context,
- structure,
- language,
- usability, and

- other factors that are difficult to include in general guidelines.

Several guidelines have been published to enable those involved in creating and developing digital interfaces and products to ensure that people with learning disabilities have access to the information and services online.

WC3 (2021) has a list of the most recent recommendations of design considerations in order to include those with learning disabilities:

- Help users find what they need
- Use clear content (text, images and media)
- Help users avoid mistakes
- Help users focus
- Ensure processes do not rely on memory
- Provide help and support
- Support adaptation and personalization
- Test with real users

The guidelines provided by the WC3 seem to be some of the most recent and quite generalised (it leaves quite a lot of space of interpretation). There is some research that looked at the various aspects of the design in more detail. Peter Williams and Christian Hennig (2015) for instance found that in order to ensure that cognitive accessibility is optimised, the flowing rules need to be observed:

- Juxtaposition of text and images
- Most important information should be at the top

- Minimising the word count
- Using a fairly large text size
- Accompanying images need to be chosen carefully when aiming to use them for comprehension facilitation.
- Menu layout should be visible and clear

Moreover, Yaneva, Temnikova and Mitkov (2015) in their eye-tracking study with people with ASD concluded that carefully selected images can aid text comprehension, irrelevant images and incomprehensible text can have a negative effect on cognitive accessibility, any irrelevant information should be excluded (e.g. adverts), photographs and symbols are equally important, and should be pleased as close to the relevant text as possible.

A review of literature conducted by Fieldman and Bryen (2007) found the following guidelines to be most frequently recommended:

1. Use pictures, icons and symbols along with text.
2. Use clear and simple text.
3. Consistent navigation and design on every page.
1. Use headings, titles and prompts.
2. Support screen readers. Use alternate text tags.
3. Use larger fonts, fonts in minimum 12pt or 14pt.
4. Uncluttered, simple screen layout.
5. Maintain white space: Use wide margins.
6. Website customizable, control of: type size, placement of navigation (right, left side) contrast, large print, sound.

While the above study is relatively old, the finding seems to be similar with the more recent studies and in compliance with the WC3 most recent recommendations.

Even though quite a comprehensive list of guidelines for cognitive accessibility seem to exist, Borg, Lantz, and Gulliksen (2015) argue that those guidelines are often proposed by the limited number of experts and suggest the need to move towards more evidence based practice. Evidence based practice (EBP) has its origins in healthcare and has been seen as one of the biggest success stories in the 1990s. At it's very core, EBP involves integrating scientific evidence and expertise with the preferences and needs of the patients (Trinder, 2008). It is also suggested that it is through the EBP that the best outcomes are achieved. More recently, evidence based practice has been used in education research and Borg, Lantz, and Gulliksen (2015) suggest that extending it to ICT could be beneficial.

Borg et al (2015) also acknowledge that due to the very wide variety of abilities and disabilities of those who fall under the term of cognitive or learning disability, cognitive access is not a straightforward concept. In order to assess it effectively and to therefore facilitate genuine access for those who have cognitive disabilities can be a difficult task.

2.11. BENEFITS OF DIGITAL INCLUSION

The UK government (Digital Skills and Inclusion Policy, 2017) defines digital inclusion as having the right access, skills, motivation and trust to confidently go online. In 2017 it published it's digital strategy which aimed to increase inclusion amongst other goals.
A survey conducted by the Office of National Statistics released in March 2019, a few weeks before the lockdown started in the UK, found that 10% of the UK population were

‘internet non-users’ and 56% of them were people with disabilities. The 56% is much higher than the number of people with disabilities - which was estimated to be 22% in 2016 - 2017. The report identified a number of reasons for the exclusion of people with disabilities with lack of skills and accessibility being some of them.

Digital inclusion, on the other hand, has been found to have numerous benefits (Sanders, 2020). It has been found to help people to overcome social exclusion, which then minimises loneliness and depression (Lelkes, 2013; Aguilar, Boerema, and Harrison, 2010, Sum, 2008, Ferri and Favalli, 2018). Ordonez, Yassuda and Cachioni (2010) found that digital inclusion can improve cognitive performance, particularly in the language and memory domains.

A study completed by Sieck at al (2021) found that digital inclusion was a determinant for health - this is mostly due to the healthcare system increasingly becoming reliant on digital tools such as patient portals, health trackers, and remote monitoring devices (Sieck at al, 2021). And these artefacts were found to have a greater engagement, it could also leave the more vulnerable members of the society at even bigger risk.

Tsatsou (2020) suggests that digital inclusion can help people become more independent and autonomous, it can increase their sense of self-worth. She argues that technology has the potential to promote people’s agency and individuality (Tsatsou, 2020, Vicente and Lopez-Menendez, 2010).

In terms of understanding the cause of digital exclusion, Tsatsou (2020) suggests that it is rooted in the stigmatisation of people with disabilities. It is argued that stigma happens ‘when elements of labelling, stereotyping, separation, status loss, and discrimination co-occur in a power situation that allows the components of stigma to

unfold' (Link and Phelan, 2001). While some research suggests that online interactions can support people with disabilities to redefine their identities because it can make their disability less obvious, if visible at all (Bowker and Tuffin, 2002) - that could be very enabling and help people overcome stigmatisation. However, due to the nature of their disabilities and the limitations that people with learning disabilities experience, removing barriers and helping people to benefit from digital inclusion is a much more complex task. Tsatsou (2011) argues that digital inclusion is a multi-faceted concept and needs to be viewed that way in order to understand the challenges that people with cognitive disabilities face. Tsatsou (2019) proposes that digital exclusion includes access and cost problems, material asset inequalities, lack of skill and unsustainable everyday life contexts. Digital literacy pays a key role in the challenges that people with learning disabilities face. It has been suggested that digital literacy at its very core can be viewed as certain skills and knowledge (Tsatsou, 2019), the more recent research suggests that self-efficacy is instrumental too (Helsper and Eynon, 2013). Self-efficacy is defined as one's belief in one's own capability to organise and execute the courses of action required to manage prospective situations', moreover, that belief is created through mastery experiences (Bandura, 1997).

In terms of the reasons for digital exclusion, Britto, T., and Pizzolato, E. (2016) suggest that software developers have a very limited understanding of the needs of people with disabilities and how to meet those needs. Borg, Lantz, and Gulliksen (2015) suggest that there is not enough research to provide the best understanding of the accessibility needs, requirements, and preferences of people with cognitive disabilities. And while with the change of the law, the awareness of the importance of accessibility is growing,

those who design and develop interfaces often lack practical knowledge of how to implement accessibility, they lack focus on people with disabilities, and may not have the right skills (Leite et al, 2021). Chadwick, Wesson and Fullwood (2013) argue that access is often binder by a number of factors, including carers' attitudes as well as societal priorities and values, and educational opportunities.

3. RESEARCH METHODOLOGY

3.1. DESIGN OF THE STUDY

A mixed methods study was chosen as the design for this research.

The two parts of our study were as follows:

a) In order to assess the users' views on visual aesthetics and to help to select the stimuli for the second part of the research, Tractinsky's questionnaire (Lavie and Tractinsky, 2004) was used to assess classical and expressive aesthetics of 6 prototypes. Prior to that a survey of online blogs and articles was conducted in order to have an overview of the most recent trends in visual aesthetics of web design.

b) Qualitative interviews with people have learning disabilities.

3.2. PARTICIPANTS

For the first part of the research participants were randomly recruited online - via social media. 24 people agreed to fill in the questionnaire. Amongst the 24 participants, 5 were male and 19 were female.

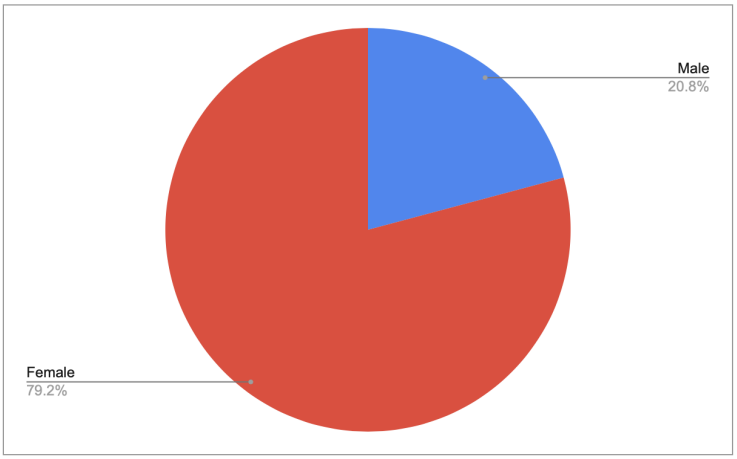


Figure 1: Gender distribution of participants - quantitative study

The participants aged between 31 and 70:

- 14 were aged between 31 and 40,
- 8 were aged between 41 and 50
- 2 were between 61 and 70.

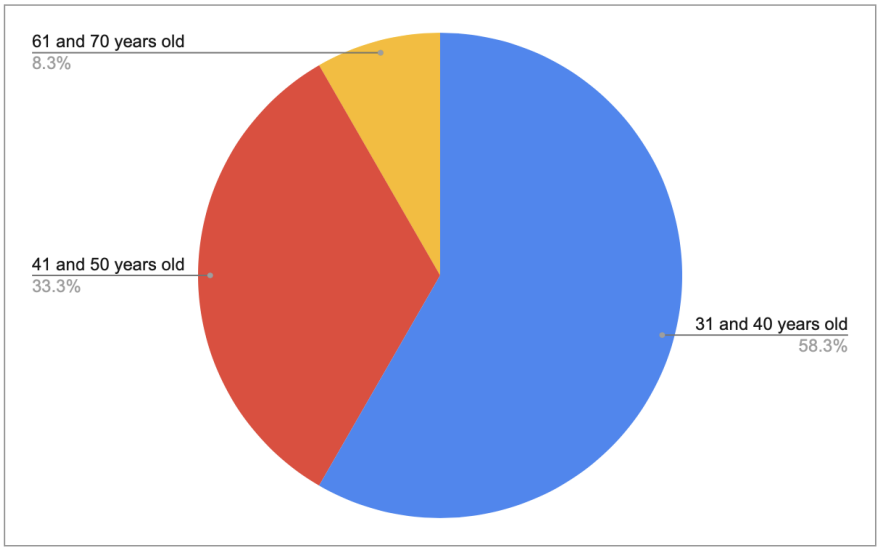


Figure 2: Age distribution of participants - quantitative study

These were mostly people without any disabilities (two participants said they considered themselves to have a learning disability and one said ‘maybe’). The decision to not deliberately include people with learning disability was based on the study carried out by Park et al. (2018) where they concluded that aesthetic judgments on artwork by a group of people with Autistic Spectrum Disorders were significantly different compared to the control group.

