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Accessibility in Social Media

Facebook and the Older Adult

ANGIE JEANSSON HALL
ARSHED AL-HADEETHI
JENNY GUSTAFSSON

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Author(s):	Angie Jeansson Hall, Arshed Al-Hadeethi, Jenny Gustafsson
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Abstract:	In recent years, there has been a substantial increase in the percentage of seniors using social media, yet few studies have been conducted to understand the challenges underlying social network utilisation by seniors. By understanding what motivates seniors to use social media, the difficulties they encounter while using them and what would be an inclusive social media from their perspective is paramount for designing inclusive user interfaces that suit this growing population. This study explores the accessibility challenges faced by older adults, specifically those aged over sixty, when using social media platforms by focussing on Facebook as a case study. Through a heuristic evaluation and a user study this research assesses Facebook's compliance with Web Content Accessibility Guidelines (WCAG) and specific usability issues faced by people over sixty. The focus is on understanding the barriers that hinder effective engagement of older adults on social media platforms. Our findings highlight significant areas where Facebook fails to meet accessibility standards, potentially leading to digital exclusion of the elderly. The study also discusses the broader implications of these findings, emphasising the need for more inclusive design practices in social media platforms to accommodate the diverse needs of older adults. This research seeks to contribute to the field of inclusive design and accessibility by providing insights into how social media platforms can become more accommodating and accessible to older users.
Keywords:	Older Social Media Users; Heuristic Evaluation; Inclusive Design; WCAG Compliance; Digital Exclusion; Facebook Usability; User Study.

Contents

1 Introduction

Technology is evolving at a phenomenal rate, and alongside this evolution the aged population in the world is rapidly increasing. According to the *World Health Organisation* (WHO) (2022), by 2020 the number of people over sixty outnumbered children under five, and the proportion of the world's population over 60 years of age is projected to almost double from 12% in 2015 to 22% in 2050. This is estimated to be 2.1 billion people (World Health Organisation, *Ageing and Health*, 2022)

There are multiple fields and disciplines involved in technological development. The field of *Information Architecture* (IA) focuses on creating a systematic organised design which users consuming content and designers generating content can easily assimilate (Benyon, 2019). Within this field *User Experience Design* (UX-design) is the discipline focussed on human-centered design to create interfaces with emphasis on the experience of the user (Benyon, 2019).

Accessibility in UX-design, is the practice of designing to ensure people with physical disabilities, situational disabilities, and socio-economic restrictions on bandwidth and speed can access websites unhindered. Inclusive design refers to creating products and services that can be used by as many people as possible, regardless of age, ability, or situation. This approach is particularly important for older people (defined as 60+ in this research) as it considers their specific needs and aims to address digital exclusion.

For everyone, regardless of age, to be able to use online services, they must be accessible and easy to use. Because people over sixty make up a significant percentage of the population, it is important to consider their needs, which differ from those of younger users, due to age-related physical, cognitive, and sensory changes.

Having access to *social media platforms* (SMPs) allows us the freedom to remain connected to loved ones, our communities, and the world at large. Social media is of particular interest with so many people using it daily. Statistics show that there is a considerable gap in social media use between young adults 18–29-year-olds at 84%, and older adults 65-year-olds and up at 45% (Auxier & Anderson, 2021). It is essential to address accessibility issues and lack of inclusive design for older adults, which we will do through analysis of the popular SMP, Facebook. Facebook is the SMP that older adults (50+) in Sweden, USA and other countries use the most (Internetstiftelsen, 2022; Kakulla, 2023).

Sinclair and Grieve (2016) highlight the need for communication to stay connected with the world amidst decreased physical connectedness among older people.

1.1 Problem Definition

Jung and Sundar (2016) note that "senior citizens […] have been overlooked in previous SNS[1] studies". In recent years, there have been numerous studies conducted on older adults in a social media context which will be outlined in the section *Previous Research.* Despite this, accessible design in social media is not appropriately applied for adults aged 60+. To expand on this, while it is acknowledged that senior citizens face difficulties in website navigation and that many websites do not comply with current accessibility standards, our research aims to uncover the deeper, less understood aspects of these challenges. Specifically, we seek to understand the gaps in existing research regarding the accessibility needs of older adults on social media, and how these unaddressed needs contribute to their social and digital exclusion.

Social exclusion, where a person is partially or wholly excluded from social, economic, and cultural contexts, can in turn have a detrimental impact on health and longevity for this group (Stokes et al., 2021). Digital exclusion can create or enhance social exclusion. Jung and Sundar (2016) note that most older adults use Facebook to stay connected with family and old friends, to plan social gatherings or events, and to look at photos. However, there is a lack of detailed understanding of how the design and functionality of SMPs like Facebook may inadvertently marginalise older users, and what specific aspects of these platforms need to be reevaluated to enhance accessibility and inclusivity.

In 2023, 50 % of Swedish persons born between 1920-1949 used social media every day, while the percentage was at 45% in 2022 and 60% of persons born during the 1950s, increasing from 58% in 2022 (Internetstiftelsen, 2022). These statistics indicate a growing need to address the accessibility barriers that prevent older adults from fully engaging with social media, which our study aims to explore.

Yang and Khoo (2020) set out to research if older adults' Facebook use had an indirect effect on their executive functions through perceived enhanced social support by family and friends, which is something that directly correlates with better executive functions during ageing. The findings were not fully conclusive regarding the cognition effect, but the perceived enhanced social connectedness was explicitly stated. Sinclair and Grieve (2016) also found that older adults experienced a greater social connectedness through their Facebook use and that this compensated partly for the social exclusion they experienced during retirement. A later study by Nam (2021) also found that Facebook use correlated positively with a perceived greater social support.

We believe best practice and branch standards should be adopted more widely to increase accessibility for older people. A more inclusive design, with emphasis on semantic structure, standards, and readability, may also improve non-disabled users' experiences. Comprehensive structured frameworks for evaluating web design specifically for older people may need to be either

[1] Social Networking Sites

produced or further developed. According to Funka (2022) adherence to official guidelines for accessible web design is still lacking in Sweden. An automatic test of 19 criteria (chosen from the 50 success criteria in WCAG 2.1 A and AA) in 2023 showed that only 309 out of 1784 public sector websites passed all 19 tests. WCAG 2.2, published in 2023, does not fully accommodate users with cognitive, learning, and language disabilities, where learning and cognitive decline are issues that are frequent among aging people (W3C, 2018). The upcoming, more thoroughly reworked WCAG 3.0, where special focus has been placed on learning and cognitive disabled users, is in development (W3C, 2023b). As age-related decline in functions is not classified as a disability, there is a risk that older adults are overlooked in the implementation of official guidelines, regulations, and best practice (European Commission, 2018; Funka, 2022; W3C, 2018, 2023b). The current WCAG guidelines and the EU accessibility directive are the closest to official frameworks and regulations at the time of this study

Research also shows that older people have difficulty recognising modern symbols and icons due to inexperience, and a reduced ability to learn because of the ageing process (Wilkinson & Cornish, 2018). Most websites contain symbols and icons, decreasing the likelihood of successful interaction for older adults.

Martin-Hammond, Patil and Tandukar (2021) discovered in their study of older adult website users, that people who did not self-report disabilities had problems accessing information on the studied website. These users also showed a lack in knowledge when it came to using in-built features in web browsers such as CTRL+ to zoom in/enlarge content on a webpage. According to the accessibility consult firm Funka's "inclusion barometer" in 2023 only 8% of the homepages of official websites in Sweden adhered to 19 of the 50 accessibility guidelines from WCAG 2.1 (levels A and AA). The test was based on WCAG 2.1) and included 19 of the 50 WCAG 2.1 level A and AA issues that European public sector websites are legally required to adhere to (Funka, 2022).

As discussed by Wilkinson and Cornish (2018) there have been suggestions to create adapted websites specifically for older adults, however this is not inclusive design and risks stigmatising older people by *othering* them. It is our opinion that making use of accessibility guidelines to create a user-friendly website will lead to an inclusive and functional website which all ages are able to enjoy, while still being accessible to older adults. While there is abundant research outlining the importance of social media for persons over sixty from a social perspective, there is still little research exploring the physiological and cognitive challenges preventing them from engaging in SMPs. We believe our research will be a start to informing future accessible design of these challenges and how they affect people over sixty.

Unfortunately, despite the importance of involving older users in the design process, it is common for websites and SMPs to fail to include older users in user testing. This may be due to insufficient awareness of the needs of older users, a lack of guidelines and tools to assess accessibility for this target group, or insufficient consideration of design methods.

1.1.1 The current state of accessibility standards

The European accessibility directive

Adopted 2016 (and updated based on WCAG 2.1 (Web Content Accessibility Guidelines, developed by the W3C consortium) 2019 by the *European Union* (EU) and adopted by the member states in 2019, the accessibility act applies to "products and services that have been identified as being most important for persons with disabilities while being most likely to have diverging accessibility requirements across EU countries (European Commission, 2018). These products and services include computers, operating systems, cash machines, smartphones, TV related equipment, telephone services, access to broadcasting, services related to travel, banking services, e-books, and e-commerce. The act applies to public websites and smartphone apps as of 2021.

The act defines disabled persons based on the UN Convention on the Rights of Persons with Disabilities, adopted in 2006. The UN convention defines disabled persons as to "include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others."

Age-related declines in functions are not considered disabilities, but rather expected effects of natural aging. This is evident in point 4 of the (European Commission, 2018)Directive (EU) 2019/790, 2019) which states that "Other persons who experience functional limitations, such as elderly persons, pregnant women or persons travelling with luggage, would also benefit from this Directive." This indicates that age-related disabilities are not viewed as something equally important as disabilities, in that these are grouped with pregnant or carrying heavy luggage. The directive continues: "The concept of 'persons with functional limitations', as referred to in this Directive, includes persons who have any physical, mental, intellectual or sensory impairments, age related impairments, or other human body performance related causes, permanent or temporary, which, in interaction with various barriers, result in their reduced access to products and services, leading to a situation that requires those products and services to be adapted to their particular needs" (Directive (EU) 2019/790, 2019).

People with age-related impairments are presented as part of a group that "will benefit" from the directive, while the focus is on accessibility for people with disabilities. In point 50, the directive elaborates on the development of services, applications, and systems, stating they should be rooted in a "design for all" approach from the start.

1.2 Objective

The main objective of this study is to investigate the accessibility challenges older adults encounter when using SMPs. The focus will be on defining the specific issues they face and the potential accessibility barriers that hinder their participation. We know from previous research that older adults face physiological and cognitive declines related to aging, however, not enough is

known about how these declines hinder successful participation in the digital world. This study intends to contribute knowledge of this through a user study.

Additionally, the study will explore various aspects of accessibility, considering cognitive and physiological challenges that may affect older adults' ability to effectively engage with SMPs. This involves assessing the design, features, and user interface elements of Facebook to pinpoint areas where accessibility and usability could be improved for older users. This will be achieved through an evaluation of accessibility compliance of Facebook's website. The analysis will be performed using existing WCAG accessibility guidelines.

1.3 Research Questions

What accessibility shortcomings exist in SMPs that hinder successful participation of people over sixty?

This is an important question because inaccessible design leads to exclusion (Stokes et al., 2021), and considering the growing population of older adults, neglecting their accessibility needs could amplify social isolation (Gomes et al., 2014). Moreover, in this case according to Gomes et al. (2014), it could even be viewed as discrimination of a specific group of users, as platforms and online services have a responsibility to cater to diverse user needs.

How do these accessibility shortcomings affect the participation of adults over sixty in social media?

1.4 Delimitations

This study combines a *heuristic evaluation* (HE) with a user study to evaluate accessibility compliance and the effect on older users. The focus of this study is SMPs using Facebook as a case study.

