Revealed or Reinforced: How Assistive Technologies Shape the Experience with Dark Patterns for Blind and Low-Vision Users

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Abstract

Dark patterns have gained increasing attention among the HCI and design communities, but little is known about how they intersect with assistive technologies (ATs) and impact people with accessibility needs, such as blind and low-vision (BLV) individuals. To address this gap, we conducted an in-lab user study with 18 BLV participants using a custom-built social media application that embeds six common dark patterns. Through observing participant experiences with assigned tasks and semi-structured post-study interviews, we explored how screen readers and magnification tools influence the perception and amplification of deceptive design elements. In contrast to prior work that identified accessibility-induced deception, our findings demonstrate a dual role of ATs where dark patterns are either revealed or intensified. Screen readers exposed hidden manipulations like *bad defaults* but amplified other dark patterns through sequential reading. Similarly, magnifiers intensified deceptive effects through viewport reduction by restricting the visible area. We conceptualize this mechanism as *assistive amplification* and show how dark patterns manifest differently for BLV users, informing the design of more inclusive and manipulation-resistant interfaces.

CCS Concepts

• **Security and privacy → Social aspects of security and privacy**; • **Human-centered computing → User studies**; **Accessibility design and evaluation methods**; Smartphones.

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Keywords

Dark patterns, deceptive design, accessibility, visual impairment, assistive technologies, screen readers, magnification, mobile app usability, user experience, qualitative study.

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1 Introduction

Dark patterns are manipulative interface design practices that pressure or coerce users into making decisions that primarily benefit service providers rather than users [39]. First introduced by Brignull [11], they have since been systematically examined in human-computer interaction (HCI) research [28, 38] as deceptive design strategies that exploit cognitive and perceptual biases. Previous studies [19, 43, 52] have documented the widespread presence of dark patterns across digital systems, including e-commerce platforms, mobile applications (apps), and social media. While this body of research has substantially advanced our understanding of how dark patterns operate and how users recognize them, less work has examined the disparate impact of dark patterns on different user groups with varying access needs.

One group for whom these practices have disproportionate consequences is blind and low-vision (BLV) users. According to the World Health Organization (WHO) [1], at least 2.2 billion people worldwide live with some form of vision impairment, including 39 million classified as blind.[1] For BLV users, digital technologies, in

[1] In this paper, we use the term *blind and low-vision* (BLV) to describe people, whose visual function cannot be fully corrected with glasses or contact lenses. Internationally, the WHO defines blindness as a visual acuity of less than 3/60, meaning that a person can see at three meters what a person with typical vision can see at 60 meters. In other words, even at a very close distance, visual detail is severely reduced. Low vision, by contrast, refers to a range of visual conditions that still allow for some functional sight but may significantly affect daily activities. In the German context, legal classifications follow a similar structure. Individuals are considered blind when their remaining vision

particular mobile apps, play an essential role in communication and access to information [34]. However, many mobile apps rely on interaction strategies that shape user decisions in ways that primarily serve platform interests. In visually rich and attention-driven interfaces, such strategies often operate through visual prominence, layout, and hierarchy, which could disproportionately impact users who cannot rely on visual cues to interpret or resist such influences, and could be further intensified when interaction takes place through ATs such as screen readers or magnifiers. In this context, accessibility is not just a technical requirement, but a matter of fairness and digital justice [2].

ATs such as screen readers with TalkBack [25] and magnification tools are built-in accessibility features provided by mobile operating systems such as Android or iOS. These features are designed to support BLV individuals in interacting with digital content [18, 36, 62]. They translate visual information into auditory, tactile, or enlarged representations and are essential for enabling independent access to online environments [13]. Existing work [17, 30] has shown that even when interfaces are not intentionally deceptive, accessibility barriers can still emerge through visual or structural inconsistencies. Such barriers can obscure the way manipulative design cues are presented, leading to distorted user experiences. Given that both dark patterns and ATs are highly prevalent in everyday mobile use, understanding their intersection is key for developing inclusive and ethically responsible design practices.

While prior work has documented that accessibility barriers and deceptive designs co-occur [35, 37], it has not theorized how ATs systematically transform the effects of dark patterns during interaction. In particular, it remains unclear how modality-specific interaction (e.g., sequential reading vs. constrained visual viewports) reshapes users' perception and susceptibility to manipulation. To address this gap, we introduce the concept of *assistive amplification*, describing how ATs can both reveal and intensify the effects of dark patterns through their interaction mechanisms.