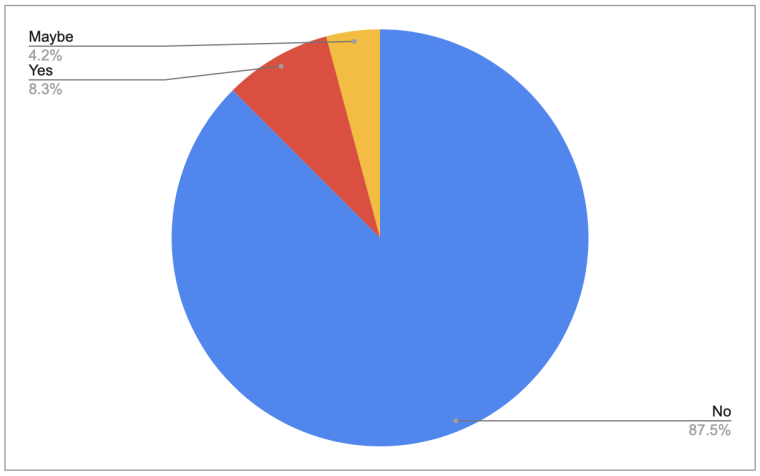


Figure 3: Disability distribution amongst the participants - quantitative study

The second part of the research involved people with very mild learning disabilities - they were recruited via the organisations that provide support for people with learning disabilities. The criteria for the participant selection was - formal diagnosis of a cognitive disability (in the UK it is more often referred to as a learning disability), receiving minimal formal support (funded by the state), access and use of the internet and basic understanding of the process of online shopping. Amongst the participants, 2 were male and two were female; some of the participants were members of various advocacy

groups for people with learning disabilities. There were 5 participants who agreed to take part in the study - 4 of them were interviewed via Zoom and one person was interviewed in person. All the participants had the capacity to make the decision regarding their participation. Informed verbal consent was given before the start of each interview.

Inclusive research was chosen because it allows people with lived experience to be seen as instigators of ideas, disseminators and users (Wamsley and Johnson, 2003). Nind (2014) argues that inclusive research overlaps with participatory research because both involve ‘democratic relationships to produce knowledge which incorporates participants’ everyday knowledge, and enables them to be part of the solution to problems’. She also suggests that inclusive research could be seen as an umbrella term for participatory, emancipatory and participatory action research (Nind, 2014). Inclusive research allows people with learning disabilities to be seen as experts in their own lives and can be agents for change because their voice can be heard (Johnson, Minogue and Hopklins, 2014). Wamsley and Johnson (2003) argue that such ‘research is seen as holistic in nature, concerned not to fragment the individual, but rather to focus on freeing their voices and enabling a consideration of lived experience, taking into account the broader context of lives’. According to Wamsley and Johnson (2003) it was normalization and social role valorization that paved the way to people with learning disabilities being included in research, it did not seek people’s views, but assumed the knowledge of them - and that is the risk that accessibility research could face when the voices of those who have the lived experience are excluded. Besides, including people with learning disabilities in the research can provide a richer understanding of a problem

space from a different perspective (Sloan, 2016). Besides, the choice was influenced by the shift in the way vulnerable people are seen in the professional settings currently in the UK - those with lived experiences are being referred to as ‘experts by experience’ (McLaughlin, 2009). It acknowledges the value of working alongside people with learning disabilities and values their specialist knowledge rooted in their experience, it acknowledges and affirms the expertise of the other (McLaughlin, 2009). People with lived experience have increasingly been involved in the work of regulatory and governing bodies, in defining policies and procedures (McLaughlin, 2009).

3.3. INSTRUMENTS

While there are quite a few well established tools for assessing visual aesthetics and these include Tractinsky’s questionnaire, Attrakdiff and WisAWI, Tractinsky’s questionnaire (Lavie and Tractinsky, 2004) was chosen as the tool for data collection and a 7-point Likert scale was used to assess the various aspects of visual aesthetics, with 1 meaning ‘strongly disagree’ and 7 - 'strongly agree’. Tractinsky’s questionnaire is considered to be one of the most validated approaches to measuring the aesthetics of websites (Willigen, 2019) and therefore it was the tool of choice for this part of the study. It is used to measure perceived aesthetics through the evaluation of the following facets of visual aesthetics: clean, clear, aesthetic, pleasant, symmetric, creative, fascinating using special effects, original, sophisticated (Sonderegger et al, 2014). The aim of the fist part of this study was to find out participants’ opinion on the visual aesthetics of the prototypes, to ask them to evaluate and to judge the aesthetic value of the prototypes. The advantage of using Tractinsky’s questionnaire is that it is fairly simple and straightforward when compared to other tools; the tool measures the two dimensions of

visual aesthetics - classic and expressive, it asks ten questions. VisAWI for example, measures 4 facets of vual aesthetics - Simplicity, Diversity, Colorfulness and Craftsmanship (Moshagen and Thielsch, 2013) and asks participants to evaluate 18 aspects of visual aesthetics (Moshagen and Thielsch, 2010). Meanwhile, Attarkdiff assesses pragmatic and hedonic qualities and consists of 28 adjective pairs that aim at measuring pragmatic quality, identification, stimulation, and appeal of products (Hassenzahl, 2004; Hassenzahl et al., 2003). Tractinsky's questionnaire appears to be more simple and the distinction between classic and expressive aspects of aesthetics could facilitate making interviews with the participants who have cognitive difficulties more accessible.

Semi-structured qualitative interviews were conducted to gain insight into the perceived accessibility of the two prototypes - the one that scored highest and lowest on the questionnaire. The aim of the second part was to understand the views and perceptions of individuals. Qualitative research was chosen for the second part of the study reasons because it is considered to be the best way to understand people's experiences (Dennyand Weckesser, 2019).

Semi structured interviews were chosen in order to give the flexibility for the researcher to engage with participants in a more person-centred way and to be able to adapt to the communication needs of each participant, to collect the open-ended data, to explore the participants' thoughts and feelings, to understand their experiences better (DeJonckheere and Vaughn, 2019). It was assumed that not all the participants might be able to engage in conversation in the uniform way due to their unique disabilities and therefore the interviews needed flexibility.

3.4. STIMULI

Prior to the development of the prototypes, an interview with one person with learning disabilities was conducted to find out the kind of websites that might be designed especially for people with disabilities. The interviewee suggested holiday websites - there are companies that specialise in providing assisted (supported) holidays for people with disabilities and are often used by those who may not have much formal support in their day-to-day lives due to the nature of their disabilities and who have support structures in place to enable their independence, but who might need to have more support when going away to new and unfamiliar environments.

After the interview, an online research was conducted to find the websites of the companies that provide both supported holidays for people with disabilities and holidays for non-disabled adults. On top of that, an online survey of the most recent articles and blogs was done in order to find out the most recent trends in visual aspects of web design. The table bellow gives an overview of the most commonly quoted visual features of good web design:

Design element	Features of the design element
Colours	Gradients, dark mode, black and white, low light, bold colours, colour branding, shadows, negative colours, light colours,
Fonts	Bold font, playful typography effects, elegant serif fonts, breaking typography rules

Shapes	Simple shapes, black outlines
Interactions	Non-traditional scrolling, scroll triggered animation, dynamic scrolling, hover gallery menu, playful cursors
Layout	Modern minimalism, layers and overlap, white space, floating elements, grid design, full page headers, streamlined navigation
Use of media	Illustrations, mixing illustration and realism, animations, 3D, user triggered animation, hand drawn elements, liquid animations, use of emojis, embedded videos, impactful and engaging stories, college art, creative and atypical product photos, black and white illustrations, seamless surrealism

Table 2. The current trends in visual design

Then, six high fidelity prototypes were created - the design of each one of them was based on the current trends in web design; some prototypes were inspired by some of the websites that provide supported holiday services for people with learning disabilities.

Participants who filled in the quantitative questionnaire had access to all six prototypes and were able to browse and interact with each one of them.

Once the data from the questionnaires was analyzed and the final two prototypes with the highest and the lowest scores were chosen, the prototypes were further developed to add more interactivity and to enable the participants to complete a task that resembled real life experience relating to booking a holiday.

Participants in the qualitative part of the study were asked to firstly browse around the first prototype in order to get familiar with it. Then they were asked to complete a task - to find out the price of a particular holiday during one particular week. Afterwards, they followed the same procedure with the second prototype. All 5 participants were asked to complete the same taks. Due to technical difficulties, two participants were unable to share their screens, therefore instead of navigating through the prototypes themselves, they were asked to guide the researcher while she was sharing her screen with the participants.

3.5. PROCEDURE

For the first part of the study, participants were asked to assess the visual aesthetics of the 6 website prototypes. Participants were asked to express their agreement/disagreement with various statements relating to the expressive and classical aesthetics of each website prototype.

After the data was collected, the mean average scores for each prototype were counted in order to find out the prototypes with the highest and the lowest scores. Moreover, the confidence intervals for each sore were counted and a two-dimensional graph was used to visualize the data.

Once the data of the questionnaires was analysed, two prototypes were chosen for the second part of the research. The two prototypes were chosen based on the mean average scores of their aesthetic value - the one with highest and the lowest scores. The confidence intervals were used to make the final decision regarding the scores that were close in their value.

The second part of the study aimed to collect qualitative data relating to visual aesthetics and cognitive accessibility. The interviews were recorded with the participants' verbal consent. The recordings were then transcribed, all the information that could identify the participants was removed, and in vivo coding was carried out in order to assign labels to the raw data. Later, the data from the interviews was matched with the data from observations and themes were defined. The researcher's expertise (a wide variety of previous work done with people with learning disabilities in a large number of professional settings) was used to interpret some of the data.

4. RESULTS

4. 1. PART 1 - TRACTINSKI'S QUESTIONNAIRE

Tractinsky's questionnaire was used to help choose the stimuli with highest and lowest aesthetic values. The mean average scores and confidence intervals at 95% level for each prototype were calculated.

	OVERALL AVERAGE SCORE	MARGIN OF ERROR at 95% CONFIDENCE LEVEL
Prototype 1	4.46	0.62
Prototype 2	4.47	0.61
Prototype 3	2.90	0.66
Prototype 4	2.79	0.72
Prototype 5	5.60	0.45
Prototype 6	5.17	0.55

Table 3: Mean average scores and confidence intervals for the 6 prototypes.