The purpose of our research is to identify compliance with WCAG 2.1 accessibility guidelines. User testing complemented our study by measuring the degree of difficulty experienced by people over sixty in using Facebook and identifying the challenges they faced.

This study is focused on older adults, specifically those aged sixty and above, as the primary group of interest. Although the findings may be relevant for other user groups with accessibility needs, the central emphasis is on highlighting the challenges and limitations experienced by older adults. The research is confined to the context of the social media platform Facebook, and it will not delve into other forms of digital communication, such as email or messaging apps, however, the result of this study may be applied to other digital artifacts. The central emphasis remains on highlighting the challenges and limitations experienced by older adults and the importance of accessible, inclusive design in SMPs.

The study highlights the importance of accessibility and usability issues related to the design and implementation of SMPs, rather than examining broader

aspects of social media use like privacy, security, or their impact on mental health. Furthermore, the scope of the study will be limited to the widely used social media platform, Facebook, which is the SMP that is most widely used by Swedish adults over 60 (Internetstiftelsen, 2023). Our focus for this research is Facebook's compliance with WCAG 2.1 accessibility guidelines as outlined in the WebAim checklist.

By establishing these delimitations, the research can offer focused insights into the specific age-related WCAG 2.1 compliance issues, and accessible design flaws, that older adults encounter when interacting with Facebook, which can be applied to other SMPs and digital artifacts.

1.5 Disposition

The structure of this paper provides a coherent roadmap of the topics addressed, guiding the reader through the complex terrain of accessibility and inclusive design for older adults, particularly in the context of SMPs like Facebook.

Chapter 2: Previous research

This section offers an in-depth review of existing literature focusing on older adults' engagement with Social Media Platforms, primarily Facebook. It elucidates on past research endeavours, existing findings, and areas where there is a gap in knowledge, laying a foundation for the current study's objectives.

Chapter 3: Theoretical framework

This section will establish the foundational theories and models that underpin the study. We will delve into key concepts like Information Architecture, User Experience Design, accessibility in UX-design, and inclusive design. These components will collectively provide the research with its conceptual structure.

Chapter 4: Method

This section details the methodologies employed in the research, from data collection to analysis. It will elaborate on the heuristic evaluation, the rationale behind its selection over user studies, and how the research aims to identify compliance/non-compliance with WCAG 2.1 accessibility guidelines. The chapter will also explain the tools and criteria used to evaluate Facebook's accessibility features for older adults.

Chapter 5: Results, discussion, and recommendations

Here, the findings from the heuristic evaluation of Facebook will be presented. The chapter will list the identified accessibility shortcomings and potential areas of improvement. These results will be discussed in the context of previous research, theoretical framework, and the overarching aim of promoting inclusive design for older adults.

Drawing from the research findings, this chapter will propose actionable recommendations for Facebook and other similar platforms to enhance their

accessibility features. These suggestions will prioritize a more inclusive online environment tailored to the needs and preferences of older adults.

Chapter 6: Conclusion

This concluding chapter will provide a summary of the research's key findings, their implications, and the significance of creating inclusive digital spaces for older adults. It will also highlight the study's contributions to the fields of inclusive design and accessibility, setting the stage for future research in this domain.

2 Previous research

2.1 Social Media and Older Adults (Social needs, interaction, uses)

In recent years, there has been growing interest in understanding the experiences and challenges of older adults in the context of SMPs. Key studies have investigated various aspects of older adults' engagement with social media, particularly Facebook, highlighting the importance of accessibility, usability, and inclusive design for this user group.

In their study on social media and older adults, Jung and Sundar (2016) identify key reasons motivating older adults to use Facebook. According to their survey of 352 adults over 60 years of age there are four main motivations, two of which, social bonding and social bridging, are identified respectively as the strongest motivators for using Facebook. The social benefit of SMPs to older people is obvious, however, according to Jung and Sundar (2016) younger people remain the largest user group, and as a result younger people remain the focus of research and design.

One notable study conducted Sacramento, Bacellar and Bicharra (2019) focused on the accessibility and communicability of Facebook for Brazilian elderly users. They found that older adults encountered challenges when it came to understanding and navigating the platform, indicating the need for more intuitive user interfaces and better support mechanisms. Sacramento et al. (2019) observed that older adults have difficulties understanding signs and symbols, due to a lack of experience and knowledge.

Recognizing the importance of inclusive design, Gomes et al. (2014) explored the development of a Facebook interface specifically for older adult users. Their work underlines the significance of adapting interfaces to accommodate older adults' preferences and cognitive abilities, ensuring a more seamless and enjoyable user experience.

Jung and Sundar (2016) found that interacting with other users through comments and messaging on threads is likely to lead to increased Facebook use, suggesting the importance of accessibility for older adults. Enabling older people to interact freely with Facebook can improve the likelihood of increased or sustained interaction and use.

SMPs offer unhindered access to social interaction and relationships. Users are not bound by location or time, making them a perfect tool for older adults to maintain social connections without travel. A lack of experience and negative perceptions coupled with design that does not account for this user profile means many older adults do not engage with SMPs (Arfaa & Wang, 2014).

Czaja et al. (2018) examined the potential of technology to improve social support for older adults. Their findings indicated that technology interventions could enhance older adults' social connectedness and well-being, further

emphasizing the importance of accessible and user-friendly SMPs for this user group.

2.2 Age-related declines and older adults' internet use

Rodrigues, Scuracchio and de Mattos Fortes (2018) conducted a literature review in which they identify areas to consider when designing websites for older people. They have identified four areas commonly affected by the ageing process: vision, hearing, motor skills, and cognition. According to the Web accessibility initiative: ageing education and harmonisation, European Commission/CORDIS EU research results electronic technology use by older adults is affected by changes in cognition and vision, for instance, the ability to reason, think, learn, and remember. Changes in cognitive abilities affect working memory, spatial memory, attentional functioning, text comprehension, and perpetual speed (European Commission, 2010). The World Health Organization highlights that Facebook icons, symbols, and language are tailored for younger users, which may lead to comprehension failures among older adults.

Wilkinson and Cornish (2018) note that decline in physiological or cognitive capabilities are not a guaranteed consequence of aging, giving us a diverse range of abilities in our user group. Older people can be affected by declines in any combination of these areas, or none of them, making this user group heterogeneous in nature. With advancing age people are more likely to suffer from common age-related eye disease, such as macular degeneration. Eyes become less sensitive to light and detail, affecting their ability to see, and read computer screens effectively (Rodrigues, Scuracchio, & de Mattos Fortes, 2018).

Hearing loss is often gradual, affecting 75% of 75–79-year-olds (Rodrigues, Scuracchio, & de Mattos Fortes, 2018) making audio difficult to impossible to hear depending on the grade of loss.

Motor skills can be affected by simple ageing, or disease common in older adults, causing hand tremors, weakness, or affecting speed (Rodrigues, Scuracchio, & de Mattos Fortes, 2018). Diminished motor control in the hands can make keyboard and mouse use difficult and affect accuracy when clicking on small items on the screen.

Cognition is affected by the ageing process resulting in a diminished ability to comprehend, concentrate, learn, and remember (Rodrigues, Scuracchio, & de Mattos Fortes, 2018). This can have a significant effect on learning how to use a website, or navigating a website which has not been designed appropriately. UX-design must consider these functional limitations in design; however, more profound research is required to ascertain how older people are affected when using websites for comprehensive guidelines to be created.

A study by Vines et al. (2015) notes that it is of utmost importance to understand deficits related to old age to develop features, systems, and interfaces,

particularly in Facebook, that are easy, usable, and inclusive for older adults. Web usability by older adults is affected by hearing, cognition, motor skills and vision impairment. The decline in capability negatively affects the performance of older adult citizens on digital technologies like Facebook.

In their study, Gell et al. (2015) investigated technology usage patterns among older adults with and without disabilities. Their research identified a range of barriers to the adoption of technology, including accessibility issues and a lack of digital literacy. These findings highlight the need for more accessible and user-friendly platforms, as well as digital education programs tailored to older adults' needs and abilities.

The study by Sacramento, Bacellar and Bicharra (2019) on evaluating the communicability of Facebook to older people noted that most of the assessed older adults suggested that Facebook's language does not favour intuition during the interaction. The participants complained about the words and vocabulary Facebook uses, stating that they were unclear, indicating a hardship in language comprehension among the older adults. Reports from the study by Sacramento et al. also suggest that most older adults did not understand or notice indications by the Facebook user interface, which was contributed by inappropriate colour contrasts used in the platform.

Yu et al. (2016) investigated the digital divide among older adults in the United States, revealing that Internet access and social network site adoption were significantly lower among this population. This study highlights the importance of addressing accessibility and usability barriers to ensure that older adults can fully participate in the digital world.

Arfaa and Wang (2014) discuss how usability and accessibility are affected by previous computer experience amongst older adults. They found that low computer literacy and lack of knowledge significantly impacts older adults' ability to effectively use SMPs. In the EU directive 2019/790 Creata and Marinescu (2019) recognise that older people have the same classification as, for example, people with functional disabilities traveling with luggage, and women who are pregnant, which indicates that even though the directive aims to promote the development of services and products that suit this category of people, this is a generalisation which may not capture the exact needs of each group of people.

2.3 Accessible Design Features

Rodrigues, Scuracchio and de Mattos Fortes (2018) determined specific areas older people struggle with when using websites after a thorough literature review of existing research: Reading and text comprehension, difficulty to recognise and access links, difficulty navigating, and difficulty in searching and locating information. We can infer from this that poor layout, unreadable fonts, cluttered web pages, and unclearly styled links can hinder older adults from successfully using SMPs.

Hutto et al. (2015) approached the subject from a gerontological perspective, exploring social media usage among older adults. They found that older adults faced unique challenges in adopting and using SMPs, which could be addressed through a combination of inclusive design and education initiatives. While there is a need for a combination of design and educational initiatives, our study explores the design aspect of SMPs.

Social bonding was strongly associated with different modalities for interaction, such as a like button, posting or viewing photos and videos, as well as text communication, and therefore suggests that visual modalities aid older adults in forming and maintaining bonds with their families. Visual modalities were found to be important for older adults who may suffer physiological declines which impair their ability to read text (Jung & Sundar, 2016). This indicates that older adults would benefit from multimodal communication affordances to allow for more effective use of SMPs.

Inexperience with modern affordances and semiotics can lead to confusion or lack of comprehension. This is confirmed by the Sacramento, Bacellar and Bicharra (2019) study, which identified the term "What's this", common among older people. Lack of experience results in lack of comprehension and an inability to identify core items on the screen. This increases the time it takes to perform a single task, and sometimes leads to failure.

2.4 Summary of previous research

Older adults use social media for a variety of reasons, including staying connected with family and friends, keeping up with current events, and learning new things. However, older adults face challenges when using social media, such as vision problems, hearing loss, cognitive declines, and degeneration of motor skills. These physiological and cognitive changes affect older adults' ability to: recognise links which are not appropriately differentiated from other text; localise and click on links and icons which are too small or placed too close to other item; read and see text, links, and icons which are too small or where the contrast is too low; follow and comprehend content without a logical layout (left to right and top down).

By drawing on the insights from these studies, we will conduct a heuristic evaluation to determine exact accessibility failings as well as a user study to find out how the age-related challenges affect older adults' ability to engage successfully in SMPs. We hope to inform the development of more accessible and inclusive digital environments that cater to the unique challenges this demographic faces when interacting with SMPs.

The outcomes of this research aim to inform the development of more inclusive digital environments. Our work contributes to the ongoing dialogue on digital accessibility and serves as a reference point for tech companies and policymakers working on the digital inclusion of older adults. In the future we envision multiple milestones, including the completion of user testing, data analysis, and the publication of our findings, which will be integral in achieving our research objectives.