We conducted an in-lab user study with BLV participants using a custom-built social media app that systematically embedded six well-established dark patterns into sign-up and account deletion flows, two core interaction processes that nearly all mobile apps require users to complete at least once. Unlike retrospective or diary-based research, this controlled setting allows us to observe dark patterns in real-time, reducing recall bias and enabling direct comparison between different AT modalities. Participants completed two controlled tasks while using their preferred ATs (e.g., screen readers or magnifiers). We focus specifically on screen readers and magnification tools, which represent two fundamentally different modes of access: screen readers translate interface elements into sequential auditory output, while magnification tools preserve visual interaction by enlarging the visible interface. We collected qualitative data (observations and post-task interviews), complemented by descriptive measures such as task completion times and self-reported recognition, to examine how dark patterns were experienced and navigated. Specifically, our study addresses the following research questions:

is below 2%, severely visually impaired when their remaining vision is below 5% and visually impaired when their remaining vision is below 30%.

(1) **RQ1:** How do BLV users perceive and interact with dark patterns during sign-up and account deletion in social media apps?
(2) **RQ2:** In what ways do ATs help or hinder BLV users in recognizing dark patterns in these processes?

Our findings demonstrate two key insights. First, BLV users perceive dark patterns differently depending on whether the interaction is auditory (through a screen reader) or magnified. Participants reported misdirection, hierarchical confusion, and cognitive load in ways that differ from prior work on non-BLV users.

Second, ATs play a dual role in the user interactions as they reveal some dark patterns (e.g., clickable buttons with terms and conditions are announced aloud) while intensifying others through sequential reading—for example, when content must be accessed linearly in the order it is announced or through viewport reduction, where zooming in restricts the visible area and distorts visual hierarchy.

This paper makes the following contributions:

(1) We present an in-lab user study investigating the experiences of BLV users with dark patterns in a controlled mobile app environment. Our research employs a custom-built social media app to systematically integrate dark patterns and assess their effect on sign-up and account deletion flows.
(2) We identify the dual role of ATs and dark patterns, showing how screen readers and magnifiers can both expose and amplify manipulative design cues and conceptualize this mechanism as *assistive amplification*.
(3) We show that existing dark pattern categories manifest differently under assistive interaction, and identify accessibility-specific variants that extend current ontologies.
(4) We derive design implications that specifically address the intersection of dark patterns and ATs to help mobile app developers identify and avoid dark patterns that disproportionately affect BLV users.

2 Related Work

When examining how dark patterns operate on social networking sites (SNSs) and how these effects are shaped by the use of ATs among BLV users, it is important to consider prior work from both research areas. This section begins with an overview of research on dark patterns and then moves on to related work in the field of BLV and accessibility research.

2.1 Dark Patterns

The concept of dark patterns was introduced by Brignull in 2010 to describe interface design choices that intentionally steer, coerce, or deceive users into making decisions that may not align with their best interests [11]. While the terminology has sparked debate, as some researchers advocate for alternative terms such as deceptive design or manipulative design to avoid unintended connotations, dark patterns remain the most widely used term in academic research and regulatory contexts [15, 28]. In this work, we use the term in line with prior studies to refer to design practices that hide information, exploit cognitive biases, or obstruct user autonomy.

Over the past decade, dark patterns have been systematically identified and classified across a variety of contexts, including e-commerce [38], mobile applications [16, 19], and social networking services (SNSs) [42, 43]. Mathur et al. [38] developed a taxonomy of five dimensions to describe how these patterns operate: asymmetric (where the effort required to make one choice is significantly higher than another); covert (where the manipulation is hidden from the user); deceptive (where misleading information is provided); hides information (where relevant information is obscured); and restrictive (where options are limited to force certain actions). Building on this, Gray et al. [28] synthesized regulatory reports and academic studies into a comprehensive ontology comprising 64 types of dark patterns organized in a three-tier hierarchy, creating a shared vocabulary to support both research and enforcement efforts. Among these, patterns such as *confirmshaming*, *forced continuity*, *roach motel*, and *bait and switch* are particularly relevant to account management flows in social media platforms. These tactics are often combined to form multi-layered manipulations that exploit users' cognitive load and time pressure [10, 43].