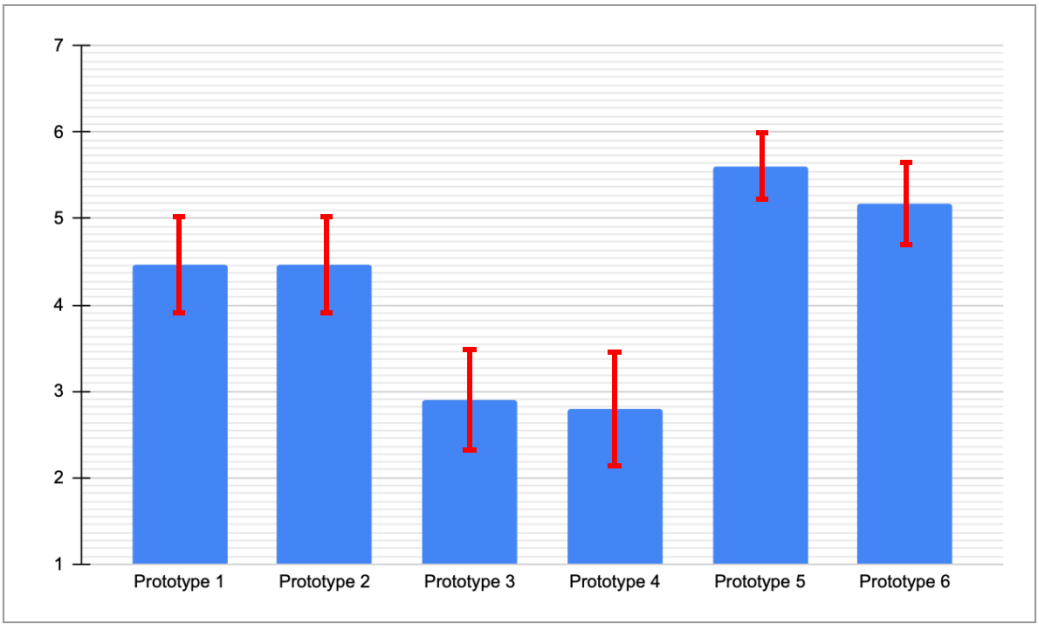


Figure 4: Bar chart showing the mean average scores for each prototype and their 95% confidence intervals

Figure 1 suggests that Prototype 5 has the highest aesthetic value with its overall average score being 5.60. In terms of the lowest scoring prototypes number 3 and 4 came close - Prototype 3 scored an average of 2.9 and Prototype 4 scored 2.79. However, the confidence interval at 95% was narrower for Prototype 3, therefore it was chosen as a second stimulus for the second part of the research.

4. 2. PART 2 - QUALITATIVE INTERVIEW THEMES

Thematic analysis was carried out on both, the interviews and observations of the user behaviours. The researcher's expertise was used to interpret the findings and to discover the themes. The diagram bellow shows the themes of the qualitative interviews:

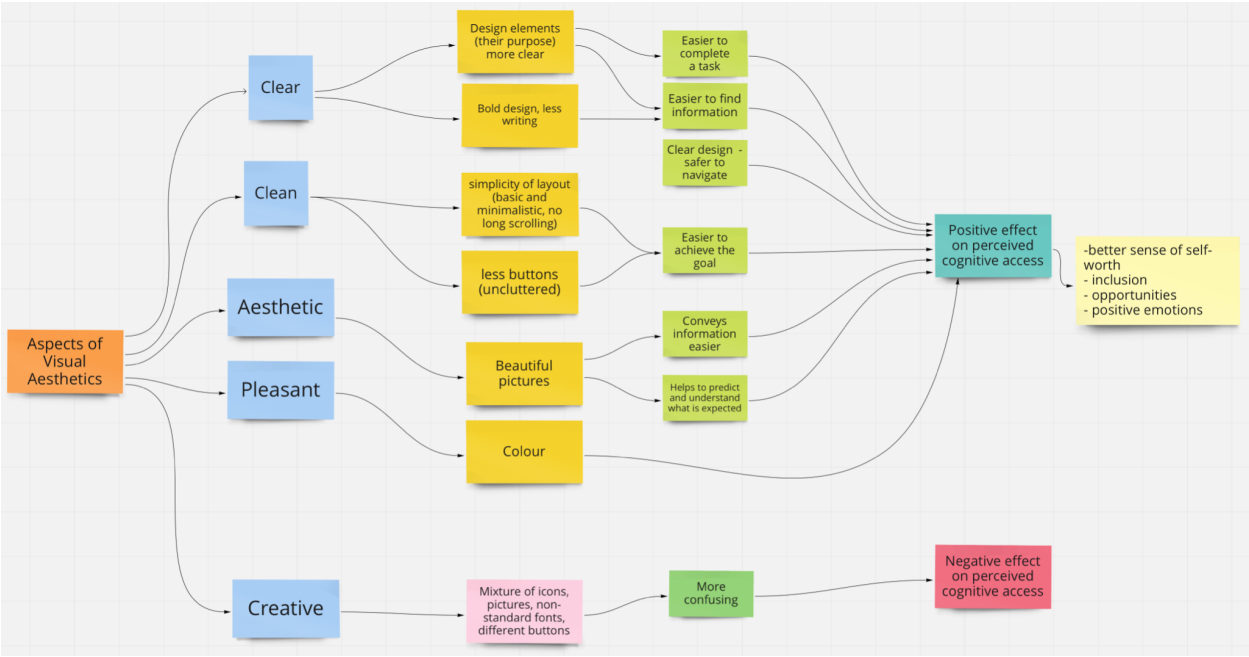


Figure 5: visual representation of the thematic analysis of the results of the qualitative interviews.

The first four attributes of visual aesthetics are in order of their importance of their influence on perceived cognitive access with ‘clarity’ being seen as the most significant facet with the biggest impact; whilst the last attribute - creative - could potentially have a negative impact on access. The themes of the interviews are summarised in the following way:

1. Clear visual aesthetics through boldness and uniformity of design features make it easier to find information, and therefore increases accessibility.
2. Features of visual aesthetics that help to achieve a clean interface through simple and minimal layout can enable the users to achieve their goals easier.
3. The right use of beautiful pictures can create a sense of a more aesthetic design and that can help convey information easier, help the users to predict and

understand what is expected of them - that in turn can lead to better perceived accessibility.

4. Colour made Prototype 3 more visually appealing.
5. The 5th attribute - creative - seemed to have the opposite effect on the perceived cognitive accessibility.
6. Accessibility is the priority - numerous positive effects of good accessibility were identified.

Before the themes are explained in more detail, it should be noted that 4 out of 5 participants thought that the interface that they perceived as more beautiful, was also seen as more accessible. They thought that Prototype 3 was more visually appealing when compared to Prototype 5 - meanwhile the quantitative questionnaire results suggested the opposite.

Participant code	Higher Aesthetic Value	Better Perceived Cognitive Access
Participant 1	Prototype 3	Prototype 3
Participant 2	Prototype 3	Prototype 3
Participant 3	Prototype 3	Prototype 3
Participant 4	Prototype 5	Prototype 3
Participant 5	Prototype 3	Prototype 3

Table 4: Participants' choice of the prototypes with the higher aesthetic value and better cognitive access.

Below are details of each of the themes.

4.2.1. CLEAR VISUAL AESTHETICS THROUGH BOLDNESS AND UNIFORMITY OF DESIGN FEATURES MAKE IT EASIER TO FIND INFORMATION, AND THEREFORE INCREASES ACCESSIBILITY

Participants spoke about the importance of clarity in their perception of beauty - which was achieved through certain features of design such as bold font and other bold features in Prototype 3. Boldness was seen as part of the clear and beautiful design - this referred to the choice of the qualities of the font, the size of the icons, pictures that had high contrast. ‘Clear writing’ and buttons being used in an obvious and uniform way also helped to access the prototype that was seen as more beautiful.

When interacting with Prototype 5 participants did not notice some of the buttons as they did not immediately look like buttons in the most traditional sense (some of them did not have an outline of a button, for instance). When navigating through Prototype 5 Participant 2 seemed more reluctant to choose certain buttons to click which indicated lack of clarity in some of the elements of the design.

Furthermore, some icons were confused for buttons (for instance, when trying to complete the task while interacting with Prototype 5, Participant 4 tried clicking on the icons that were there for illustration only, then eventually the person asked for help) - all of this affected the participants’ ability to complete the tasks easier, some participants needed prompts to click on the right part of the interface as there were possibly too many elements that might have appeared clickable.

The participants spoke about less writing and more pictures as being more visually appealing - it also helped the participants to find information easier. All the participants

were able to read so understanding written information was not an obstacle to access; however, the participants said that fewer words was more visually appealing.

4.2.2. FEATURES OF VISUAL AESTHETICS THAT HELP TO ACHIEVE A CLEAN INTERFACE THROUGH SIMPLE AND MINIMAL LAYOUT CAN ENABLE THE USERS ACHIEVE THEIR GOALS EASIER

There were certain features of visual aesthetics that the participants identified as contributing to the cleanliness of the design that they thought to be more beautiful - simple layout and the use of a limited number of design elements. For instance, Participant 1 spoke about not having ‘too many things to click on’ on their preferred prototype as a more appealing feature of the visual aesthetics.

The person also said that ‘It's a lot easier to be able to just navigate to... things simpler’ which referred to the perceived simplicity of Prototype 3.

While appearing quite confident in processing information, Participant 4 did require a few prompts to scroll down in order to find the required information on the prototype that she chose as a less accessible one. Shortened pages and less scrolling could contribute to the sense of simplicity of the page which in turn can be seen as more clean. Participant 5 faced similar challenges - she needed a few more prompts to scroll through certain pages of Prototype 5 and considered it to be less beautiful.

4.2.3. THE RIGHT USE OF BEAUTIFUL PICTURES CAN CREATE A SENSE OF A MORE AESTHETIC DESIGN AND THAT CAN HELP CONVEY INFORMATION EASIER, HELP THE USERS TO PREDICT AND UNDERSTAND WHAT IS EXPECTED OF THEM

Participants agreed that pictures help to access information easier.

Most of the participants agreed that pictures affected the perceived aesthetic value of the prototypes; for instance, when asked what made a certain prototype more beautiful one of the first answers was ‘pictures’. The images participants 2, 3 and 5 liked in prototype 3 were described as ‘more exotic’. Participant 2 observed that the pictures that were thought to be more beautiful were represented ‘somewhere I would like to go’. Participant 2 observed that pictures helped to understand and predict what was expected of them and that helped them to take the next steps with more ease. Participant 4 also pointed out that the pictures with a higher aesthetic value enabled the person to manage their own expectations and to know what to anticipate.

4.2.4. COLOUR MADE PROTOTYPE 3 APPEAR MORE VISUALLY APPEALING

Two participants said that colour made prototype 3 more attractive - the predominant colour in the prototype was blue. One of the participants described the colours as bright and colourful. Those two statements referred to the prototype that they thought to be both more beautiful and more accessible. However, it was not obvious how colour could have contributed to better cognitive access.

4.2.5. THE 5TH ATTRIBUTE - CREATIVE - SEEMED TO HAVE THE OPPOSITE EFFECT ON THE PERCEIVED COGNITIVE ACCESSIBILITY

Participant 1 has mentioned that while prototype 3 was more beautiful, he thought that Prototype 5 was more pretty, that was also the less accessible prototype from the point of view of that participant. When comparing the two prototypes, the word ‘pretty’ seems to have referred to the creative aspect of the visual aesthetics. Participant 1 said: ‘I tell you one thing the first one to me was a lot more easy to click at things. Second one was.. its prettier design, it took a little bit more time to work out how to find where to click’. Prototype 5 did have a higher number of icons, the fonts were not the most commonly used ones, gradients were used in the design as well some buttons overlaid photos.