3 Theoretical Framework

3.1 Web Content Accessibility Guidelines

3.1.1 WCAG 2.1 and WCAG 2.2

W3C is an international community that work with developing global web standards, to realise “the web for all” (W3C, 2022). W3C was founded in 1994, and their first guidelines for accessible websites were published in 1995. The current WCAG guidelines, version 2.1, were adopted in 2018 by the World Wide Web Consortium's (W3C) Accessibility Initiative (WAI, focusing on accessibility for disabled). In 2007 to 2010, WAI’s project for specifically web accessibility for older adults, WAI-AGE, were given an EU grant to further their work. The resulting knowledge was then incorporated into the development of WCAG guidelines (European Commission, 2010).

The WCAG 2.1 guidelines are backwards compatible with the previous WCAG 2.0 (2008) and WCAG 1.0 (1999). The WCAG 2.2 guidelines were published in October 2023 and are likewise compatible with previous versions.

The guidelines aim to make web content accessible to a wider range of people with disabilities, including accommodations for blindness and low vision, deafness and hearing loss, limited movement, speech disabilities, photosensitivity, and combinations of these, and some accommodation for learning disabilities and cognitive limitations; but will not address every user need for people with these disabilities” (W3C, 2018). In the introduction to WCAG 2.1, the authors, as seen in the quote above, explicitly state that the guidelines and principles will not ensure accessibility for every single individual.

Users with age-related decline functions are specifically mentioned; this group will benefit from adhering to the guidelines but are not the focus (W3C, 2018).

The authors also note that the work on more accessibility guidelines, covering more user groups, is ongoing at W3C, and that they especially have encountered challenges in the areas of accessibility related to cognitive, learning and language disabilities.

WCAG 2.2 continues the work from 2.1. The new additions in WCAG 2.2 consist of nine additional success criteria to the guidelines. W3C views WCAG 2.2 as an interim set of guidelines, to be in use while WCAG 3.0 is under development. The third version of the guidelines is “a multi-year effort” (W3C, 2023b) and the W3C view is that there was a need for updated guidelines before 3.0 can be finalised and adopted. 3.0 has a special focus on learning and cognitive disabilities (as well as visual and other disabilities) and aims to make guidelines for a wider range of user groups. The structure of the guidelines will be reworked as well, to make the document more generally accessible regarding structure, readability, and ease of use.

The WCAG 2.1 guidelines are applied in assorted studies, such as Sacramento, Bacellar and Bicharra (2019) which assesses accessibility and communicability of Facebook for Brazilian elderly users.

Under these principles, there are thirteen guidelines dealing with various aspects of web accessibility. These guidelines emphasize the importance of providing text alternatives to non-text content, alternatives to time-based media, and adaptable content that can be provided without losing information or structure. It also stresses the need for content that is easy to see and hear, as well as ensure that all functionality is accessible from the keyboard.

The digital gap and the differential dependence on social media were examined among the elderly by many researchers (Gell et al., 2015; Yu et al., 2016). With these studies, our analysis will determine the possible areas of improvement in the design of social media facades specifically designed for older adult users.

A systematic review by Newman, Stoner and Spector (2021) explored the experiences of older adult users on SMPs, providing valuable insight into factors that affect their participation. Moreover, Hutto et al. (2015) conducted research to understand the patterns of social media use among older adults. These studies, along with the PRISM Randomized Controlled Trial (Czaja et al., 2018), which aimed to improve social support for older adults through technology, serve as a basis for our research.

To give users enough time to read and use content, instructions suggest providing options to control time limits or stop content which plays automatically. They also recommend avoiding content that can cause physical reactions like seizures, such as flashing content at certain frequencies. Navigability is another major aspect, as guidelines focus on helping users navigate, find content, and orient themselves within the site structure (W3C, 2018).

The guidelines also deal with input modalities, which encourage the ease of operating functions through different input methods outside the keyboard, such as speech or other auxiliary technologies. Readability is emphasized with guidelines that defend plain language, proper punctuation, and appropriate text formatting. Predictability is necessary, as guidelines call for the appearance of web pages and their operation in predictable ways, which helps users to understand how the content is structured and how to interact with it (W3C, 2018).

Input assistance is another vital aspect of guidelines, which recommends helping users to avoid errors and correct them by making clear error messages, suggestions and help to correct errors, and mechanisms to confirm the user procedures. Finally, compatibility is particularly important in guidelines, as it emphasizes an increase in compatibility with current and future user agents, including auxiliary technologies, by following best practices for markup and coding (W3C, 2018). By adhering to best practices for markup and coding we improve accessibility and promote inclusive design.

Markup refers to the process of using a unified system of tags and attributes to define the presentation, layout, and structure of content on a web page. An

example of this is *Hypertext Markup Language* (HTML) which is used to create the structure and layout of a web page, while *Cascading Style Sheets* (CSS) is used to control the display of content, such as colours, fonts, and layout. One of the things involved in using proper markup is to curate content and make it accessible to a wide range of users and devices, as well as assistive technologies (W3C, 2018).

On the other hand, coding refers to the process of writing certain instructions in a programming language to create dynamic functions and interactive elements on a web page. JavaScript is a widely used programming language for web development that allows developers to create interactive elements, manage user input, and modify web page content based on user needs. It is especially important to write clean, efficient, and well-structured code to ensure that a website works properly and is accessible to all users including the older adults and people with disabilities (W3C, 2018).

In the context of the guidelines, coding and markup best practices are essential to ensuring that websites are accessible to users with diverse needs and can be easily used with multiple user agents and assistive technologies. Use appropriate HTML semantics best practices includes providing alt text for images, using appropriate heading levels, and ensuring that interactive elements can be accessed by using a keyboard (W3C, 2018).

3.1.2 WCAG in this study

As mentioned previously, WCAG 2.1 accessibility guidelines are still lacking in areas for people over sixty, such as cognition. However, we have chosen to use WCAG 2.1 guidelines as a basis for our data collection and analysis, as they are the most widely adopted W3C guidelines, as well as being the framework used in the EU Accessibility Act. The next version of WCAG (WCAG 3.0) guidelines are being developed to improve such flaws, and will address "users with blindness, low vision and other vision impairments; deafness and hearing loss; limited movement and dexterity; speech disabilities; sensory disorders; cognitive and learning disabilities; and combinations of these." (W3C, 2023a).

We have chosen to use these guidelines because websites that adhere to them meet the current minimum standard of accessibility; while they have flaws, they are the current standards, and if a website as big as Facebook does not meet WCAG 2.1, that can inform us about accessibility of other SMPs for older adults. We have based our HE on WCAG 2.1 and complemented our findings with a user study.

It will also make it possible to do the same study later, using WCAG 3.0, to see if and how the results change.

3.2 Heuristic evaluation

Heuristic evaluation (HE) as a method for evaluating and finding usability problems in human-computer interfaces, was developed by Jakob Nielsen and Rolf Molich in the beginning of the 1990s and presented by Nielsen in Usability Engineering 1994. The method has been developed further since. Nielsen

updated the set of heuristics for computer software in 2014. He co-founded the Nielsen Norman Group, which is an organisation that still works with and develops HE as a method, and is an organisation that is an industry leader in UX and accessibility

HE is a method where a selected, small group of evaluators evaluate a web interface, for example a website, against a set of defined criteria or guidelines (heuristics). The evaluators are usually usability experts or people with other skillsets necessary to carry out the test; the evaluators should be experts, not end users, The evaluators are informed about the procedure, and do their evaluations while documenting them, looking for anything that violates the heuristics in design, layout, structure, coding, language, and overall functionality. The method is used both in commercial web, application, and system development as well as in academic research.

The number of evaluators is suggested by Jakob Nielsen's Nielsen Group's study and others to be 3-5. More users find more usability problems than one, but with too many, the problems they find tend to mostly be the same and the administration around the process tends to overshadow the actual findings (Moran & Gordon, 2023; Wong, 2022). 3-5 evaluators find around 75% of usability problems using this method.

We have chosen an HE to methodically check Facebook for accessibility shortcomings according to WCAG 2.1 guidelines.

4 Method

4.1 Research Design

In this study, we conduct a qualitative content analysis in the form of a heuristic evaluation to evaluate Facebook's compliance with accessibility guidelines. This will enable us to better understand the accessibility challenges older adults face when using SMPs and identify areas for improvement in accessibility and inclusive design.

4.1.1 Other SMPs and accessibility

We have focused on Facebook in-depth. To gather some data on other SMP's, we have conducted a cursory analysis of the SMPs LinkedIn, Instagram and X (previously known as Twitter) and information on how they work with accessibility. We have read what they state about their own work on their official websites and summarise this information below.

LinkedIn accessibility overview

LinkedIn demonstrates a commitment to accessibility, as outlined in their official documentation. The platform focuses on key areas aligning with WCAG 2.1 standards, such as screen reader compatibility, keyboard navigation, and alternative text for images, ensuring that content is accessible to visually impaired users. Additionally, LinkedIn emphasizes inclusive design in user interfaces, aiming to cater to a diverse range of users with different abilities. However, the extent of their alignment with specific WCAG 2.1 guidelines or any deviations in implementation are not explicitly detailed in the documentation (LinkedIn, 2024).

Instagram accessibility overview

Instagram has incorporated several features to enhance accessibility, aligning with WCAG 2.1 standards in certain aspects. Key features include screen reader support and automatic alternative text for images, which aid visually impaired users. However, the platform's approach to alt text is not entirely compliant with WCAG guidelines. The functionality is deeply embedded, making it less accessible (Instagram, 2024). This contrasts with WCAG 2.1's emphasis on straightforward and easily accessible content. Additionally, Instagram's official documentation highlights their ongoing efforts in improving interface design and user navigability, suggesting a commitment to broader accessibility improvements over time (Instagram, 2024).

X accessibility overview

X (formerly known as Twitter) has implemented various accessibility features in line with WCAG 2.1 standards. These include screen reader support, keyboard navigation, and alternative text for images, which significantly assist users with

visual impairments. The platform also offers customizable display settings, such as increased colour contrast and font size adjustments, enhancing usability for those with visual processing challenges. However, detailed information regarding any deviations from WCAG 2.1 standards is not explicitly outlined in their documentation (X, 2024).

4.1.2 Limitations

WCAG 2.2 was published at a point where the thesis data collection and reading phases were done. For transparency, the added criteria in 2.2 concern focus of elements (unobscured and clear focus of interactive elements), input modalities (ensure that other modalities than keyboards are supported), minimum size of target objects, consistent help, and more accessible log-in and authentication functionalities.

WCAG 3.0 is still years away, which makes our conclusion and discussion sections tentative. While WCAG 2.2 does focus on cognitive and physical impairments, we decided to still use WCAG 2.1 for the following reasons:

1. The Funka Inclusivity Barometer (Funka, 2022, 2023) show that many public sector websites don't adhere to the 19 criteria (chosen from WCAG 2.1 A and AA) chosen for the accessibility test. Only 8% of the tested websites passed in 2023. As the WCAG 2.2 guidelines will be backwards compatible, we assessed the 2.1 guidelines to be the bare minimum; if a website does not follow 2.1, they certainly will not pass the success criteria in 2.2.
2. WCAG 2.2 is very new and has not been used in many previously published studies or tests. We will therefore use WCAG 2.1 for consistency and reliability.

Another limitation for this study, as well as many others researching older adults and web use, is that we do not yet know if some of the problems the current generation of 60+ users meet are universal, or if they are specific for the generations of users who did not start using the internet until adulthood (not understanding icons, not used to standards in navigation design, unfamiliar with the wording of labels).