Dark Pattern in Social Media. Dark patterns are particularly prevalent on social media platforms, which informed our decision to implement them in a customized social media app in our user study. Dark patterns' persuasive and manipulative nature is often intertwined with social media platforms' business models that rely heavily on sustained user engagement. Prior work has systematically examined how dark patterns are embedded in sign-up processes, notification systems, subscription flows, and account deletion procedures [29, 43, 52]. For example, Mildner et al. [43] identified a range of "engaging" and "governing" strategies in SNSs, including tactics that encourage users to remain active, such as default-on notifications or the strategic surfacing of social validation cues. Sign-up interfaces frequently incorporate pre-selected options or bundled consents that nudge users toward data sharing or premium subscriptions without explicit, informed choice [29]. Subscription models may feature *hidden costs* or *forced continuity*, in which trial periods automatically convert to paid plans unless the user proactively cancels.

Account deletion processes have been shown to be particularly prone to obstruction-based dark patterns, e.g., as service providers hide the deletion option deep within settings menus, require multiple confirmation steps, or present emotionally charged messages aimed at discouraging account closure [52].

Dark patterns on social media can also manifest as infinite scroll feeds or integrated payment processes to make privacy protection measures more difficult, while making it easier for users to engage in behavior that generates revenue [33, 42]. While prior work has documented these manipulations for sighted users, our work contributes empirical knowledge of how BLV users encounter and navigate dark patterns, especially when relying on ATs to interact with complex social media interfaces.

2.2 Technology Use Among BLV Users

BLV users use a wide range of ATs to improve access, including screen readers, magnifiers, tactile keyboards, and voice assistants [18, 36, 62]. Numerous studies have investigated the practices and issues that BLV users face when interacting with specific apps [9, 14, 65], SNSs [45, 63], voice assistants [3, 47], devices [18], or mobile phones and interfaces [31, 32, 48]. Barriers to accessibility in mobile interfaces—such as missing labels, inconsistent focus management, or inadequate dynamic feedback—directly interfere with the perception and cognitive processes of BLV users. Missing or imprecise labels, for example, force users to guess functions or figure them out through trial and error, which creates uncertainty and encourages misinterpretation [23].

Beyond usability, recent research has paid increasing attention to the security and privacy concerns, needs, and practices among BLV users [53] with regard to authentication methods [4, 12, 20, 46], privacy management when using camera-based assistive applications [5, 6, 67], generative AI [60], and privacy advice through Q&A assistants [22]. Prior studies also designed systems for accessible obfuscation support [59, 66] and crypto wallets [68] for BLV users. Additionally, Sharveski et al. investigated BLV users' experiences with misinformation on social media [54, 56, 58], detection of audio deepfakes [57], and assessment of suspicious emails with banner warnings [55].

Security and privacy issues are also deeply intertwined with interface issues (e.g., dark patterns) that can disproportionally affect BLV users [50] due to their visual-centric nature and BLV users' reliance on ATs to navigate online spaces. Although dark patterns have been extensively studied in domains such as e-commerce and social media, research has only recently begun to investigate their interplay with accessibility. Chamorro [49] highlights how deceptive designs reinforce digital inequalities and disproportionately disadvantage groups with limited digital skills and disabilities. Prior research has also shown that vulnerable populations, such as older adults, children or users with lower digital literacy, are particularly susceptible to deceptive design practices due to differences in cognitive load, experience, and access [8, 41, 51]. These findings provide a broader foundation for understanding why BLV users may experience distinct or amplified effects when interacting with dark patterns through ATs. From this perspective, accessibility is seen not only as a question of user friendliness but rather of fairness and justice in the digital environment.

Building on this, Gray et al. [26] argue for a transdisciplinary approach—combining insights from HCI, law, ethics and accessibility —to understand how deceptive design practices harm different user groups. Early work by Kodandaram et al. [35] examined how blind users encounter deceptive advertisements while using screen readers, finding that contextually integrated ads often misled participants and that common defenses such as ad blockers were not always effective. Similarly, Alluqmani et al. found deceptive or incorrect product descriptions and the knock-on effect on Amazon search tools' reliability [7]. These findings highlighted how accessibility barriers can amplify the deceptive impact of such designs. Clarke et al. [17] further demonstrated this interplay in their study of cookie notices on major UK websites, finding that participants with visual impairments still faced significant barriers, despite the cookie notices' formal compliance with accessibility and data privacy regulations.