4.2.6. ACCESSIBILITY IS THE PRIORITY - NUMEROUS POSITIVE EFFECTS OF GOOD ACCESSIBILITY WERE IDENTIFIED

While current academic literature and modern practices emphasize the importance of aesthetics, most participants agreed that creating interfaces that are beautiful is important, the results of the interviews suggest that accessibility is the priority - this is the topic that people were able to engage with and relate to much easier. This seemed to be the construct that had the bigger impact on the quality of their lives - people spoke about negative emotions that they experience when struggling with cognitive access, the effect that poor accessibility has on their self esteem and sense of inclusion, their ability to participate, on their emotional wellbeing and independence.

5. DISCUSSION

The interviews of people with disabilities have revealed a number of values that they as a group hold and were nicely summed up by one of the participants who said that ‘technology should be created for everyone’. This echoes the promise that the emergence of the internet made - it has the potential to make information and services accessible for more people due to its ubiquity (Saltes, 2013; Willliams and Henning, 2015). It needs to be acknowledged that accessibility and inclusion of people with disabilities has been of concern since 1997 and issues rating to internet access received a considerable amount of attention from various researchers (Saltes, 2013). However, the participants were very clear that more work needs to be done to ensure that people with disabilities are given equal opportunities to enjoy using the internet, accessing information and services that are both designed for them and for the rest of the population.

Those who are on the edge of society have a desire to be included, to be offered the same opportunities and to enjoy the same rights. The participants in this research were in agreement with the current government goals that advocate for the need for greater accessibility (Digital Skills and Inclusion Policy, 2017) through which better inclusion and personal outcomes can be achieved. Participants were able to name a number of ways that lack of access can have an effect on them - negative experiences can lead to one feeling lost and frustrated, it affects one’s independence and that can lead to lower self-esteem which in turn has been found to reduce the quality of most aspects of one’s life - worsen mental health, reduce the quality of social interactions, increase in one’s vulnerability (NHS, n.d.). When aspiring to design interfaces that are person centred,

empathy is considered to be at the very core of the human centred design process (Dam and Siang, 2020). Gasparini (2015) defines empathy as a phenomenon with two dimensions: emotional and cognitive. Emotional empathy requires the designer to be able to feel what the other person feels and cognitive empathy enables one to understand the other person's feelings (Gasparini, 2015). Therefore, when designing interfaces that meet the accessibility standards, it is important to honour the experiences of those who are likely to face the consequences of bad design through the negative experiences of inaccessible design. While ideally, every design team should include a wide range of users when testing their products, this may not be easily achieved in real life due to a number of limitations, therefore studies that give a voice to the experiences of people with disabilities are crucial in capturing that information.

It was mentioned earlier that the participants with learning disabilities chose Prototype 3 as the more beautiful and more accessible; meanwhile, this prototype had one of the lowest scores in Tractinsky's questionnaire. These results agree with the findings of the study conducted by Park et al in 2018 where they found that people with an autistic spectrum disorder diagnosis reported the artwork to be less beautiful when compared with the control group of neurotypical participants. The quoted study concluded that these results were due to the neurological differences that were related to how one's brain processes aesthetic experiences. Numerous studies carried out by other scientists suggested the relationship between visual aesthetic evaluation and brain activity (Jacobsen et al, 2006, Kornysheva et al, 2010). A study done by Hesslinger, Carbon and Hecht (2017) suggested that our aesthetic judgement is influenced by a number of factors that do not relate to visual aesthetics directly, such as pressure to conform, and

a sense of being watched. Moreover, there are many other factors that influence our perception of beauty - education, background, experience (Fritzsche and Oz, 2007). While it could be argued that due to neurological differences, people with learning disabilities chose Prototype 3 as a more beautiful one because their ability to make aesthetic judgement was affected, the analysis of the interviews suggests that with accessibility being of high value for people with learning disabilities, this might have affected their choice for the more beautiful prototype. This also suggests that cognitive accessibility and visual aesthetics are interrelated, that aesthetic judgement is made in the context of each person's life.

The finding of this current research suggests that it is the classical features of visual aesthetics that have a higher impact on perceived cognitive accessibility. The analysis of the interviews suggests that it is the cleanliness, clarity and aesthetics of the design that should be prioritized. Creativity (which is a part of expressive aesthetics) on the other hand, if not used carefully can obstruct users' ability to successfully interact with interfaces. This was also suggested by Mbipom (2013) where results of her study allowed her to conclude that there was significant correlation between classical aesthetics and accessibility; it we also concluded that expressive dimensions showed no such correlation.

Lewis, C. (2011) argues that it in order to optimise cognitive accessibility, interfaces should be clear. The interview conducted for this research seems to support this idea - the analysis of the interview data suggests that bold and simple fonts and other design elements as well as clear intention for each design element enables easier access. It

was the prototype that was viewed as more beautiful that used bold and large font for headings, had bold and obvious arrows that indicated direction of scrolling.

The analysis of the interviews and observations suggested that participants thought that the elements of interface design should have a clear and more explicit purpose. For some people it was not obvious that certain elements of the design were actually clickable on Prototype 5. And in that way, some of the information was easily missed. It appears that while the less explicit buttons might have been part of the creative design of the interface, they did not have the same affordance as the ones on Prototype 3.

In terms of cleanliness, participants identified simplicity of the layout and a more minimalistic design (with fewer buttons and shorter pages that require less scrolling) as the features that can help one achieve better perceived cognitive accessibility.

One participant spoke about design features (such as pictures) that helps one understand what is expected of them, which then makes it easier to make decisions regarding taking the steps in achieving one's goal. One of the struggles that people with disabilities face when communicating is understanding the implicit meaning. The interviews suggest the same for the design elements - it might have been harder for people with learning disabilities to understand the implied meaning of some of the features of the design, particularly those that might have been considered to be more creative. It is key, therefore, to make the purpose of design elements as explicit as possible as well as to maintain the uniformity of various elements.

Most of the participants have agreed that it was pictures that contributed to the interface being perceived as more beautiful and more accessible - this suggests the importance

of choosing the right pictures that both communicate the right information to the right audience and that are visually appealing.

Based on the finding of this research, the following recommendations for achieving more aesthetically pleasing and accessible interfaces are proposed:

1. Use a simple layout to ensure that the users are able to achieve their goal easily.
2. Reduce the length of scrolling.
3. Use the smallest number of buttons/interactive elements to help the users to achieve their goal.
4. The design elements should have a clear purpose.
5. Combine bold design features with fewer words.
6. Use pictures as a way to communicate a message.
7. Effective use of pictures should enable users to predict and understand expectations.

6. CONCLUSION

The aim of this study was to investigate the effect that perceived visual aesthetics has on perceived cognitive accessibility. The results of the study suggest that certain facets of classical visual aesthetics (clear, clean and aesthetic) can have a positive impact on perceived cognitive accessibility. Design features such as simple and minimalistic layout, reduced scrolling were seen as more visually attractive and contributed to a better cognitive access; design elements that have a clear purpose, that help users to understand expectations have the potential to increase accessibility. The results also suggest that expressive aesthetics that relate to creativity and originality could possibly be an obstacle to perceived cognitive accessibility. Despite the efforts of the United Nation and many other institutions who advocate for the rights of people

with disabilities, research suggests that a lot still needs to be done for a genuine inclusion to happen. This can be facilitated through our better understanding of the negative effects of digital exclusion which can contribute to better person centred design outcomes.

6.1. LIMITATIONS

There are several limitations affecting the study. Only a small number of people with disabilities were interviewed and they may not have represented a wider group of people with learning disabilities as well as a bigger group could have.

The interviews were conducted mostly online and that could have limited the opportunities to collect richer data, it also might have affected people's ability to participate in the research as some of them were less confident in using some features of Zoom application.

Moreover, the interviews were analysed by only one researcher and that could limit the objectivity of the analysis; having a secondary opinion could have possibly provided more insights into the data interpretation and conclusions.

6.2. FURTHER WORK

Further studies could examine the relationship between each individual attribute of visual aesthetics and cognitive accessibility to gain better understanding of dynamics to provide more detail of what elements of visual aesthetics have the potential to both create more beautiful interfaces and make them easier to access for those with learning disabilities as well as the neurotypical population.

The study was small scale and therefore a study that includes more people with learning disabilities could be helpful in order to confirm the findings and to also see how results differ across groups of people with different learning disabilities.

REFERENCES:

Aguilar, A., Boerema, C. and Harrison, J. (2010) Meanings attributed by older adults to computer use. *Journal of Occupational Science,* 17:1, 27-33, DOI: 10.1080/14427591.2010.9686669

Aizpurua, A., Harper, S., & Vigo, M. (2016). Exploring the Relationship between Web Accessibility and User Experience. *International Journal of Human-Computer Studies*, 91, 13-23. https://doi.org/10.1016/j.ijhcs.2016.03.008

Aizpurua, A., Arrue, M. and Vigo, M. (2013). Uncovering the Role of Expectations on Perceived Web Accessibility. *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility, ASSETS 2013.* DOI: 10.1145/2513383.2513411.

Alsudani, F. and Casey, M. (2009). The effect of aesthetics on web credibility. People and Computers XXIII Celebrating People and Technology - Proceedings of HCI 2009. 512-519. DOI: 10.1145/1671011.1671077.

Avery, C. (2005). *Only Screen Deep? Evaluating Aesthetics, Usability, And Satisfaction In Informational Websites*. Downloaded from: https://www.semanticscholar.org/paper/Only-Screen-Deep-Evaluating-Aesthetics%2C-Usability%2C-Avery/c0804c92edd60957e622a2a2a937fe2ef142cf71

Bandura, A. (1997). *Self-efficacy: the exercise of control.* W H Freeman/Times Books/ Henry Holt & Co.

Balsam, K. F., Martell, C. R., Jones, K. P., & Safren, S. A. (2019). Affirmative cognitive behavior therapy with sexual and gender minority people. In G. Y Iwamasa & P. A. Hays (Eds.), *Culturally responsive cognitive behavior therapy: Practice and supervision*, 287-314. American Psychological Association. https://doi.org/10.1037/000119-012

Böcker, M., Floratos, N., Martínez, L., Pluke, M., Von Niman, B. and Whitney G. (2016). *Cognitive accessibility to mobile ICT.* Computers Helping People with Special Needs. (ICCHP 2016), 13-15 July 2016, Linz, Austria. ISBN 9783319412634.

Bonnardel, N., Piolat, A. and Le Bigot, L. (2011). The impact of colour on Website appeal and users' cognitive processes. *Displays,* 32, (2), 69-80. DOI: https://doi.org/10.1016/j.displa.2010.12.002.