4.1.3 Heuristic Evaluation

By analysing the WAG 2.1 compliance on Facebook, the study examined at the following elements: text, contrast, links, images, and content/layout. Devices and web browsers used in this study

The heuristic evaluation consists of assessing the widely used social media platform, Facebook as a case study for SMPs, using the established Web Content Accessibility Guidelines (WCAG). We will use an existing checklist (see Appendix A) based on WCAG 2.0/2.1 usability and accessibility principles to assess the desktop version of Facebook. We will examine the design and user interface elements of Facebook, with particular attention to aspects that may impact accessibility and usability for older adults, based on specific age-related challenges identified through previous research. The evaluation focus on

identifying specific issues of non-compliance that may hinder older adults' participation and inclusion on Facebook. We will do one evaluation per person, which is in accordance with the recommendations by Nielsen, who found that 3-5 evaluators garner the most usable results as the proportions of evaluators to findings will lessen significantly (Moran & Gordon, 2023; Nielsen, 2000).

As we will do our own HE, we have asked two external evaluators to do their own evaluations, so that our results can be doublechecked using investigator triangulation (Bryman, 2016).

We have followed the guide for heuristic evaluation provided by Moran and Gordon (2023). For our external evaluators, the process is as follows:

1. The evaluators are given the heuristics, WCAG 2.1, to read and understand. During this, one of us were always accessible to answer questions.
2. Presentation of activities, practice round
3. Get to know the website
4. Documentation in individual copies of an Excel spreadsheet
5. For our own evaluations, we discussed the heuristics to make sure we had the same understanding of concepts and words within WCAG 2.1. Besides that, the process was the same as for the external evaluators.

Evaluators

Outside of ourselves, we have selected two external persons to do their own heuristic evaluations, using the same heuristics (WCAG 2.1) and the same set of activities. We have chosen people in our social circles with competences and skills within or adjacent to the field of IA and UX.

Data Analysis

By addressing each of these guidelines in our analysis, we can evaluate comprehensive accessibility to the SMPs of older users and identify the possible areas of improvement. By using WCAG 2.1 guidelines in our study, we will make recommendations to create more comprehensive environments online for older adults.

4.1.4 User Testing

The user study consisted of a series of tasks (see Appendix C and D for tasks and results) to be completed by participants over the age of 60, under the observation of an interviewer. The tasks were determined by common actions carried out on Facebook, and by areas we have determined to be problematic according to the HE in relation to age-related challenges. During and after each task the participants were asked to comment on any challenges they faced.

The user study consisted of 9 participants recruited using a notice on a community notice board. The interview/test times ranged from 35 minutes to 61 minutes with an average of 43.4 minutes. None of the participants have a

Facebook account, and none of them have used it prior to the interview and testing. All participants know what Facebook is used for. A test account was used.

4.2 Validity and Reliability of Our Research Methods

Reliability and validity are terms originating from quantitative research. Researchers commonly use modified versions of these in assessing the quality of qualitative research methods.

4.2.1 Reliability and dependability

The internal reliability depends upon to which extent the researchers share their interpretations of the data and analysis (Bryman, 2016). We have discussed differing interpretations until we have come to a consensus regarding data and/or analysis details.

The external reliability of this study, whether the study can be replicated, is low. Not only do web browsers and the Facebook website evolve rapidly (with updates that can occur monthly), but our user group will also change over time, with younger adult users being more used to internet and other modern technologies as they age and become older adults themselves. However, the design of the study may be useful in comparison with others; we have used WCAG 2.1, a set of most popular activities on the SMP Facebook, focusing on the user group's most common age-related ability declines. Modelling a study in the same way, based on the current WCAG guidelines and the currently most popular SMP can use this strategy to build more knowledge, meaning that there is an external validity (Bryman, 2016).

Heuristic evaluations are subjective, and the researchers' own biases can influence their findings. To mitigate this, we tried to be aware of our own biases and took steps to minimize their impact, such as having multiple researchers conduct the evaluation, and using a checklist to guide the evaluation. We also used persons outside of this research to conduct the evaluation.

4.2.2 Validity

Internal validity, or credibility, is used to assess how well the observations and analysis of the researchers and the theories they adhere to or develop (Bryman, 2016). In this study this is a question of whether the findings match the accessibility issues the user group of adults has according to previous research, our chosen heuristics, and the effect on participants in the user study. Using investigator triangulation, we can make a better analysis, having addressed, and assessed our bias. The user test with people from the target age group will further inform us on which problems the users may encounter, and if they can be solved by the current accessibility features of the tested SMP.

The external validity, whether this study can be generalised to other situations and environments (Bryman, 2016), is possible: any SMP can be checked against

the WCAG 2.1 guidelines with the same user group, or others, in mind. The heuristic evaluations can be complemented by user testing with the same focus, to further the findings.

4.2.3 Ethical Considerations

The first discussion on this topic was what to call people in the user group, as not to other them. We were guided by the language used in previous research, and settled for the term “older adults”, rather than “seniors” or any other term which could carry any kind of unwanted meaning for anyone part of the user group, which we identify as stakeholders in this study (Vetenskapsrådet, 2019).

The following are ethical considerations that we kept in mind when conducting the heuristic evaluation and the user study:

- **Transparency:** We have been transparent about the purpose of the evaluation, and how the data and findings will be used and presented in our research. No personal data was collected or used in this study.

  Perspective and neutrality: we involved multiple evaluators to get different perspectives. No evaluator was coached on responses or feedback. We had clear instructions on how to conduct the evaluation without pressure or discussion about possible or desired outcomes. The same approach was used for the user study.

5 Results and recommendations

5.1 Heuristic evaluation data

The table below shows a summary of the HE data (see appendix B for more granular data). For every criterion, we decided that if less than three of the evaluators deemed a criterion to not be passed, we would mark that as a non-compliancy.

The column “Non-compliant” lists the number of non-compliant criteria for the section. Likewise, in the column “Compliant,” is the number of compliant criteria listed.

In aggregation, the guidelines under section 1, Perceivable, was compliant to a degree of ca 90%. These criteria concern chiefly visual impairments. 1.1.1 Non-text content did not pass for any evaluator when it came to alt texts for non informative images and descriptions of embedded media. Under 1.4.1, The use of colour, the website failed when it came to identifying links solely by colour (passed by none). 1.4.3, 1.4.6 and 1.4.11 all concern contrast ratio, and failed (one evaluator deemed 1.4.3 and 1.4.6 compliant). Criteria regarding contrasts in different states (focus, hover, click, active) failed by all. 1.4.5, Resize text (website functionality is 100% even if zoomed in to 200% the size), was passed by only one evaluator. 1.4.13, Content on hover or focus (how content behaves in these states) were passed by only one evaluator. 1.4.8, Blocks of texts no more than 80 characters wide, failed (one evaluator passed this as compliant).

Section 2, Operable, had a success rate of 39%, significantly lower. These criteria cover input modalities and operable navigation. 2.1.1, Keyboard (all functionality accessible via the keyboard) was not passed by any evaluators. 2.1.2 No keyboard trap (that keyboard focus is never locked at a certain element on a page) was passed by one evaluator. User control over content was found lacking by all but one evaluator (2.2.2 Pause, stop, hide and 2.2.4 Interruptions). 2.4.3, Focus order (that navigation order of links and form controls is logical or intuitive) was passed by none of the evaluators, and 2.4.4 Link purpose (the purpose of a link is clear from the link text) was passed by one evaluator.

The success rate for section 3, Understandable, was 86%. The criteria where Facebook failed in this section were 3.1.1, where Language of parts (using specific lang-attributes for parts of websites where the language in the section deviates from the global website language) failed with only one evaluator passing. 3.3.1 Error Prevention (not giving enough information on the correct format of input), which passed by 1 evaluator, and 3.3.2 Labels or instructions (sufficient labels and instructions) which passed by 2 evaluators.

All five evaluators were in consensus about all criteria that Facebook passed.

The evaluators disagreed more when it came to the criteria where Facebook was deemed non-compliant.

We have not asked the evaluators to explain what has made them vote a criterion as not fulfilled, so the differences in evaluation cannot be explained – other than to note that they exist. We have not gone back after the evaluation to doublecheck if the evaluators are right or wrong.

Table 1: Evaluators, and their technological specifications

Tester	OS	Web browser
1. HE-1	Windows 11	Chrome
2. HE-2	Windows 11	Firefox
3. HE-3	Windows 10	Firefox
4. HE-4	Windows 11	Chrome
5. HE-5	*Windows 11*	*Chrome*

Table 2: Evaluated accessibility criteria.

Guideline	No. of tested criteria	Non-compliant	Compliant
Guideline 1.1 Text Alternatives Provide text alternatives for any non-text content	6	3	3
Guideline 1.3 Adaptable: Create content that can be presented in different ways (e.g., simpler layout) without losing information or structure	2	0	2
Guideline 1.4 Distinguishable: Make it easier for users to see and hear content including separating foreground from background	21	10	11
Guideline 2.1 Keyboard Accessible: Make all functionality available from a keyboard	3	3	0
Guideline 2.2 Enough Time: Provide users enough time to read and use content	4	2	2
Guideline 2.4 Navigable: Provide ways to help users navigate, find content, and determine where they are	12	6	6
Guideline 2.5 Input Modalities: Make it easier for users to operate functionality through various inputs beyond keyboard	4	3	1
Guideline 3.1 Readable: Make text content readable and understandable	2	1	1
Guideline 3.2 Predictable: Make Web pages appear and operate in predictable ways	5	0	5

Guideline 3.3 Input Assistance: Help users avoid and correct mistakes	7	2	5

5.2 Heuristic evaluation findings

In our heuristic evaluation, we identified accessibility shortcomings within Facebook's design that we believe could hinder the successful participation of people over sixty. These shortcomings, identified through compliance testing against established web accessibility standards, point towards broader issues in the design of SMPs that could lead to the digital exclusion of older adults. These findings, while specific to Facebook, reflect broader issues prevalent across various social media platforms and highlight the risk of digital exclusion for older adults.

In line with the literature, our heuristic evaluation findings suggest that the accessibility shortcomings in Facebook could contribute to the digital exclusion of older adults, and that the WCAG guidelines need to be complemented by user testing to accommodate this heterogenic user group. When accessibility issues exist, users may interpret and experience them differently; even between the five evaluators, none having any functional declines, the results varied when it came to some non-compliant criteria. Possible digital exclusion is particularly concerning given the growing importance of social media for maintaining social connections and accessing information, and our cursory check of other SMP's accessibility information suggests that this problem is bigger than Facebook.

5.3 User Study Data

Table 3: Participants and their age-related declines

Age related declines (asked after the walkthrough to avoid any bias)

P1: Hearing loss, vision decline (macular degeneration), hand tremors
P2: Vision decline
P3: Arthritis in hands
P4: Vision decline (cataracts)
P5: Vision decline (macular degeneration)
P6: Hearing loss, vision decline (macular degeneration)
P7: Early vascular dementia, hand tremors
P8: Hearing loss, vision decline
P9: Vision decline, arthritis in hands

Table 4: User study raw data (see Appendix D for detailed results data)

	Results								
Task	P1	P2	P3	P4	P5	P6	P7	P8	P9
1. Log in	Y	Y	Y	Y	Y	Y	WH	Y	Y
2. Locate a	WD	WH	Y	Y	Y	Y	WD	Y	Y
3. Locate t	WH	WH	WH	Y	Y	Y	WD	WH	WH
4. Locate a	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Hover o	WD	WD	Y	Y	Y	Y	WH	Y	WD
6. Open o	Y	Y	Y	Y	Y	Y	Y	Y	Y
7. Locate a	Y	Y	Y	Y	Y	Y	Y	Y	Y
8. Enlarge	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH	i:Y ii:WH
9. Locate t	i:WD ii:WI	i:WH ii:Y	i:Y ii:Y	i:Y ii:Y	i:Y ii:Y	i:Y ii:Y	i:WH ii:WI	i:Y ii:Y	i:WD ii:Y
10. Like ar	Y	Y	Y	Y	Y	Y	Y	Y	Y
11. Locate	N	N	N	N	N	N	N	N	N
12. Go to t	WH	WH	WH	WH	WH	WH	WH	WH	WH
13. Locate	WH	WH	WH	WH	WH	WH	WH	WH	WH
14. Go bac	Y	Y	Y	Y	Y	Y	Y	Y	Y
15. Locate	WH	WH	WH	WH	WH	WH	WH	WH	WH
16. Locate	N	N	N	N	N	N	N	N	N

Legend:

P#	participant designation
Y	YES, able to complete task
N	NO, unable to complete task
WH	WITH HELP (help consisted of suggestions such as holding the curser over elements on the page to see pop-ups, clarification of what they should be looking for on the screen)
WD	WITH DIFFICULTY

5.4 User study findings

The user test results encapsulated in the spreadsheet reflect a range of experiences older adults had while navigating Facebook. It is evident that certain tasks, such as 'Logging in' and 'Locating friends list icon,' were completed successfully by most participants, as indicated by the predominance of 'Y' (Yes) across the board. This suggests that some interface elements are well-designed and accessible for the older demographic. However, other tasks highlighted more considerable challenges. Notably, several participants needed help ('WH') or faced difficulty ('WD') when trying to locate and use the 'See all' link within the friends list, or when attempting to return to the friends screen from other pages. These findings are indicative of navigational and design issues that may not be immediately apparent through heuristic evaluation alone but are experienced by users in real-life scenarios.