Most directly related to our work, Lewis et al. [37] conducted an interview and diary study with people using visual accessibility technologies on their experiences with dark patterns, finding that participants not only encountered established dark patterns such as sneaking, misdirection, and obstruction, but also described accessibility barriers themselves as deceptive when they prevented informed decision-making. This previous work motivates our study, in which we examined how dark patterns intersect with different kinds of ATs for BLV users in a more controlled setting (where all participants were asked to complete the same tasks) and showed how ATs can either facilitate or hinder navigation in interacting with dark patterns.

3 Methodology

We developed a task-based study using a custom-built social media app. Our aim was to investigate how different ATs influence users' experiences with dark patterns during sign-up and account deletion. Below, we present the core components of our study design, including the app design and set-up, task structure, and participant approach.

3.1 SocialGram: Custom-built Social Media App

Social media apps provide an especially relevant setting for studying dark patterns. With more than 5.4 billion active users globally [24], platforms such as Instagram, TikTok, and Meta have become almost natural entry points for social interaction and content creation. They are also among the most frequent contexts in which users sign-up, modify, and attempt to delete accounts that are known to contain user interfaces with some of the most manipulative dark patterns [33, 52]. Because these platforms rely heavily on visually demanding and fast changing interfaces, dark patterns in this space can overly affect users who depend on ATs to navigate them. To investigate how BLV users experience dark patterns in mobile user interfaces, we developed a custom-built social media app using the low-code platform, FlutterFlow[2]. Our app, *SocialGram* was designed to closely resemble real-world social media platforms in terms of layout, navigation structures, and features. Using a custom-built system allowed us to precisely control the presence, placement, and combination of dark patterns across flows, which would not have been possible with existing commercial platforms. Real-world platforms introduce variability in interface design and evolving interaction logic, making it difficult to attribute observed effects to particular dark patterns. In addition, modifying existing platforms to embed specific dark patterns is not technically feasible without altering systems and may raise legal and ethical concerns. A custom-built app also reduced the influence of prior familiarity with existing social media interfaces, allowing us to focus on interaction mechanisms rather than learned platform behavior.

The implementation process followed Android's developer accessibility guidelines[3] to ensure that the app was fully functional with screen readers and magnifiers. Specifically, semantic labels compatible with TalkBack were assigned to all interactive elements (e.g., buttons and checkboxes). The logical focus order was manually reviewed to ensure that sequential navigation was predictable when using screen readers. Touch targets followed recommended minimum sizes, and dynamic elements such as dialogs and confirmation screens were implemented using standard Android components to ensure proper announcement and focus behavior. Visual design choices such as color contrast, font size, and spacing were selected to meet accessibility recommendations and to avoid introducing unintended accessibility barriers unrelated to the dark patterns under investigation. By controlling these factors, we aimed to minimize usability issues and isolate the effects of the implemented manipulative structures. Although the app includes accessibility-focused refinements, it does not support automated event logging or telemetry-based tracking. All interaction data were collected through external observation, screen recording (with consent), and post-task interviews. This approach allows us to focus on participants' subjective experiences and reflections, rather than automated behavioral metrics. All study tasks were conducted using three identical *Google Pixel 6a* smartphones (Android 15, standard resolution, and accessibility settings reset before each session) to ensure consistency across participants. Participants used standardized study devices rather than their personal smartphones. Importantly, we standardized the device, not the AT: participants used the AT they regularly relied on in everyday life (e.g., screen reader or magnification), preserving consistency with their established interaction practices. Standardizing the device allowed us to reduce confounding effects caused by differences in hardware, operating system versions, display scaling, or installed applications. To mitigate unfamiliarity with the study device, participants completed a warm-up phase and were given the opportunity to ask questions before beginning the main tasks.

Dark Pattern Integration. The overall design of the custom-built app was guided by the ontology proposed by Gray et al. [28], which distinguishes between low-level, meso-level, and high-level manipulative mechanisms. Low-level patterns in the app included visual prominence, false hierarchy, and emotional framing. Meso-level strategies involved manipulating choice architecture and creating obstacles and high-level structures encompassed obstruction, forced action, and forms of social engineering. The specific pattern selection was further informed by prior studies [41, 43, 44] examining dark patterns in social networking platforms, ensuring that the integrated dark patterns reflected realistic and empirically grounded user experiences. An overview of our mapping of the featured dark patterns and our integration can be seen in Table 1.