Borg, J., Lantz, A. & Gulliksen, J. (2015). Accessibility to electronic communication for people with cognitive disabilities: a systematic search and review of empirical evidence. *Univ Access Inf Soc,* 14, 547–562 (2015). https://doi.org/10.1007/s10209-014-0351-6

Bowker, N., & Tuffin, K. (2002). Disability discourses for online identities. *Disability & Society, 17*(3), 327–344. https://doi.org/10.1080/09687590220139883

Britto, T., & Pizzolato, E. (2016). Towards web accessibility guidelines of interaction and interface design for people with autism spectrum disorder. In *ACHI 2016: the ninth international conference on advances in computer-human interactions,* 1-7. Retrieved from: https://www.researchgate.net/publication/301552021_Towards_Web_Accessibility_Guidelines_of_Interaction_and_Interface_Design_for_People_with_Autism_Spectrum_Disorder

Braddock, D., Rizzolo, M.C., Thompson, M. and Bell, R. (2003). Emerging Technologies and Cognitive Disability. *Journal of Special Education Technology*, 19(4), 49-56. doi:10.1177/016264340401900406

Burmeister, O. K. (2010). Websites for Seniors: Cognitive Accessibility. *International Journal of Emerging Technologies and Society*, 8 (2), 99,113. DOI: https://researchoutput.csu.edu.au/ws/portalfiles/portal/8778491/PostpubPID22728.pdf

Cai, S. and Xu, Y. (2011). Designing Not Just for Pleasure: Effects of Web Site Aesthetics on Consumer Shopping Value. *International Journal of Electronic Commerce.* 15 (4). DOI: 10.2753/JEC1086-4415150405.

Cai, S., Xu, Y., Yu, J. and De Souza, R. (2008). Understanding Aesthetics Design for E-Commerce Web sites: a Cognitive-Affective Framework. *PACIS*. 60. DOI: https://aisel.aisnet.org/pacis2008/60

Chadwick, D., Wesson, C. and Fullwood, C. (2013). Internet Access by People with Intellectual Disabilities: Inequalities and Opportunities. *Future Internet*, 5, 376-397. DOI: 10.3390/fi5030376.

CDC. (2020). *Disability and Health Overview*. Retrieved 2 December 2020 from: https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html

Courtney-Long, E. A., Carroll, D. D., Zhang, Q. C., Stevens, A. C., Griffin-Blake, S., Armour, B. S., & Campbell, V. A. (2015). Prevalence of Disability and Disability Type Among Adults--United States, 2013. *MMWR. Morbidity and mortality weekly report*, *64*(29), 777–783. https://doi.org/10.15585/mmwr.mm6429a2

Dam, R.F. and Siang, T.Y. (2020). *Design Thinking: Getting Started with Empathy.* Retrieved from: https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy

DeJonckheere M. and Vaughn L. M. (2019). Semi Structured interviewing in primary care research: a balance of relationship and rigour. *Family Medicine and Community Health*. doi: 10.1136/fmch-2018-000057.

Denny, E. and Weckesser, A. (2019) 'Qualitative research: what it is and what it is not: Study design: qualitative research', *BJOG : an international journal of obstetrics and gynaecology*, 126(3), 369–369. DOI: 10.1111/1471-0528.15198.

Ferri, D. and Favalli. S. (2018). Web Accessibility for People with Disabilities in the European Union: Paving the Road to Social Inclusion. *Societies*, 8(2):40. DOI: https://doi.org/10.3390/soc8020040

Firth, A. (2019) Practical Web Inclusion and Accessibility. Apress. https://doi-org.libezproxy.open.ac.uk/10.1007/978-1-4842-5452-3_6

Friedman, M. and Bryen, D. (2007). Web accessibility design recommendations for people with cognitive disabilities. *Technology and Disability*. 19 (4), 205-212. DOI: 10.3233/TAD-2007-19406.

Fritzsche, D. and Oz, E. (2007). Personal Values' Influence on the Ethical Dimension of Decision Making, *Journal of Business Ethics,* 75, 335–343. https://doi.org/10.1007/s10551-006-9256-5

Gasparini, A. (2015). Perspective and Use of Empathy in Design Thinking. *Conference: Advancements in Computer-Human Interaction, ACHI 2015*. Retrieved from: https://www.researchgate.net/publication/273126653_Perspective_and_Use_of_Empathy_in_Design_Thinking.

Harper, S., & Michailidou, E. and Stevens, R. (2009). Toward a Definition of Visual Complexity as an Implicit Measure of Cognitive Load. *ACM Transactions on Applied Perception*, 6(2). DOI: 10.1145/1498700.1498704.

Helsper, E.J., and Eynon, R. (2013). Distinct Skill Pathways to Digital Engagement. *European Journal of Communication,* 28(6), 696-713. DOI: https://doi.org/10.1177/0267323113499113

Hesslinger, V.M., Carbon, C.C., and Hecht, H. (2017). Social Factors in Aesthetics: Social Conformity Pressure and a Sense of Being Watched Affect Aesthetic Judgments. *Iperception.* 8(6). DOI: 10.1177/2041669517736322. PMID: 29201336; PMCID: PMC5697602.

Hoffmann, R. and Krauss, K. (2004). A critical evaluation of literature on visual aesthetics for the web. 205-209. *Proceedings of the 2004 annual research conference of the South African institute of computer scientists and information technologists on IT research in developing countries*.

Horton, S. and Sloan, D. (2016). Accessibility for business and pleasure. *Interactions*. 23, (1), 80-84. DOI:https://doi.org/10.1145/2843590

Jacobsen, T., Schubotz, R.I., Höfel, L. and Cramon, D.Y. (2006). Brain correlates of aesthetic judgment of beauty. *Neuroimage, 29(1):276-85. DOI: 10.1016/j.neuroimage.2005.07.010*

Jaeger, P.T (2012). Disability and the Internet: Confronting a Digital Divide. Lynne Rienner Publishers.

Johnson, K., Minogue, G. and Hopklins, R. (2014). Inclusive Research: Making a Difference to Policy and Legislation. *Journal of Applied Research in Intellectual Disabilities,* 27, 76-84. DOI: https://doi.org/10.1111/jar.12085

Kornysheva, K., von Cramon, D.Y., Jacobsen, T. and Schubotz, R.I. (2010).Tuning-in to the beat: Aesthetic appreciation of musical rhythms correlates with a premotor activity boost. *Hum Brain Mapp*, 31(1):48-64. DOI: 10.1002/hbm.20844

Kulkarni. M. (2019). Digital accessibility: Challenges and opportunities. *IIMB Management Review*, 31, (1), 91-98. DOI: https://doi.org/10.1016/j.iimb.2018.05.009.

Lavie, T. and Tractinsky, N. (2004). Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*. 60 (2), 269-298. DOI: https://doi.org/10.1016/j.ijhcs.2003.09.002.

Leite, M. V. R., Scatalon, L. P., Freire, A. P. and Eler, M. M. (2021). Accessibility in the mobile development industry in Brazil: Awareness, knowledge, adoption, motivations and barriers. *The Journal of Systems and Software*, 177. DOI: https://doi.org/10.1016/j.jss.2021.110942

Lelkes, O. (2013). Happier and less isolated: Internet use in old age. *Journal of Poverty and Social Justice*, 21, 33-46. DOI: 10.1332/175982713X664047.

Lewis, C. (2011). Issues in Web Presentation for Cognitive Accessibility. *Universal Access in Human-Computer Interaction. Design for All and eInclusion*. Berlin, Heidelberg: Springer Berlin Heidelberg, 244–248. doi: 10.1007/978-3-642-21672-5_27.

Lindgaard, G., Fernandes, G., Dudek, C., & Brown, J. (2006). Attention web designers: you have 50 ms to make a good first impression! *Behaviour & Information Technology*. 25, 115–126. DOI: 10.1080/01449290500330448

Link, B.G. and Phelan, J.C. (2001). Conceptualizing Stigma. *Annual Review of Sociology*, 27 (1), 363-385. DOI: https://doi.org/10.1146/annurev.soc.27.1.363

Magni, G. and Bilotta, F. (2016) Postoperative Cognitive Dysfunction. In H. Prabhakar (Ed.), *Complications in Neuroanesthesia*, 411-427. DOI: https://doi.org/10.1016/B978-0-12-804075-1.00041-9.

McLaughlin, H. (2009) . What's in a Name: 'Client', 'Patient', 'Customer', 'Consumer', 'Expert by Experience', 'Service User'—What's Next? *British Journal of Social Work*, 39, 1101–1117. DOI:10.1093/bjsw/bcm155

Mbipom, G. (2009). Good visual aesthetics equals good web accessibility. *SIGACCESS Accessibility and Computing*. 93, 75-83. DOI: https://doi.org/10.1145/1531930.1531939

Mbipom, G. and Harper. S. (2011). The interplay between web aesthetics and accessibility. *The proceedings of the 13th international ACM SIGACCESS conference on Computers and accessibility (ASSETS 11)*. 147-154. DOI:https://doi.org/10.1145/2049536.2049564.

Miesenberger K., Edler C., Heumader P. and Petz A. (2019). Tools and Applications for Cognitive Accessibility. *Web Accessibility*. 523-546. DOI: https://doi.org/10.1007/978-1-4471-7440-0_28

Microsoft Design. (n.d.) *Inclusive Design*. Retrieved from: https://www.microsoft.com/design/inclusive/

Moshagen, M. and Thielsch, M. T. (2010). Facets of visual aesthetics. *International Journal of Human-Computer Studies*, 68 (10), 689-709. DOI: https://doi.org/10.1016/j.ijhcs.2010.05.006.

Moshagen, M. & Thielsch, M. T. (2013). A short version of the visual aesthetics of websites inventory. *Behaviour & Information Technology, 32* (12), 1305-1311. doi: 10.1080/0144929X.2012.694910

Moshagen, M., Musch, J. and Goritz, A. (2009). A blessing, not a curse: Experimental evidence for beneficial effects of visual aesthetics on performance. *Ergonomics*. 52 (10), 1311-1320. DOI: 10.1080/00140130903061717.

Moacdieh, N. (2015). *Eye Tracking: A Promising Means of Tracing, Explaining, and Preventing the Effects of Display Clutter in Real Time*. DOI: http://hdl.handle.net/2027.42/113627

NHS. (n.d.). Raising low self-esteem. Retrieved from: https://www.nhs.uk/mental-health/self-help/tips-and-support/raise-low-self-esteem/

Norman, D. (2002). Emotion & Design: Attractive Things Work Better. *Interactions Magazine*. 9, 36-42. DOI: 10.1145/543434.543435.

Norman, D. (2007). *Emotional Design*. New York: Basic.

Office For Disability Issues. (2021). Inclusive Language: Words to Use And Avoid When Writing About Disability. Retrieved from: https://www.gov.uk/government/publications/inclusive-communication/inclusive-language-words-to-use-and-avoid-when-writing-about-disability

Office for National Statistics. (2019). *Exploring the UK's Digital Divide*. Retrieved from: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/articles/exploringtheuksdigitaldivide/2019-03-04

Oliver, M. (2004). If I Had a Hammer: The Social Model in Action.In . Swain, S. French, C. Barnes, and C. Thomas. *Disabling Barriers - Enabling Environments*. (pp. 7–12). London: Sage.

Ordonez, T.N., Yassuda, M.S. and Cachioni, M. (2011). Elderly online: effects of a digital inclusion program in cognitive performance. *Archives of Gerontology and Geriatrics*, 53(2), 216-9. DOI: 10.1016/j.archger.2010.11.007.

Peng, X., Peak, D., Prybutok, V.R. and Xu, C. (2017). The Effect of Product Aesthetics Information on Website Appeal in Online Shopping. N*ankai Business Review International.* 8. DOI: 10.1108/NBRI-11-2016-0038.