Every user also needed help to find Facebook's accessibility help and information section. Three of the users faced problems due to mobility issues (shaking hands), and four users had visual problems with text or icons being too small.

Three users did not recognize icons (friends icon and reactions/likes icon), and none of the users could scroll through photos in carousels.

5.5 Recommendations

Based on the heuristic evaluation and user study, we have outlined the following recommendations for SMPs to improve accessibility and enhance the participation and experience of older adult users. This includes simplifying navigation, enhancing the clarity of design elements such as icons, and ensuring compliance with accessibility guidelines to cater to the diverse needs of older users. By doing so, SMPs can help mitigate the risks of social isolation and digital exclusion of people over sixty.

5.5.1 Images

Generate accurate automatic alt-text for images. It may be necessary to employ better image recognition technology, or develop the technology currently used, to achieve this. Alternatively, require users to add a brief caption which could be applied as alt-text, when uploading images. Images should not be hidden from assistive technology like screen readers, to avoid confusion for users with vision declines or impairments.

Examples taken from Facebook:
Facebook automatically generates alt-text (a brief description of the image), but the text is often inaccurate and, in most cases, too long and confusing. Users have the option to edit the alt-text manually, but this is not an obvious feature and did not appear to have been employed by users for any of the images we checked.

Results from the heuristic evaluation showed that screen readers could not locate alt-text. The alt-text is marked in the code with the attribute aria-hidden=”true” which is commonly used for non-interactive content (mdn web docs, 2023). It hides the object from assistive technology like screen readers and ordinarily would be appropriate for images with no purpose. The problem with this is that SMPs are primarily used to upload media such as images. Users with vision impairments will lack context for the comments under an image without a description of the image.

5.5.2 Contrast

Low contrast makes it difficult for older adults with vision problems to differentiate between text and background or recognise links with highlights.

Using pure white as a background colour creates contrast issues between letters and components for older people by generating a brightness difficult for older users’ eyes to tolerate. Consider an off-white background.

Apply a high enough contrast between text and background to be readable.

5.5.3 Navigation and links

Use text with icons for navigation. As we have already established, older people are more likely to lack the experience required to recognise icons. Adding text labels enhances understanding for inexperienced individuals, and for those with cognitive declines.

See Figure 1 and Figure 2 below for an example taken from Facebook. In Figure 1 no text is used with navigation icons while Figure 2 uses text.

Figure 1: Example of navigation icons sans text

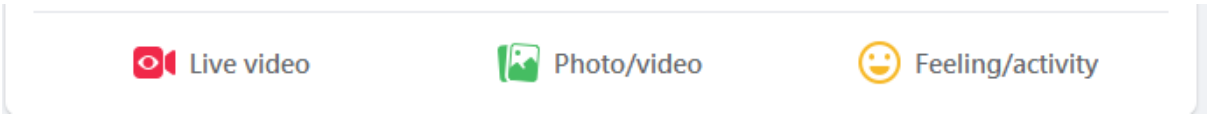

Figure 2: Example of navigation icons with accompanying text

Links should be styled in a consistently uniform way to improve recognisability. According to WCAG 2.1 guidelines more than one design element should be used to differentiate an element from others, such as underline and highlight together to distinguish a link from other text.

Allow enough space between a link and other elements on the screen to aid the older user in localising the link with the mouse.

Ensure adequate contrast between links, background and any on-hover highlight to improve recognisability

Examples of inconsistent link design on Facebook include:

Links in posts and in comments: blue when unvisited, purple when visited, and underlined on-hover.

Links in images: profile/account names, tagged persons, and locations are in bold black text and underlined on hover.

Links in navigation menu: active navigation items are marked with a colour change and underline (blue) and have a grey highlight with an exceptionally low contrast of 1.12:1 on-hover. Text will pop-up on hover, however it is small white text on a transparent black background. The text is at times obscured by images underneath depending on where it pops-up.

Links in text: small and close to other text making it difficult for a person with vision declines to distinguish them from other text, also making it difficult for a

person with age-related motor declines to be able to locate the links with the mouse pointer.

5.5.4 Text

Offer settings to adjust text size on the home page rather than requiring them to change browser or operating system settings.

Ensure there is adequate space between words to avoid a cluttered look and improve readability.

5.5.5 Content and layout

Design navigation elements that are predictable, explicit, and consistent.

Place a search box in the same position on every page to avoid confusion.

Use large buttons and icons and ensure their colour differs from the surrounding text.

Write link text that is easy to read and descriptive so that older adults can know what to expect when they click links.

Remove or offer an uncomplicated way to disable pop-ups and unnecessary visuals to avoid causing distraction and confusion.

Add labels in forms to allow detection by screen readers.

Ensure content reads from top to bottom and is uncluttered, clear and understandable.

Logically arrange sections by considering the linear way older adults search for and consume information.

Group content into short sections to improve comprehensibility for users with cognition declines.

Examples of layout issues found on Facebook:

The layout is not intuitive with three scrollable panels or columns. Older adults are more accustomed to linear designs such as books and newspapers.

Text row length is over the maximum standard eighty characters increasing risk of comprehension problems for older users with cognitive declines. There are text, links, headings, and advertisements organised in an undesirable way causing a cluttered appearance. This can cause issues for older users due to both inexperience and cognitive declines.

Labels were missing from forms which caused screen readers to hop over interactive elements.

6 Discussion

Our results indicate that current WCAG standards are not enough to make websites accessible for older adults. While current standards and practices can help avoid many accessibility issues, they don't necessarily accommodate users with multiple problems, where one disability or decline makes it hard to find other needed accessibility features; a person with cognitive decline will maybe not be able to know, find or remember the way to features for hearing or visual impairments, as shown in our user study, where no user found this section without help. A website can therefore live up to the WCAG 2.1 guidelines technically, but still be inaccessible to a large subset of users. It's noteworthy that the users in our study had problems finding, understanding and using the friend list icon, viewing or adding reactions, and the photo carousels, as these activities according to Jung and Sundar (2016) are highly motivating for older adults.

The focus on clearly defined, separate and physical, disabilities in current guidelines leads to a similar focus for web designers, as evident in official documents from the SMPs we have looked at and the HE of Facebook. If the reworked WCAG 3.0 will find a way to manage these complex accessibility issues is unknown. Our study indicates to us that persistent user testing is needed to understand older adult web users over time. As older adults are more likely to experience declines in functions in different combinations and levels of severity, the understanding of accessible web design needs to evolve to accommodate to users with complex disability profiles.

If difficulties for people over 60 today are age-related rather than caused by lack of knowledge is still not clear, which makes involving this user group in development of standards, guidelines, and websites even more important. In our user study, several of the subjects had problems finding, understanding, or using the back button, the friends icon, and the image carousel. All of these could in our estimation well stem from a technological inexperience rather than being connected to a functional decline. Another factor is that people can have declines in functions that they themselves do not see as obstacles or disabilities, which may be something that occurred in our HE. Older adults can also have more than one problem; if someone has a vision impairment and a decline in cognition, they will have problems finding the right accessibility features any time they use the SMP in question.

With today's poor compliance, why not make the EU directive binding for member states, as a minimum, where websites' organisations can be subjected to fines if they do not comply? If it works with personal integrity and GDPR, it could work for this problem as well, given reasonable delimitations of which websites that need to fall under the law (size, what kind of use/benefit and target groups, etc).

7 Conclusion

7.1 Our Conclusions

Based on our HE and user study, Facebook is not as accessible as they state on their accessibility information page. Given the size and prevalence of Facebook we are of the opinion that other SMPs are likely to have similar accessibility issues – this is also the indication we get from the official accessibility information from LinkedIn, Instagram, and X(Twitter).

Older adults as a user group are very heterogenic, with differing functionalities and declines. Their needs can not be met through the current standards and practices and need a multifaceted approach from guidelines, developers and web developers and designers. Until there is sufficient knowledge about what problems are due to age-related decline versus a lack of technological familiarity, the user group is even more important to include, to not risk social exclusion – and to close knowledge gaps on the nature of the obstacles they face. Relying solely on guidelines and checklists may be reasonable 20 years from now, but it is not the case now. So many of the potential problems a user can encounter on a website are subjective, depending on the individual and their general context (age, gender, language, place).

The user test outcomes underscore the necessity of a user-centered approach to designing social media platforms. While heuristic evaluation can pinpoint compliance with accessibility standards, it does not always capture the nuances of user interaction and experience. The mixed results, characterized by difficulties and the need for help, reveal a critical insight: there is a disconnect between the design of Facebook's features and the usability for older adults.

We conclude that, in addition to complying with accessibility standards, social media platforms like Facebook must consider the practical challenges faced by older adults. Designers should prioritize intuitive navigation, clear labelling, and interactive elements that accommodate the perceptual and motor skills of this user group. By doing so, we can bridge the gap between accessibility compliance and actual usability, fostering an inclusive environment where older adults can engage with social media platforms without facing barriers to participation.

7.2 Future Research

More research is needed with the involvement of older adults. Research on improving accessibility for older users with cognitive declines is lacking. Research and development of technology aiding accessibility, such as image recognition technology.

There is another aspect of social exclusion of older adults: this goes both ways. If platforms exclude older adults, younger adults and children may also risk becoming socially excluded from the older generations, which could be of detriment to them as well. While there are studies on social benefits for younger

adults and children to socialising with older adults, there are knowledge gaps when it comes to interactions online and on social media.

Research also needs to be done consistently as younger adults age, to learn more about what problems persist over time and do not come from unfamiliarity with different user interfaces and common web design standards (icons, placement of elements, expected functionality, and more).

This paper's findings could be expanded upon by adding user testing of more SMPs, and by using the new guidelines in WCAG 3.0 when those are finalised. Researching accessibility for users with cognitive disabilities or decline is more complex and will be of importance after WCAG 3.0, which will focus on this user group.

Appendix A

WebAim WCAG 2 Checklist

WebAIM
web accessibility in mind

KEY:
Not relevant. Do not complete.

Principle 1: Perceivable

Web content is made available to the senses - sight, hearing, and/or touch.

Guideline 1.1 Text Alternatives

Provide text alternatives for any non-text content.