The app simulates key interaction flows typical of social media platforms, including sign-up, subscription management, privacy settings, and account deletion, with a core focus on reproducing realistic and structured dark pattern integration. The sign-up and set-up flow integrates several well-established types of manipulative design. The most expensive subscription plan ($15.99 per month) was pre-selected by default, representing a *bad defaults* pattern [44]. Progression through the sign-up sequence was blocked unless users accepted multiple terms at the same time, specifically both the Terms and Conditions and the Subscription Plan, which enforced a *forced action* pattern [43]. In addition, alternative subscription options were visually not emphasized, illustrating a combination of *misdirection* and *false hierarchy*.

In the account deletion flow, a multi-step process with layered confirmation points was implemented, inspired by Gray et al.'s analysis of Amazon's "Iliad Flow" [27] (see Figure 1). During this process, users were repeatedly presented with alternative actions

[2]https://www.flutterflow.io
[3]https://developer.android.com/guide/topics/ui/accessibility

Flow	Step	Dark Pattern	Description
Sign-up flow	Preselected subscription	Bad Defaults	The sign-up process includes a pre-selected subscription model as default. Users may be nudged to subscribe to a more expensive model unintentionally.
	Mandatory acceptance of multiple items	Forced Action	Users are required to accept multiple items before being able to proceed with the sign-up process.
	Hidden alternatives	False Hierarchy	Certain subscription buttons are highlighted while some alternatives in the subscription plan are smaller.
Deletion flow	Multi-step confirmation	Obstruction	The deletion flow requires the user to walkthrough multiple steps and provide several confirmations.
	Alternative "Pause account"	Nagging	When the user requests an account deletion, they are nagged to pause their account instead.
	Emotional phrasing	Confirmshaming	The account deletion flow uses confirmation messages that are designed to elicit an emotional response from the user (e.g., "Are you sure?" and "All your memories will be lost").

Table 1: Dark patterns mapped to the respective flow and step.

such as "Pause account" or "Remind me later," invoking the strategies of *nagging*, *confirmshaming*, and *obstruction* [41]. This structure mirrors the inter-page manipulation observed in commercial cancellation flows, where repetition discourage users from completing account deletion [27].

3.2 Task Design & Scenario

The study consisted of two main consecutive tasks that were intended to depict typical interactions with social media apps. The tasks should reflect dark pattern containing interactions such as account sign-up and deletion. These tasks were chosen because they represent common account management interactions in mobile applications while allowing structured examination of dark patterns. At the same time, we do not treat them as equally representative of everyday use: in particular, account deletion is often a relatively infrequent action in real-world settings and may involve emotional investment that develops only over longer-term platform use. In our study, the task primarily served as a controlled way to examine obstructive and confirmatory manipulations in a comparable interaction flow.

Warm-Up: Device Familiarization. Participants were initially given time to become comfortable with the Android phone we provided and its accessibility features. They were instructed to find and launch the built-in app, unlock the phone, and make sure their selected AT was turned on. This step helped reduce the effects of device unfamiliarity and ensured that participants could begin the study tasks with a basic level of confidence in the provided setup.

Task 1: Account Sign-Up. In the first task, participants were asked to create a new user account in the SocialGram app. They were instructed to enter self-chosen login credentials and complete the full sign-up process, which included navigating a subscription selection, agreeing to terms and conditions, and confirming account set-up. The interface required the use of typical UI elements (forms, buttons, and checkboxes), allowing us to observe how well different ATs supported independent interaction.

Intermediate Task: Content Interaction. Before moving to the second main task, participants were asked to scroll through the *SocialGram* feed and like or post a short comment such as"Hello world." This intermediate interaction was included to break the procedural flow and simulate real user behavior between sign-up and account management. Participants were offered a short informal pause between tasks, allowing them to rest or ask clarifying questions before continuing.