Persson, H., Ahman, H., Yngling, A. and Gulliksen, J. (2014). Universal design, inclusive design, accessible design, design for all: different concepts - one goal? On the

concept of accessibility - historical, methodological and philosophical aspects. *Universal Access in the Information Society*. 14 (4). DOI: 10.1007/s10209-014-0358-z.

Peter, C. and Bradbard, D. A. (2009). Web Accessibility: An Introduction and Implications for a Corporate Social Responsibility Marketing Strategy. *Journal of internet commerce,* 6, 27-54. DOI: https://doi.org/10.1080/15332860802086185.

Postrel, V. (2004). The Substance of Style: How the Rise of Aesthetic Value Is Remaking Commerce, Culture, and Consciousness. Harper Perennial, NewYork.

Robins, D. and Holmes, J. (2008). Aesthetics and credibility in web site design. *Information Processing & Management,* 44, 386-399. DOI: 10.1016/j.ipm.2007.02.003.

Russell, K. (2004). Artefacts and affordance: the surface of meaning. *Working papers in Art & Design*. 3. DOI; http://hdl.handle.net/1959.13/34277

Saltes, N. (2013). Review of Disability and the Internet: Confronting a Digital Divide. *Canadian Journal of Disability Studies*, *2*(1), 94–98. https://doi.org/10.15353/cjds.v2i1.72

Shinohara, K., Bennett, C. L. and Wobbrock. J. O. (2016). How Designing for People With and Without Disabilities Shapes Student Design Thinking. *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility*. 229-237. DOI:https://doi.org/10.1145/2982142.2982158

Shinohara, K., Bennett, C., Pratt, W. and Wobbrock, J. (2018). Tenets for Social Accessibility: Towards Humanizing Disabled People in Design. *ACM Transactions on Accessible Computing.* 11 (1), 1-31. DOI: 10.1145/3178855.

Shawn Lawton Henry, S. L., Abou-Zahra, S. and Judy Brewer, J. (2014). The role of accessibility in a universal web. In *Proceedings of the 11th Web for All Conference (W4A 14)*, 17. DOI:https://doi.org/10.1145/2596695.2596719.

Schmutz, S., Sonderegger, A. and Sauer, J. (2018). Effects of accessible website design on nondisabled users: age and device as moderating factors. *Ergonomics*, 61(5), 697-709. doi: 10.1080/00140139.2017.1405080.

Scottish Government. (2021). A changing nation: how Scotland will thrive in a digital world. Retrieved from https://www.gov.scot/publications/a-changing-nation-how-scotland-will-thrive-in-a-digital-world/pages/no-one-left-behind/

Sieck, C.J., Sheon, A., Ancker, J.S., Castek, J., Callahan, B. and Siefer, A. (2021). Digital inclusion as a social determinant of health. *Digital Medicine,* 4, 52. DOI: https://doi.org/10.1038/s41746-021-00413-8

Sloan, D. (2016). Learning by involving people with disabilities in user research. Retrieved form: https://www.tpgi.com/learning-by-involving-people-with-disabilities-in-user-research/

Small, J., Schallau, P., Brown, K. and Appleyard, R. (2005). Web accessibility for people with cognitive disabilities. *CHI '05 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '05), 1793–1796. DOI: https://doi-org.libezproxy.open.ac.uk/10.1145/1056808.1057024

Steel, E.J. and Janeslätt, G. (2017) Drafting standards on cognitive accessibility: a global collaboration. *Disability and Rehabilitation: Assistive Technology,* 12(4), 385-389. DOI: 10.1080/17483107.2016.1176260

Theuma, M. (2006). *Evaluating the Aesthetics of Websites.* Retrieved from: http://web4.cs.ucl.ac.uk/uclic/distinction-projects/2007-theuma.pdf

The W3C Web Accessibility Initiative (WAI). (n.d.).*Cognitive Accessibility at W3C*. Retrieved from: https://www.w3.org/WAI/cognitive/

Trinder, L. (2008). Introduction: The Context of Evidence Based Practice. *Evidence-Based Practice: A Critical Appraisal*. Wiley.

Tsatsou, P. (2011). Digital divides revisited: What is new about divides and their research? *Media, Culture & Society,* 33, 317–331. DOI: 10.1177/0163443710393865.

Tsatsou, P. (2019). Digital inclusion of people with disabilities: a qualitative study of intra-disability diversity in the digital realm. *Behaviour & Information Technology*, 39, 1-16. DOI: 10.1080/0144929X.2019.1636136.

Tsatsou, P. (2020). Is digital inclusion fighting disability stigma? Opportunities, barriers, and recommendations. *Disability & Society*. 10.1080/09687599.2020.1749563.

Thompson, S. (2018). Mobile technology and inclusion of persons with disabilities. Retrieved from: https://assets.publishing.service.gov.uk/media/5b43205a40f0b678b369e262/Mobile_tech_and_inclusion_of_persons_with_disability.pdf

Van der Vlugt, A. L., Curl, A. and Wittowsky, D. (2019). What about the people? Developing measures of perceived accessibility from case studies in Germany and the UK. *Applied Mobilities, 4:2, 142-162*. DOI: 10.1080/23800127.2019.1573450

Walmsley, J., and Johnson, K. (2003). *Inclusive Research with People with Learning Disabilities : Past, Present and Futures*, Jessica Kingsley Publishers. Retrieved from: https://ebookcentral.proquest.com/lib/open/detail.action?docID=290818.

Wilde, D. and Marti, P. (2018). Exploring Aesthetic Enhancement of Wearable Technologies for Deaf Women. *Designing Interactive Systems Conference*. 201–213. DOI: https://doi-org.libezproxy.open.ac.uk/10.1145/3196709.3196777

Vicente, M. and Lopez-Menendez, A. (2010). A Multidimensional Analysis of the Disability Digital Divide: Some Evidence for Internet Use. *Inf. Soc*.,26, 48-64. DOI: 10.1080/01615440903423245.

World Health Organization. (2001). *International Classification of Functioning, Disability and Health (ICF)*. Retrieved from: https://www.who.int/classifications/international-classification-of-functioning-disability-and-health

W3C (World Wide Web Consortium). (2021). *Cognitive Accessibility User Research.* Retrieved from: https://w3c.github.io/coga/user-research/#intellectual-disability

W3C (World Wide Web Consortium). (2021). *Making Content Usable for People with Cognitive and Learning Disabilities.* Retrieved from: https://www.w3.org/TR/coga-usable/

Xenakis, I. and Arnellos, A. (2013). The relation between interaction aesthetics and affordances. D*esign Studies*. 34, 57-73. DOI: 10.1016/j.destud.2012.05.004.

Yaneva, V., Temnikova, I. and Mitkov, R. (2015). Accessible Texts for Autism: An Eye-Tracking Study. In *The 17th International ACM SIGACCESS Conference of Computers and Accessibility.* DOI: 10.1145/2700648.2809852.

Yesilada, Y., Brajnik, G., Vigo, M. & Harper, M. (2015). Exploring perceptions of web accessibility: a survey approach. *Behaviour & Information Technology,* 34:2, 119-134, DOI: 10.1080/0144929X.2013.848238

Zhang.J., Purgathofer. P, Brereton M., Fitzpatrick, G. , and Guldenpfennig, F. (2016). Handle the Way: Enhancing Web Accessibility for People with Disability. *Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems (DIS 16 Companion)*, 117-120. DOI:https://doi.org/10.1145/2908805.2909403.

Zentel, P., Opfermann, M. and Krewinkel, J. (2007). Multimedia learning and the Internet: ensuring accessibility for people with learning disabilities. *Journal of Assistive Technologies*, 1 (1), 22-3. https://doi.org/10.1108/17549450200700005

APPENDIX

Appendix A: Transcript of the information for Participant Consent

Hi, my name is Raimonda. I live in Scotland. And I work in L'Arche. And I'm also student at Cyprus University of Technology and Tallinn University. I'm working on my research project for my Master's degree. And I need a bit of help. I am looking for people with learning disabilities who use the internet and who have access to a computer. In my research I'm looking at visual aesthetics and accessibility. And I want to know your opinion on these subjects. If you said yes to helping me out, we would arrange a zoom call And we would look at two fake websites. Then I would ask for your opinion on what was beautiful and what was not so beautiful. I would also want to know your opinion on accessibility - how easy or difficult it was to understand information that was there and to achieve the goal. During the interview I will not ask for any personal information, and I will not judge your ability to use the internet. I would like to record our conversation so that later I could go back and analyse the data. The recording would not be made public. When writing about my research I will not use your name or any information that could somehow identify you. If you said yes to this and later change your mind later it's perfectly ok. I'll be very happy to delete the interview and would not use the data collected. Our chat would last no longer than 45 minutes. And I hope it would be enjoyable. So if you have time to spare and would like to help please send me an email which is right below this video. And I'm looking forward to meeting you. Thanks a lot.

Appendix B: list of websites used for they survey of current web design trends

https://elementor.com/blog/web-design-trends/

https://www.webfx.com/blog/web-design/modern-web-design/

https://medium.com/nyc-design/top-11-web-design-trends-to-rule-in-2020-912e0a5bac8e

https://designmodo.com/web-design-trends-2020/

https://www.bluecompass.com/blog/web-design-trends-to-watch-for

Appendix C: Guiding Questions for Qualitative Interviews

1.	Which prototype did you think was more beautiful?
2.	What made it more beautiful? What did you like about it?
3.	Why did you think the other prototype was less beautiful?
4.	Whis prototype did you think was more accessible? Why?
6.	Do you think it is important to create beautiful websites? Why?
7.	Why do you think accessibility is important?

Appendix D: Screenshots of Prototypes

1. **Prototype 1**

Caring Supported Holiday

Welcome to Sunshine Holidays!

HOME | 1-1 tailor made holiday | New Forrest | The Carribean | Accessible camping trip

questions@sunshine.com

5 night break in August 2021

Enjoy a four night holiday staying in apartments in a peacefully tucked away complex in the New Forest. The complex has a large indoor swimming pool and jacuzzi, bar and restaurant and nightly entertainment.

We may visit The New Forest Railway, a 5 mile long heritage. We will have our picnic lunch on board the train with teas and coffees. After we will enjoy tea and cakes in the café and visit the museum and gift shop.

We will also visit Castle and Gardens, the ancient fortress home built in the 12th century. The beautiful Butterfly House within the old walled kitchen garden is a must and next door to the tea rooms where after we will all enjoy tea and cakes and a visit to the gift shop.



2. Prototype 2

Holiday for all

Home | Holidays | Team | Contact

- Mountains
- Beach
- City break

Supported holiday
for those who need some help.

3. Prototype 3

DisabilityHolidays.com

Types of the holiday we offer

ACCESSIBLE CRUISE HOLIDAY

CRUISE HOLIDAY

Enjoy the holiday of a lifetime every time you cruise with us. At B&O Cruises we want to give you a holiday to remember, filled with special occasions and memorable moments. From the friendly greeting you receive as you step on board, to Black Tie nights where the entire ship dresses to the nines, or from a lazy afternoon of pampering in The Retreat, to a romantic dinner in our restaurant, everything about your B&O Cuises holiday will make you feel special.