Success Criteria	Recommendations	Notes/Tools used
1.1.1 Non-text Content (Level A) **Target group relevance:** Cognition Vision	☐ Images, form image buttons, and image map hot spots have appropriate, equivalent alternative text. ☐ Images that do not convey content, are decorative, or contain content that is already conveyed in text are given null alt text (alt="") or implemented as CSS backgrounds. Linked images have descriptive alternative text. ☐ Equivalent alternatives to complex images are provided in context or on a separate linked page. ☐ Form buttons have a descriptive value. ☐ Form inputs have associated text labels. ☐ Embedded multimedia is identified via accessible text. ☐ Frames and iframes are appropriately titled.	

Guideline 1.3 Adaptable:

Create content that can be presented in different ways (e.g., simpler layout) without losing information or structure.

Success Criteria	Recommendations	Notes/Tools used
1.3.1 Info and Relationships (Level A)	☐ Semantic markup is used to designate headings (<h1>), regions/landmarks, lists (, , and <dl>), emphasized or special text (, <code>, <abbr>, <blockquote>, for example), etc. Semantic markup is used appropriately. ☐ Text labels are associated with form input elements. Related form elements are grouped with fieldset/legend. ARIA labelling may be used when standard HTML is insufficient.	
1.3.2 Meaningful Sequence (Level A)	☐ The reading and navigation order (determined by code order) is logical and intuitive.	
1.3.3 Sensory Characteristics (Level A) **Target group relevance:** Cognition	☐ Instructions do not rely upon shape, size, or visual location (e.g., "Click the square icon to continue" or "Instructions are in the right-hand column"). ☐ Instructions do not rely upon sound (e.g., "A beeping sound indicates you may continue.").	
1.3.5 Identify Input Purpose (WCAG 2.1 Level AA)	☐ Input fields that collect certain types of user information have an appropriate autocomplete attribute defined.	
1.3.6 Identify Purpose (WCAG 2.1 Level AAA)	☐ HTML5 regions or ARIA landmarks are used to identify page regions. ☐ ARIA is used, where appropriate, to enhance HTML semantics to better identify the purpose of interface components.	

Guideline 1.4 Distinguishable:

Make it easier for users to see and hear content including separating foreground from background.

Success Criteria	Recommendations	Notes/Tools used
1.4.1 Use of Color (Level A) **Target group relevance:** Vision	☐ Color is not used as the sole method of conveying content or distinguishing visual elements. ☐ Color alone is not used to distinguish links from surrounding text unless the contrast ratio between the link and the surrounding text is at least 3:1 and an additional distinction (e.g., underline) is provided when the link is hovered and receives focus.	https://webaim.org/resources/contrastchecker/
1.4.2 Audio Control (Level A) **Target group relevance:** Hearing Cognition	☐ A mechanism is provided to stop, pause, mute, or adjust volume for audio that automatically plays on a page for more than 3 seconds.	
1.4.3 Contrast (Minimum) (Level AA) **Target group relevance:** Vision	☐ Text and images of text have a contrast ratio of at least 4.5:1. Large text - at least 18 point (typically 24px) or 14 point (typically 18.66px) and bold - has a contrast ratio of at least 3:1.	https://webaim.org/resources/contrastchecker/
1.4.4 Resize text (Level AA) **Target group relevance:** Vision	☐ The page is readable and functional when the page is zoomed to 200%. NOTE: 1.4.10 (below) introduces a much higher requirement for zoomed content.	
1.4.6 Contrast (Enhanced) (Level AAA) **Target group relevance:** Vision	☐ Text and images of text have a contrast ratio of at least 7:1. Large text - at least 18 point (typically 24px) or 14 point (typically 18.66px) bold - has a contrast ratio of at least 4.5:1.	https://webaim.org/resources/contrastchecker/
1.4.8 Visual Presentation (Level AAA) **Target group relevance:** Cognition Vision	☐ Blocks of text over one sentence in length: ☐ Are no more than 80 characters wide. ☐ Are NOT fully justified (aligned to both the left and the right margins).	
	☐ Have adequate line spacing (at least 1/2 the height of the text) and paragraph spacing (1.5 times line spacing). ☐ Have a specified foreground and background color. These can be applied to specific elements or to the entire page using CSS (and thus inherited by all other elements). ☐ Do NOT require horizontal scrolling when the text size is doubled. (ctrl+)	
1.4.10 Reflow (WCAG 2.1 Level AA) **Target group relevance:** Cognition	☐ No loss of content or functionality occurs, and horizontal scrolling is avoided when content is presented at a width of 320 pixels. *This requires responsive design for most web sites. This is best tested by setting the browser window to 1280 pixels wide and then zooming the page content to 400%.* *Content that requires horizontal scrolling, such as data tables, complex images (such as maps and charts), toolbars, etc. are exempted.*	
1.4.11 Non-text Contrast (WCAG 2.1 Level AA) Cognition Vision	☐ A contrast ratio of at least 3:1 is present for differentiating graphical objects (such as icons and components of charts or graphs) and author-customized interface components (such as buttons, form controls, and focus indicators/outlines). ☐ At least 3:1 contrast must be provided in the various states (focus, hover, active, etc.) of author-customized interactive components.	
1.4.12 Text Spacing (WCAG 2.1 Level AA)	☐ No loss of content or functionality occurs when the user adapts paragraph spacing to 2 times the font size, text line height/spacing to 1.5 times the font size, word spacing to .16 times the font size, and letter spacing to .12 times the font size. ☐ This is best supported by avoiding pixel height definitions for elements that contain text.	
1.4.13 Content on Hover or Focus (WCAG 2.1 Level AA) **Target group relevance:** Cognition	**When additional content is presented on hover or keyboard focus:** ☐ The newly revealed content can be dismissed (generally via the Esc key) without moving the pointer or keyboard focus, unless the content presents an input error or does not obscure or interfere with other page content. ☐ The pointer can be moved to the new content without the content disappearing.	
	☐ The new content must remain visible until the pointer or keyboard focus is moved away from the triggering control, the new content is dismissed, or the new content is no longer relevant.	

Guideline 2.1 Keyboard Accessible:

Make all functionality available from a keyboard.

Success Criteria	Recommendations	Notes/Tools used
2.1.1 Keyboard (Level A) **Target group relevance:** Motor skills Cognition	☐ All page functionality is available using the keyboard, unless the functionality cannot be accomplished in any known way using a keyboard (e.g., free hand drawing).	
2.1.2 No Keyboard Trap (Level A) **Target group relevance:** Motor skills Cognition	☐ Keyboard focus is never locked or trapped at one particular page element. The user can navigate to and from all navigable page elements using only a keyboard.	
2.1.3 Keyboard (No Exception) (Level AAA) **Target group relevance:** Motor skills Cognition	☐ All page functionality is available using the keyboard.	

Guideline 2.2 Enough Time:

Provide users enough time to read and use content.

Success Criteria	Recommendations	Notes/Tools used
2.2.1 Timing Adjustable (Level A)	☐ If a page or application has a time limit, the user is given options to turn off, adjust, or extend that time limit. This is not a requirement for real-time events (e.g., an auction), where the time limit is absolutely required, or if the time limit is longer than 20 hours.	
2.2.2 Pause, Stop, Hide (Level A) **Target group relevance:** Cognition	☐ Automatically moving, blinking, or scrolling content (such as carousels, marquees, or animations) that lasts longer than 5 seconds can be paused, stopped, or hidden by the user. ☐ Automatically updating content (e.g., a dynamically-updating news ticker, chat messages, etc.) can be paused, stopped, or hidden by the user or the user can manually control the timing of the updates.	
2.2.3 No Timing (Level AAA) **Target group relevance:** Cognition	☐ The content and functionality have no time limits or constraints.	
2.2.4 Interruptions (Level AAA) **Target group relevance:** Cognition	☐ Interruptions (alerts, page updates, etc.) can be postponed or suppressed by the user.	

Guideline 2.4 Navigable:

Provide ways to help users navigate, find content, and determine where they are.

Success Criteria	Recommendations	Notes/Tools used
2.4.1 Bypass Blocks (Level A) **Target group relevance:** Cognition	☐ A link is provided to skip navigation and other page elements that are repeated across web pages. ☐ A proper heading structure and/or identification of page regions/landmarks may be considered a sufficient technique. Because navigating by headings or regions is not supported in most browsers, WebAIM recommends a "skip" link (in addition to headings and regions) to best support sighted keyboard users.	
2.4.2 Page Titled (Level A) **Target group relevance:** Cognition	☐ The web page has a descriptive and informative page title.	
2.4.3 Focus Order (Level A) **Target group relevance:** Cognition	☐ The navigation order of links, form elements, etc. is logical and intuitive.	
2.4.4 Link Purpose (In Context) (Level A) **Target group relevance:** Cognition	☐ The purpose of each link (or form image button or image map hotspot) can be determined from the link text alone, or from the link text and its context (e.g., surrounding text, list item, previous heading, or table headers). ☐ Links (or form image buttons) with the same text that go to different locations are readily distinguishable.	
2.4.5 Multiple Ways (Level AA) **Target group relevance:** Cognition	☐ Multiple ways are available to find other web pages on the site - at least two of: a list of related pages, table of contents, site map, site search, or list of all available web pages.	

2.4.6 Headings and Labels (Level AA) **Target group relevance:** Cognition	☐	Page headings and labels for form and interactive controls are informative. Avoid duplicating heading (e.g., "More Details") or label text (e.g., "First Name") unless the structure provides adequate differentiation between them.	
2.4.7 Focus Visible (Level AA) **Target group relevance:** Cognition	☐	It is visually apparent which page element has the current keyboard focus (i.e., as you tab through the page, you can see where you are).	
2.4.8 Location (Level AAA) **Target group relevance:** Cognition	☐	If a web page is part of a sequence of pages or within a complex site structure, an indication of the current page location is provided, for example, through breadcrumbs or specifying the current step in a sequence (e.g., "Step 2 of 5 - Shipping Address").	
2.4.9 Link Purpose (Link Only) (Level AAA) **Target group relevance:** Cognition	☐ ☐	The purpose of each link (or form image button or image map hotspot) can be determined from the link text alone. There are no links (or form image buttons) with the same text that go to different locations.	
2.4.10 Section Headings (Level AAA) **Target group relevance:** Cognition	☐	Beyond providing an overall document structure, individual sections of content are designated using headings, where appropriate.	

Guideline 2.5 Input Modalities:

Make it easier for users to operate functionality through various inputs beyond keyboard.

Success Criteria		Recommendations	Notes/Tools used
2.5.1 Pointer Gestures (WCAG 2.1 Level A)	☐	If multipoint or path-based gestures (such as pinching, swiping, or dragging across the screen) are not essential to the functionality, then the functionality can also be performed with a single point activation (such as activating a button).	
2.5.2 Pointer Cancellation (WCAG 2.1 Level A) **Target group relevance:** Cognition	☐	To help avoid inadvertent activation of controls, avoid non-essential down-event (e.g., onmousedown) activation when clicking, tapping, or long pressing the screen. Use onclick, onmouseup, or similar instead. If onmouseup (or similar) is used, you must provide a mechanism to abort or undo the action performed.	
2.5.3 Label in Name (WCAG 2.1 Level A) **Target group relevance:** Cognition	☐	If an interface component (link, button, etc.) presents text (or images of text), the accessible name (label, alternative text, aria-label, etc.) for that component must include the visible text.	
2.5.5 Target Size (WCAG 2.1 Level AAA) **Target group relevance:** Cognition Vision Motor skills	☐	Clickable targets are at least 44 by 44 pixels in size unless an alternative target of that size is provided, the target is inline (such as a link within a sentence), the target is not author-modified (such as a default checkbox), or the small target size is essential to the functionality.	
2.5.6 Concurrent Input Mechanisms (WCAG 2.1 Level AAA) **Target group relevance:** Cognition	☐	Content does not restrict input to a specific modality, such as touch-only or keyboard- only, but must support alternative inputs (such as using a keyboard on a mobile device).	

Vision Motor skills		

Principle 3: Understandable

Information and the operation of user interface must be understandable.

Guideline 3.1 Readable:

Make text content readable and understandable.

Success Criteria		Recommendations	Notes/Tools used
3.1.1 Language of Page (Level A) **Target group relevance:**	☐	The language of the page is identified using the HTML lang attribute (e.g., <html lang="en">).	
3.1.2 Language of Parts (Level AA) **Target group relevance:**	☐	The language of page content that is in a different language is identified using the lang attribute (e.g., <blockquote lang="es">).	

Guideline 3.2 Predictable:

Make Web pages appear and operate in predictable ways.

Success Criteria		Recommendations	Notes/Tools used
3.2.1 On Focus (Level A) **Target group relevance:** Cognition	☐	When a page element receives focus, it does not result in a substantial change to the page, the spawning of a pop-up window, an additional change of keyboard focus, or any other change that could confuse or disorient the user.	
3.2.2 On Input (Level A) **Target group relevance:** Cognition	☐	When a user inputs information or interacts with a control, it does not result in a substantial change to the page, the spawning of a pop-up window, an additional change of keyboard focus, or any other change that could confuse or disorient the user unless the user is informed of the change ahead of time.	
3.2.3 Consistent Navigation (Level AA) **Target group relevance:** Cognition	☐	Navigation links that are repeated on web pages do not change order when navigating through the site.	
3.2.4 Consistent Identification (Level AA) **Target group relevance:** Cognition	☐	Elements that have the same functionality across multiple web pages are consistently identified. For example, a search box at the top of the site should always be labeled the same way.	
3.2.5 Change on Request (Level AAA) **Target group relevance:** Cognition	☐	Substantial changes to the page, the spawning of pop-up windows, uncontrolled changes of keyboard focus, or any other change that could confuse or disorient the user must be initiated by the user. Alternatively, the user is provided an option to disable such changes.	

Guideline 3.3 Input Assistance:

Help users avoid and correct mistakes.

Success Criteria		Recommendations	Notes/Tools used
3.3.1 Error Identification (Level A) **Target group relevance:** Cognition	☐	Required form elements or form elements that require a specific format, value, or length provide this information within the element's label.	
	☐	Form validation errors are efficient, intuitive, and accessible. The error is clearly identified, quick access to the problematic element is provided, and the user can easily fix the error and resubmit the form.	
3.3.2 Labels or Instructions (Level A) **Target group relevance:** Cognition	☐	Sufficient labels, cues, and instructions for required interactive elements are provided via instructions, examples, properly positioned form labels, and/or fieldsets/legends.	
3.3.3 Error Suggestion (Level AA) **Target group relevance:** Cognition	☐	If an input error is detected (via client-side or server-side validation), suggestions are provided for fixing the input in a timely and accessible manner.	
3.3.4 Error Prevention (Legal, Financial, Data) (Level AA) **Target group relevance:** Cognition	☐	If the user can change or delete legal, financial, or test data, the changes/deletions can be reversed, verified, or confirmed.	
3.3.5 Help (Level AAA) **Target group relevance:** Cognition	☐	Instructions and cues are provided in context to help in form completion and submission.	
3.3.6 Error Prevention (All) (Level AAA) **Target group relevance:** Cognition	☐	If the user can submit information, the submission is reversible, verified, or confirmed.	

Principle 4: Robust

Content can be used reliably by a wide variety of user agents, including assistive technologies

Guideline 4.1 Compatible:

Maximize compatibility with current and future user agents, including assistive technologies.

Success Criteria		Recommendations	Notes/Tools used
4.1.1 Parsing (Level A)	☐	Significant HTML/XHTML validation/parsing errors are avoided.	
4.1.2 Name, Role, Value (Level A)	☐	Markup is used in a way that facilitates accessibility. This includes following the HTML/XHTML specifications and using forms, form labels, frame titles, etc. appropriately. ARIA is used appropriately to enhance accessibility when HTML is not sufficient.	
4.1.3 Status Messages (WCAG 2.1 Level AA)	☐	If an important status message is presented and focus is not set to that message, the message must be announced to screen reader users, typically via an ARIA alert or live region.	

Available online at: webaim.org/standards/wcag/checklist

Appendix B

Collated results of heuristic evaluation

Principle 1: Perceivable **Web content is made available to the senses - sight, hearing, and/or touch.**	
Guideline 1.1 Text Alternatives *Provide text alternatives for any non-text content*	
1.1.1 Non-text Content	
□ Images, image buttons, and image map hot spots have appropriate, equivalent alternative text.	5
□ Images that do not convey content, are decorative, or contain content that is already conveyed in text are given empty alternative text (alt="") or implemented as CSS backgrounds. All linked images have descriptive alternative text.	0
□ Equivalent alternatives to complex images are provided in context or on a separate linked page.	0
□ Form buttons have a descriptive value.	5
□ Inputs have associated text labels.	5
□ Embedded multimedia is identified via accessible text.	0
Guideline 1.3 Adaptable: *Create content that can be presented in different ways (e.g., simpler layout) without losing information or structure*	
1.3.3 Sensory Characteristics	
□ Instructions do not rely upon shape, size, or visual location (e.g., "Click the square icon to continue" or "Instructions are in the right-hand column").	5

□ Instructions do not rely upon sound (e.g., "A beeping sound indicates you may continue.").	5
Guideline 1.4 Distinguishable: *Make it easier for users to see and hear content including separating foreground from background*	
1.4.1 Use of Color	
□ Color is not used as the sole method of conveying content or distinguishing visual elements.	5
□ Color alone is not used to distinguish links from surrounding text unless the contrast ratio between the link and the surrounding text is at least 3:1 and an additional distinction (e.g., it becomes underlined) is provided when the link is hovered over and receives keyboard focus.	0
1.4.2 Audio Control	
□ A mechanism is provided to stop, pause, mute, or adjust volume for audio that automatically plays on a page for more than 3 seconds.	5
1.4.3 Contrast (Minimum)	
□ Text and images of text have a contrast ratio of at least 4.5:1.	1
□ Large text - at least 18 point (typically 24px) or 14 point (typically 18.66px) and bold - has a contrast ratio of at least 3:1.	5
1.4.4 Resize text	
□ The page is readable and functional when the page is zoomed to 200%)	1
1.4.5 Images of Text	
□ If the same visual presentation can be made using text alone, an image is not used to present that text.	5

1.4.6 Contrast (Enhanced)	
□ Text and images of text have a contrast ratio of at least 7:1.	1
□ Large text - at least 18 point (typically 24px) or 14 point (typically 18.66px) and bold - has a contrast ratio of at least 4.5:1.	1
1.4.8 Visual Presentation	
□ Blocks of text over one sentence in length:	
○ Are no more than 80 characters wide.	1
○ Are NOT fully justified (aligned to both the left and the right margins).	5
○ Have adequate line spacing (at least 1/2 the height of the text) and paragraph spacing (1.5 times line spacing).	5
○ Have defined or inherited foreground and background colors.	5
○ Do NOT require horizontal scrolling when the text size is doubled.	5
1.4.10 Reflow	
□ No loss of content or functionality occurs, and horizontal scrolling is avoided when content is presented at a width of 320 pixels. ○ This requires responsive design for most web sites. This is best tested by setting the browser window to 1280 pixels wide and then zooming the page content to 400%.	5
1.4.11 Non-text Contrast	

□ A contrast ratio of at least 3:1 is present for differentiating graphical objects (such as icons and components of charts or graphs) and author-customized interface components (such as buttons, form controls, and focus indicators/outlines).	0
□ At least 3:1 contrast is maintained in the various states (focus, hover, active, etc.) of author-customized interactive components.	0
1.4.12 Text Spacing	
□ No loss of content or functionality occurs when the user adapts paragraph spacing to 2 times the font size, text line height/spacing to 1.5 times the font size, word spacing to .16 times the font size, and letter spacing to .12 times the font size.	5
□ This is best supported by avoiding pixel height definitions for elements that contain text.	5
1.4.13 Content on Hover or Focus	
□ When additional content is presented on hover or keyboard focus:	
○ The newly revealed content can be dismissed (generally via the Esc key) without moving the pointer or keyboard focus unless the content presents an input error or does not obscure or interfere with other page content.	1
○ The new content must remain visible until the pointer or keyboard focus is moved away from the triggering control, the new content is dismissed, or the new content is no longer relevant.	1
Principle 2: Operable	

Interface forms, controls, and navigation are operable	
Guideline 2.1 Keyboard Accessible: *Make all functionality available from a keyboard*	
2.1.1 Keyboard	
□ All page functionality is available using the keyboard, unless the functionality cannot be accomplished in any known way using a keyboard (e.g., free hand drawing).	0
2.1.2 No Keyboard Trap	
□ Keyboard focus is never locked or trapped at one particular page element. The user can navigate to and from all navigable page elements using only a keyboard.	1
2.1.3 Keyboard (No Exception)	
□ All page functionality is available using the keyboard.	0
Guideline 2.2 Enough Time: *Provide users enough time to read and use content*	
2.2.2 Pause, Stop, Hide A	
□ Automatically moving, blinking, or scrolling content (such as carousels, marquees, or animations) that lasts longer than 5 seconds can be paused, stopped, or hidden by the user.	5
□ Automatically updating content (e.g., a dynamically-updating news ticker, chat messages, etc.) can be paused, stopped, or hidden by the user or the user can manually control the timing of the updates.	1
2.2.3 No Timing	
□ The content and functionality have no time limits or constraints.	5

2.2.4 Interruptions	
□ Interruptions (alerts, page updates, etc.) can be postponed or suppressed by the user.	1
Guideline 2.4 Navigable: *Provide ways to help users navigate, find content, and determine where they are*	
2.4.1 Bypass Blocks	
□ A link is provided to skip navigation and other page elements that are repeated across web pages.	5
□ While proper use of headings or regions/landmarks is sufficient to meet this success criterion because keyboard navigation by headings or regions is not supported in most browsers, WebAIM recommends a "skip" link in addition to headings and regions.	0
2.4.2 Page Titled A	
□ The web page has a descriptive and informative page title.	5
2.4.3 Focus Order A	
□ The navigation order of links, form controls, etc. is logical and intuitive.	0
2.4.4 Link Purpose (In Context)	
□ The purpose of each link (or image button or image map hotspot) can be determined from the link text alone, or from the link text and its context (e.g., surrounding text, list item, previous heading, or table headers).	1
2.4.5 Multiple Ways	

□ Multiple ways are available to find other web pages on the site - at least two of: a list of related pages, table of contents, site map, site search, or list of all available web pages.	5
2.4.6 Headings and Labels	
□ Page headings and labels for form and interactive controls are informative. Avoid duplicating heading and label text unless the structure provides adequate differentiation between them.	5
2.4.7 Focus Visible	
□ There is a visible indicator for page elements when they receive keyboard focus.	4
2.4.8 Location	
□ If a web page is part of a sequence of pages or within a complex site structure, an indication of the current page location is provided, for example, through breadcrumbs or specifying the current step in a sequence (e.g., "Step 2 of 5 - Shipping Address").	5
2.4.9 Link Purpose (Link Only)	
□ The purpose of each link (or image button or image map hotspot) can be determined from the link text alone.	5
□ There are no links with the same text that go to different locations.	5
2.4.10 Section Headings	
□ Beyond providing an overall document structure, individual sections of content are designated using headings, where appropriate.	5