LUXURY HOLIDAY IN SPAIN

We offer fully accessible villas situated within 30 mintes drive from the airport. The villas are suitable for six people. Each one has three

DisabilityHolidays.com

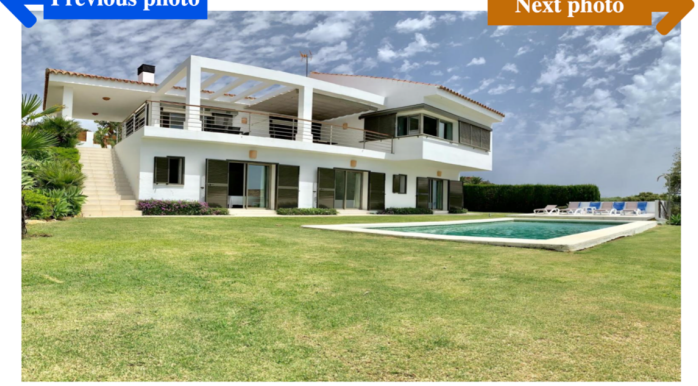
HOME | TYPES OF HOLIDAY | TEAM | WHY US? | CONTACT

Luxury villa holidays in Spain

From £1300

Previous photo

Next photo

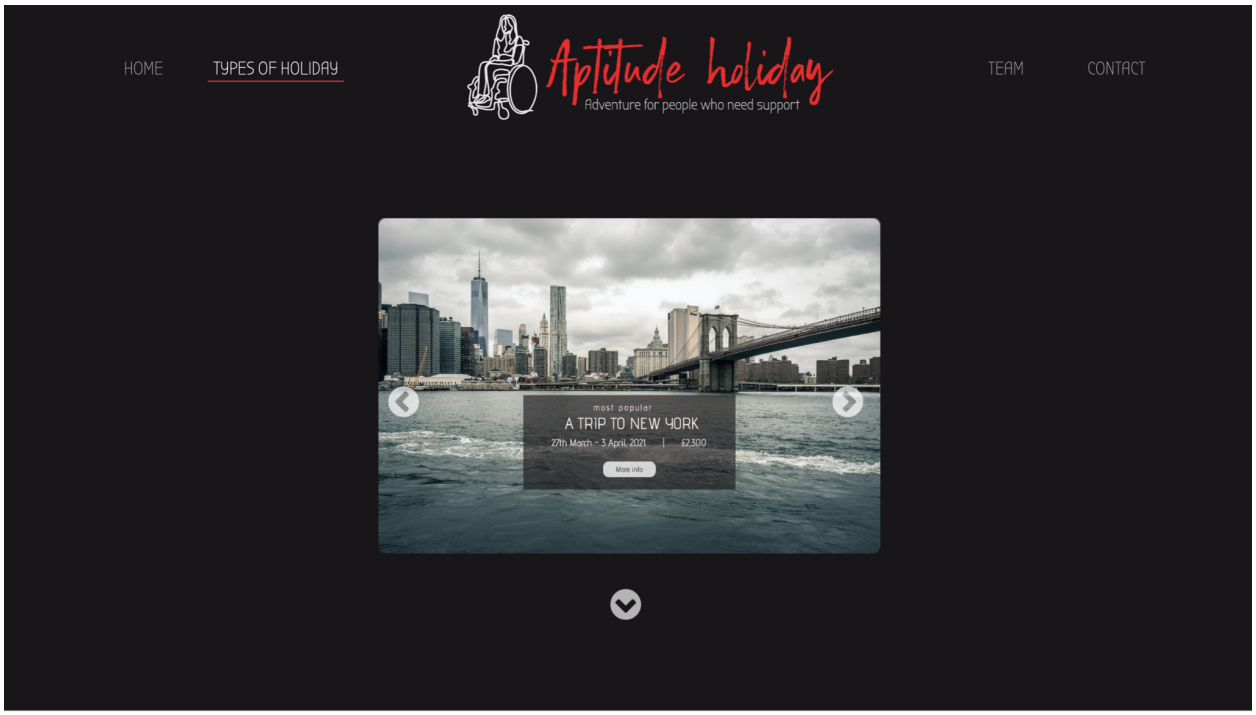


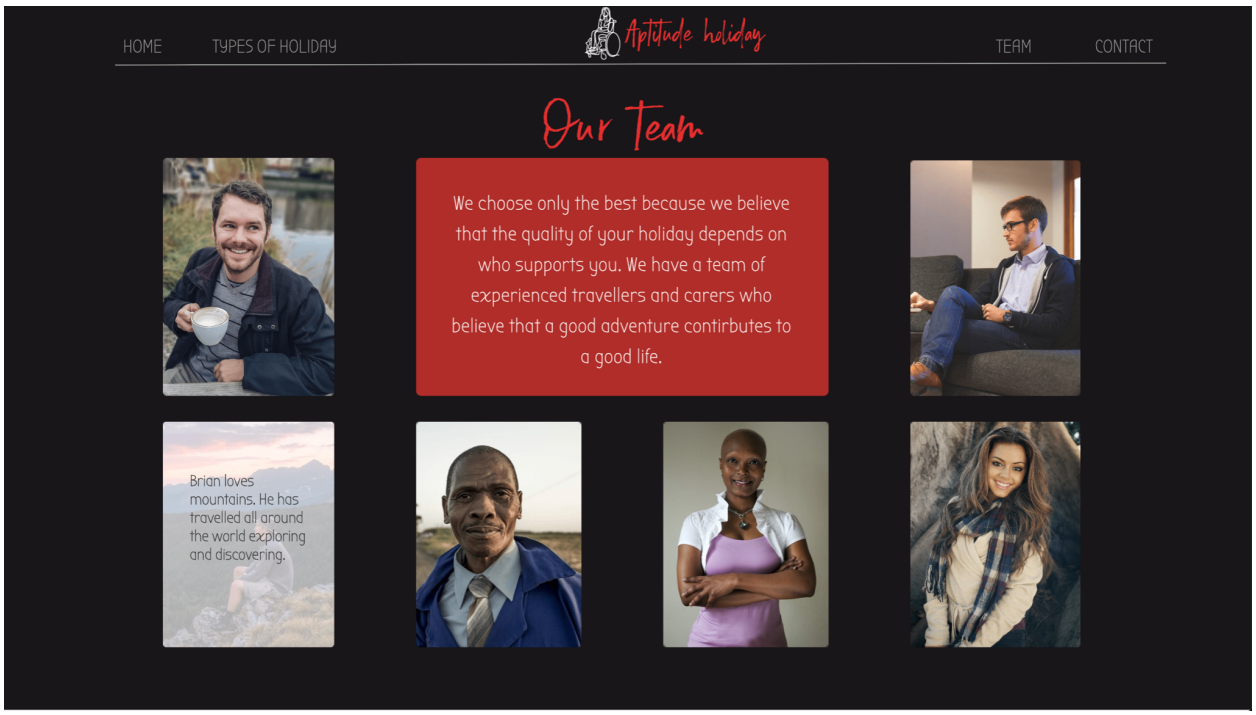
Favourites:

Cruise trip

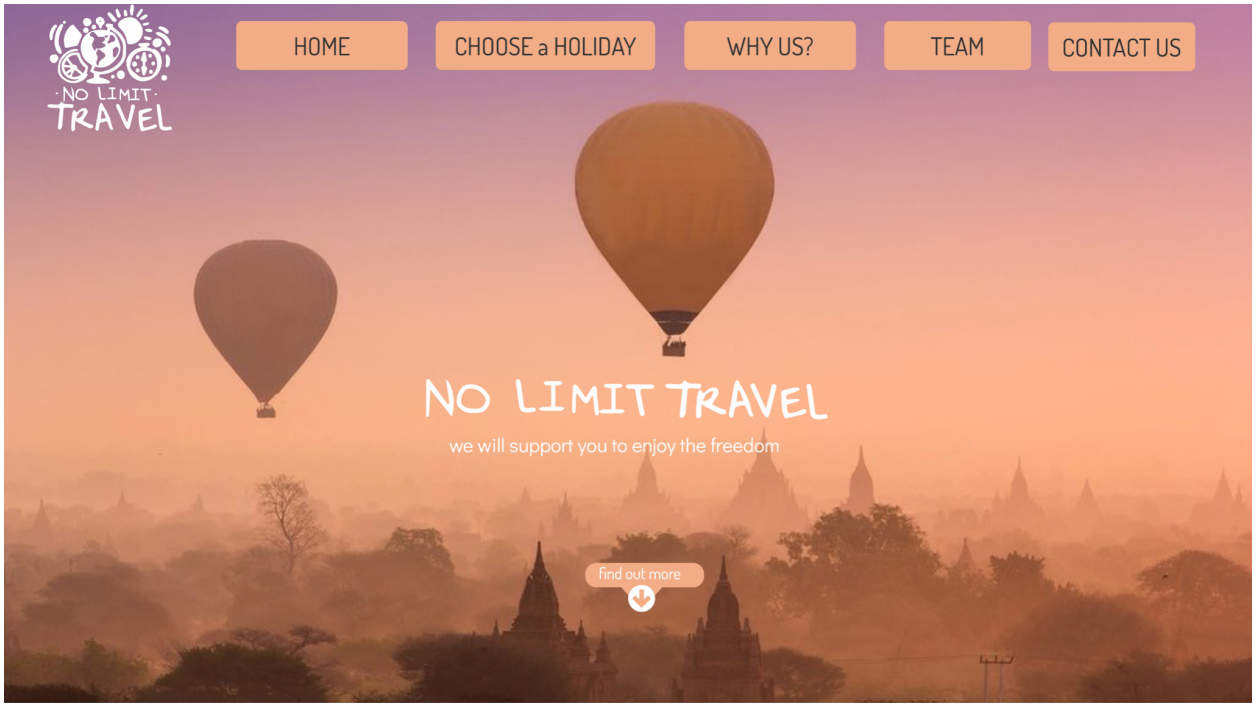
Vietnam tour

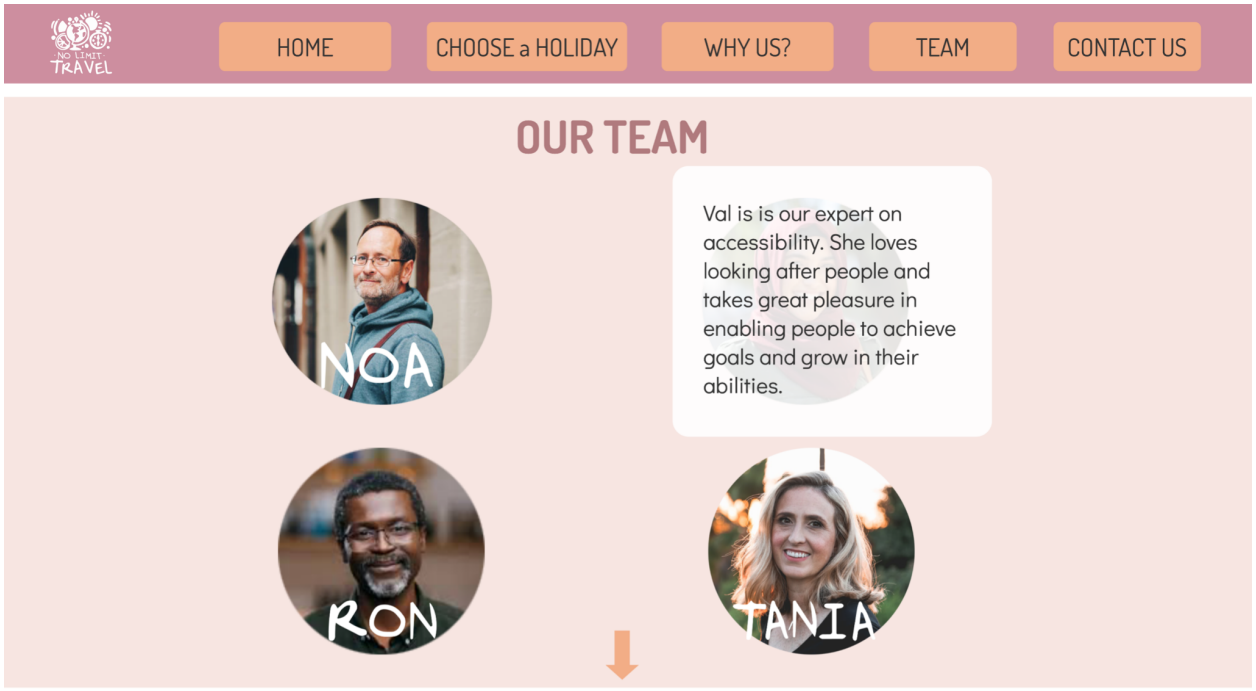
4. Prototype 4

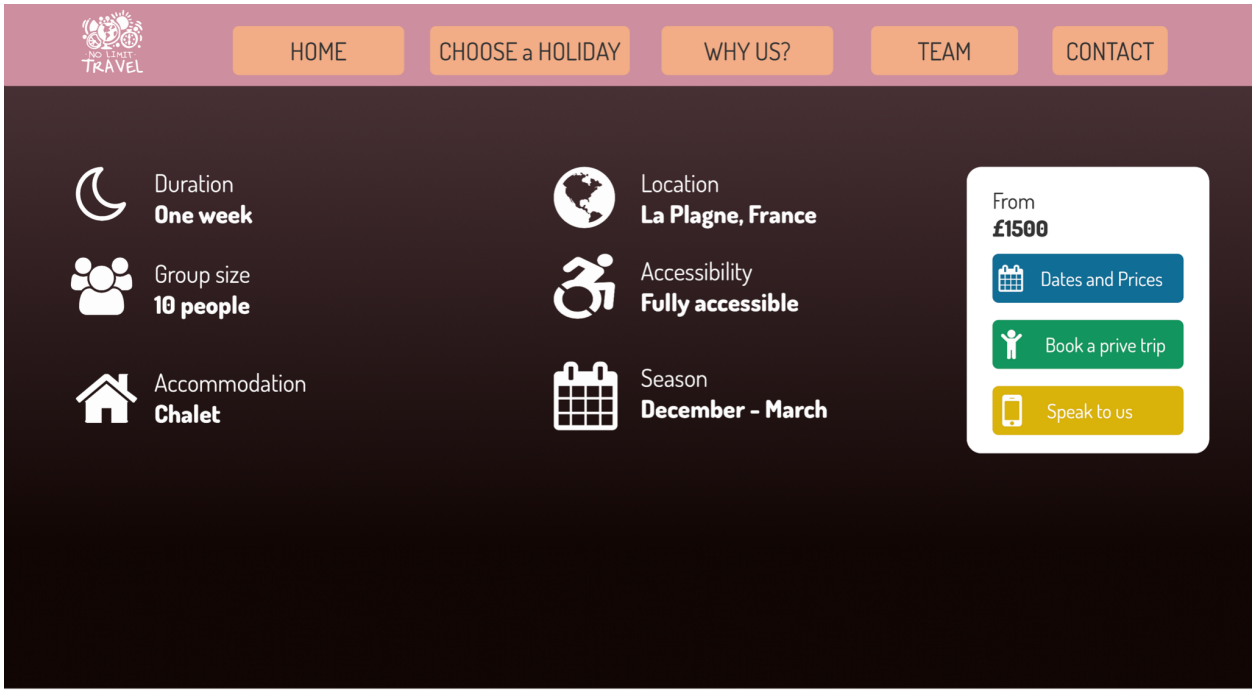


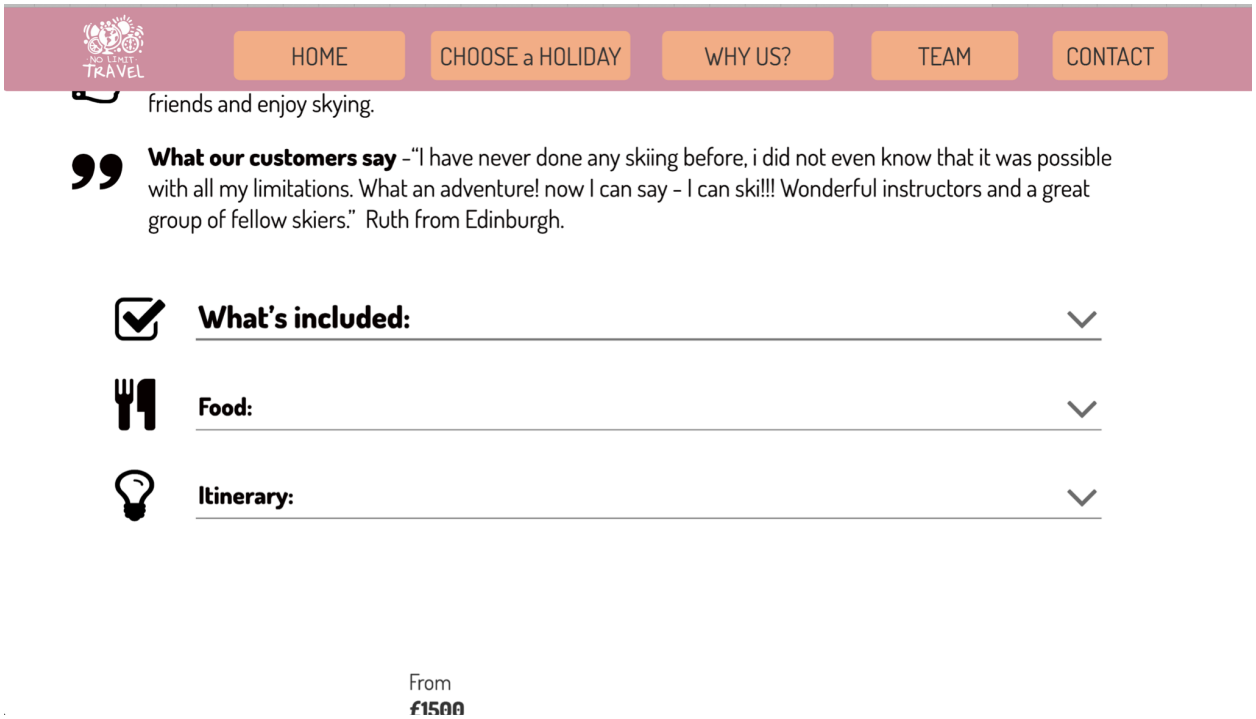


5. Prototype 5

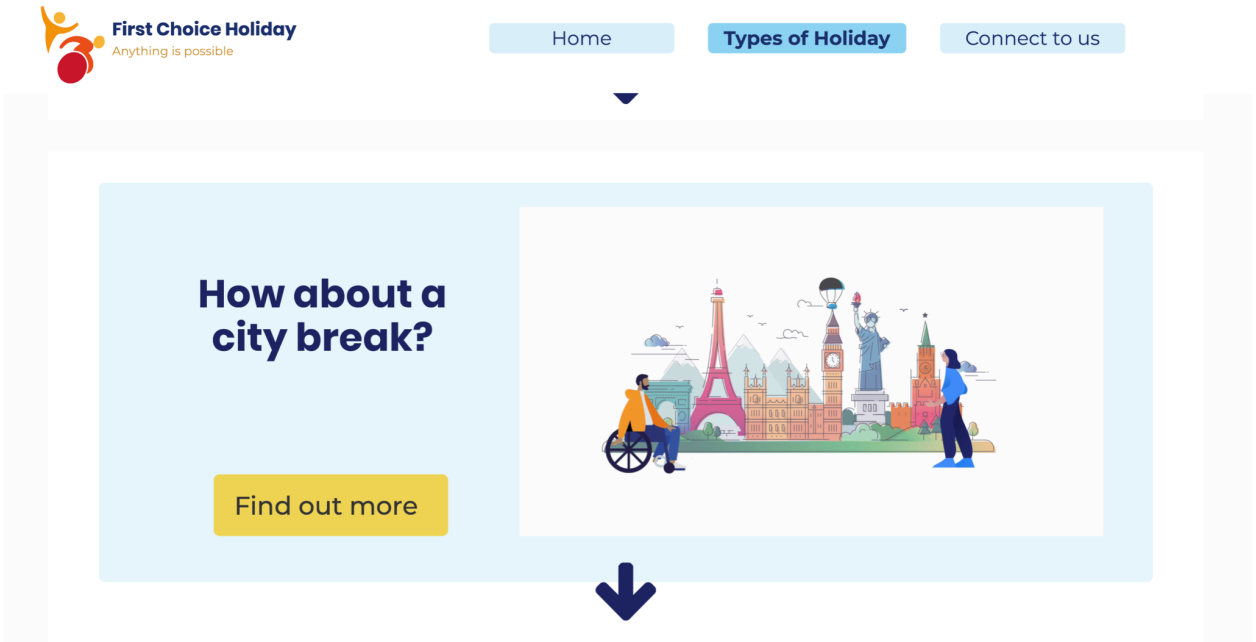





HOME
CHOOSE a HOLIDAY
WHY US?
TEAM
CONTACT
Duration
One week
Location
La Plagne, France
Group size
10 people
Accessibility
Fully accessible
Accommodation
Chalet
Season
December - March
From
£1500
Dates and Prices
Book a prive trip
Speak to us


HOME
CHOOSE a HOLIDAY
WHY US?
TEAM
CONTACT
friends and enjoy skying.
What our customers say -"I have never done any skiing before, i did not even know that it was possible with all my limitations. What an adventure! now I can say - I can ski!!! Wonderful instructors and a great group of fellow skiers." Ruth from Edinburgh.
What's included:
Food:
Itinerary:
From
£1500

6. Prototype 6



First Choice Holiday
Anything is possible

Home | Types of Holiday | Connect to us

Different ways to connect to us

Lets talk on Zoom -we speak BSL

Arrange a BSL/video call

Send us an email

Send us an email

Speak to us on the phone

Arrange a phonecall