Guideline 2.5 Input Modalities: *Make it easier for users to operate functionality through various inputs beyond keyboard*	
2.5.2 Pointer Cancellation	
□ To help avoid inadvertent activation of controls, avoid non-essential down-event (e.g., onmousedown) activation when clicking, tapping, or long pressing the screen. Use onclick, onmouseup, or similar instead. If onmouseup (or similar) is used, you must provide a mechanism to abort or undo the action performed.	5
2.5.3 Label in Name	
□ If an interface component (link, button, etc.) presents text (or images of text), the accessible name (label, alternative text, aria-label, etc.) for that component must include the visible text.	0
2.5.5 Target Size	
□ Clickable targets are at least 44 by 44 pixels in size unless an alternative target of that size is provided, the target is inline (such as a link within a sentence), the target is not author-modified (such as a default checkbox), or the small target size is essential to the functionality.	0
2.5.6 Concurrent Input Mechanisms	
□ Content does not require a specific input type, such as touch-only or keyboard-only, but must support alternative inputs (such as using a keyboard on a mobile device).	1
Principle 3: Understandable **Information and the operation of user interface must be understandable.**	
Guideline 3.1 Readable:	

Make text content readable and understandable	
3.1.1 Language of Page	
□ The language of the page is identified using the lang attribute (e.g., <html lang="en">).	5
3.1.2 Language of Parts	
□ The language of page content that is in a different language is identified using the lang attribute (e.g., <blockquote lang="es">).	1
Guideline 3.2 Predictable: *Make Web pages appear and operate in predictable ways*	
3.2.1 On Focus	
□ When a page element receives focus, it does not result in a substantial change to the page, the spawning of a pop-up window, an additional change of keyboard focus, or any other change that could confuse or disorient the user.	5
3.2.2 On Input	
□ When a user inputs information or interacts with a control, it does not result in a substantial change to the page, the spawning of a pop-up window, an additional change of keyboard focus, or any other change that could confuse or disorient the user unless the user is informed of the change ahead of time.	5
3.2.3 Consistent Navigation	
□ Navigation links that are repeated on web pages do not change order when navigating through the site.	5
3.2.4 Consistent Identification	

□ Elements that have the same functionality across multiple web pages are consistently identified. For example, a search box at the top of the site should always be labelled the same way.	5
3.2.5 Change on Request	
□ Substantial changes to the page, the spawning of pop-up windows, uncontrolled changes of keyboard focus, or any other change that could confuse or disorient the user must be initiated by the user. Alternatively, the user is provided an option to disable such changes.	5
Guideline 3.3 Input Assistance: *Help users avoid and correct mistakes*	
3.3.1 Error Identification	
□ Required inputs or inputs that require a specific format, value, or length provide this information within the element's label.	0
□ Form validation errors are efficient, intuitive, and accessible. The error is clearly identified, quick access to the problematic element is provided, and the user can easily fix the error and resubmit the form.	5
3.3.2 Labels or Instructions	
□ Sufficient labels, cues, and instructions for required interactive elements are provided via instructions, examples, properly positioned input labels, or fieldsets/legends.	2
3.3.3 Error Suggestion	
□ If an input error is detected (via client-side or server-side validation), suggestions are provided for fixing the input in a timely and accessible manner.	5
3.3.4 Error Prevention (Legal, Financial, Data)	

□ If the user can change or delete legal, financial, or test data, the changes/deletions can be reversed, verified, or confirmed.	5
3.3.5 Help	
□ Instructions and cues are provided in context to help in form completion and submission.	5
3.3.6 Error Prevention (All)	
□ If the user can submit information, the submission is reversible, verified, or confirmed.	5

Legend:

Red numbers (example: 1) = the number of evaluators out of 5 who found Facebook to be compliant in those areas

Grey highlight (example: highlight) = areas found not to be compliant

Appendix C

User study tasks

1. Log in
2. Locate and click on the friends list icon, then locate, and click the 'See all' link
3. Locate the back button and return to ‘friends’ screen
4. Locate and click 'All friends' link
5. Hover over 'Mutal friends' link on one profile in the friends list and read the first 2 names aloud
6. Open one friends profile
7. Locate and click 'See All Photos' link
8. Enlarge a photo by clicking on it (i) and scroll to the next photo (ii)
9. Locate the likes icon on the photo (i) and hover the curser over it to get a pop-up list to appear (ii)
10. Like an image
11. Locate 'Write a comment’ and explain what you think the icons mean without hovering the cursor over them
12. Go to the main page
13. Locate and watch a video
14. Go back to the home page create a post
15. Locate accessibility settings
16. Locate settings for enlarging text size

17. On a scale of 0-10 how enjoyable was your experience on Facebook? 0 being not at all, 10 being most enjoyable.

Appendix D

Detailed user study results data

Instructions: Participants were told to read the tasks and ask for clarification if they did not understand. They were told to use the mouse to hover over diffferent parts of the screen to help identify or locate things they needed to complete tasks.

Legend:

P#	participant designation
Y	YES
N	NO
WH	WITH HELP (help consisted of suggestions such as holding the curser over elements on the page to see pop-ups, clarification of what they should be looking for on the screen) text)
WD	WITH DIFFICULTY
Red text	Interviewers comments/notes

Age related declines (asked after the walkthrough to avoid any bias)

P1:	Hearing loss, vision decline (macular degeneration), hand tremors
P2:	Vision decline
P3:	Arthitis in hands
P4:	Vision decline (cataracts)
P5:	Vision decline (macular degeneration)
P6:	Hearing loss, vision decline (macular degeneration)
P7:	Early vascular dementia, hand tremors
P8:	Hearing loss, vision decline
P9:	Vision decline, arthritis in hands

1. Log in

Result:		Comments:
Y	P1:	Text in the log in fields is hard to see but I know what a login looks like so it wasn't difficult
Y	P2:	Login information is prefilled when I hover
Y	P3:	Easy
Y	P4:	No problems
Y	P5:	No comments
Y	P6:	No comments
WH	P7:	The login details popped up but the text was very small. There were 2 to choose from. I was told to select the first one.
Y	P8:	No comments
Y	P9:	Easy

2. Locate and click on the friends list icon, then locate and click the 'See all' link

Result:		Comments:
WD	P1:	(Clicked on the friends list icon) The link is blue so it is easy to see but I couldn't see when my mouse was hovering over the link. The text doesn't change and there is no highlight. It was hard to hit the link accurately with my hand shaking when I couldn't see if my mouse was on it. Note: there is a highlight when the mouse curser hovers over the text. It is grey on grey and the contrast was too low for the user to see it.
WH	P2:	How do I make the letters bigger? They are hard to read. User was unable to identify the friends list icon. They were reminded to use the mouse to hover over items on the screen, and were then able to find it. The menu icons have a text pop-up on hover.
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
WD	P7:	Did not recognise the friends icon. No text to identify the icon exept on hover.
Y	P8:	
Y	P9:	

3. Locate the back button and return to friends screen

Result:		Comments:

WH	P1:	Too small to see. P1, P7 and P9 all had difficulty clicking on the arrow due to hand mobility
WH	P2:	No text
WH	P3:	Is not obvious enough tonotice
Y	P4:	No comment
Y	P5:	No comment
Y	P6:	I found it but it wasn't easy to see
WD	P7:	I don't know what the arrow means
WH	P8:	It needs text so I know what it is
WH	P9:	No comment

4. Locate and click 'All friends' link		
Result:		Comments:
Y	P1:	
Y	P2:	
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
Y	P7:	
Y	P8:	
Y	P9:	

5. Hover over 'Mutal friends' link on one profile in the friends list and read the first 2 names aloud		
Result:		Comments:
WD	P1:	it is too small. My hand shakes. The cursor kept moving so the list came and went
WD	P2:	the text is hard to read on the link and the list that appears
Y	P3:	
Y	P4:	The list is hard to read. I can't see the words properly
Y	P5:	
Y	P6:	
WH	P7:	I didn't know that was a link. It looks like text. Interviewer was required to show the participant where to find the link in order to proceed with the tasks
Y	P8:	
WD	P9:	it was hard to hold the cursor still on the link. The list disappeared when i tried to read it

6. Open one friends profile		
Result:		Comments:
Y	P1:	
Y	P2:	
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
Y	P7:	
Y	P8:	
Y	P9:	

7. Locate and click 'See All Photos' link		
Result:		Comments:
Y	P1:	
Y	P2:	
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
Y	P7:	
Y	P8:	

Y	P9:		

8. Enlarge a photo by clicking on it (i) and scroll to the next photo (ii)			
Result: (i)	(ii)		Comments:
Y	WH	P1:	None of the participants were able to work out how to scroll to the next photo.
Y	WH	P2:	They were not familiar with the carousel style arrows found at the sides of the
Y	WH	P3:	photos. The arrows dissappeared and reappeared on mouse movement over the photo.
Y	WH	P4:	P1, P7 and P9 all had difficulty localising on the arrow due to hand mobility. It was not
Y	WH	P5:	obvious to them that they could click anywhere within the lungth of the photo.
Y	WH	P6:	
Y	WH	P7:	
Y	WH	P8:	
Y	WH	P9:	

9. Locate the likes icon on the photo (i) and hover the curser over it to get a pop-up list to appear (ii)			
Result: (i)	(ii)	Comments:	
WD	WD	P1:	P1 and P7 had difficulty holding the cursor over the likes due to hand mobility
WH	Y	P2:	Participant did not recognise the icon. Interviewer described it for the participant
Y	Y	P3:	
Y	Y	P4:	
Y	Y	P5:	
Y	Y	P6:	
WH	WD	P7:	Participant did not recognise the icon. Interviewer described it for the participant
Y	Y	P8:	
WD	Y	P9:	Participant did not recognise the icon. Interviewer described it for the participant

10. Like an image		
Result:		Comments:
Y	P1:	
Y	P2:	
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
Y	P7:	
Y	P8:	
Y	P9:	

11. Locate 'Write a comment' and explain what you think the icons mean without hovering the cursor over them		
Result:		Comments:
N	P1:	None of the participants were able to identify any of the icons, either due to an inability to see them clearly, or recognise them
N	P2:	
N	P3:	
N	P4:	
N	P5:	
N	P6:	
N	P7:	
N	P8:	
N	P9:	

12. Go to the main page		
Result:		Comments:
WH	P1:	None of the participants were able to find a way to their homepage from enlarged photo view.
WH	P2:	The homepage can be reached by clicking on the facebook symbol in the top right. There
WH	P3:	is no explanation of this, nor is there pop-up text on hover to indicate this is home
WH	P4:	

WH	P5:	
WH	P6:	
WH	P7:	
WH	P8:	
WH	P9:	

13. Locate and watch a video

Result:		Comments:
WH	P1:	None of the participants recognised the icon for playing videos. Interviewer described the icon for each participant
WH	P2:	
WH	P3:	
WH	P4:	
WH	P5:	
WH	P6:	
WH	P7:	
WH	P8:	
WH	P9:	

14. Go back to the home page create a post

Result:		Comments:
Y	P1:	
Y	P2:	
Y	P3:	
Y	P4:	
Y	P5:	
Y	P6:	
Y	P7:	
Y	P8:	
Y	P9:	

15. Locate accessibility settings

Result:		Comments:
WH	P1:	All participants required help to find accessibility settings
WH	P2:	
WH	P3:	
WH	P4:	
WH	P5:	
WH	P6:	
WH	P7:	
WH	P8:	
WH	P9:	

16. Locate settings for enlarging text size

Result:		Comments:
N	P1:	*None of the participants were able to complete this.*
N	P2:	*None were able to find settings to change text size.*
N	P3:	*Facebook only allows toggling of compact view on*
N	P4:	*and off in accessibility settings. The only way to*
N	P5:	*change text size is to use zoom settings in the*
N	P6:	*browser. When I explained this none of the*
N	P7:	*participants were able to find those settings in their*
N	P8:	*browsers. When shown the keyboard shortcut (ctrl +)*
N	P9:	*they were able to do it but all were unable to remember the shortcut when asked again after a few minutes.*

17. On a scale of 0-10 how enjoyable was your experience on Facebook? 0 being not at all, 10 being most enjoyable.

P1:	5
P2:	7
P3:	7
P4:	4
P5:	9
P6:	1
P7:	3
P8:	6
P9:	7

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