Task 2: Account Deletion. In this task, participants were instructed to locate the settings page of SocialGram and attempt to delete the account they had just created. The deletion process was intentionally designed to include multiple decision points and confirmation steps, some of which were visually or structurally obstructive. The steps are depicted in Figure 1. Participants were encouraged to complete the task independently using their AT, but could ask for clarification at any time. Although the task was intentionally structured to contain obstructive and confirmatory steps, our goal was not to study emotional attachment to deletion itself, but to examine how these manipulative structures unfold under assistive interaction.

3.3 Pre-Study

To validate the study design and refine our materials, we conducted a pilot phase with four participants. Initially, one sighted participant carried out the study. He used the screen reader TalkBack to test both tasks and gave general feedback on the study design. In addition, three BLV participants took part, one using screen magnification, one TalkBack and one using a combination of TalkBack and Voice Access (Voice control was not used in the main study). The pilot participants were between 29 and 68 years old. Feedback from the sighted participant led to adjustments to the interview guide. Following the improvements, three questions were added and the structure and clarity of the guide improved. The sessions with BLV participants revealed accessibility issues in the custom-built app, such as missing semantic labeling (e.g., for the back buttons) and elements of the navigation bar that were not correctly displayed or read aloud. In addition, the keyboard in combination with magnification or the screen reader sometimes obscured input fields. The

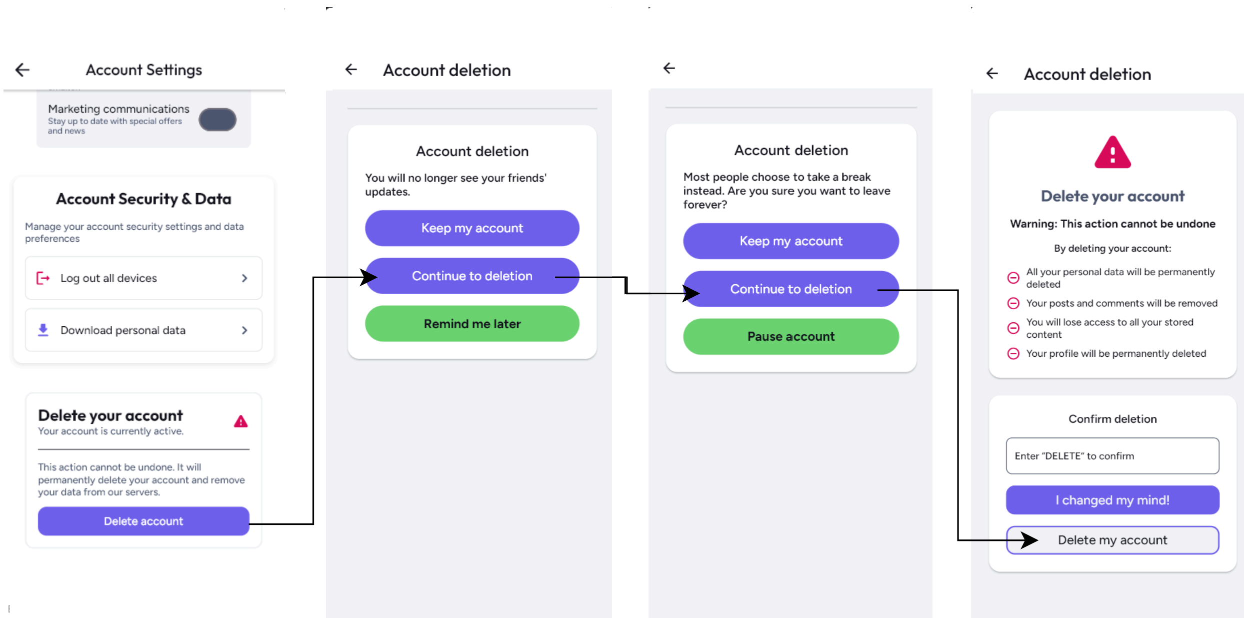

Figure 1: Multi-step account deletion flow used in the study.

magnification wheel also covered important parts of the custom-built app. Based on these findings, targeted improvements were made to ensure better compatibility with ATs.

3.4 Procedure of Experimental Set-Up

Each study session followed a structured sequence consisting of participant onboarding, task execution, and post-task reflection. The procedure was designed to ensure both comparability across participants and sufficient flexibility for individual accessibility needs. As illustrated in Figure 2, the study comprised three main phases: (1) *Preparation*, including consent, demographic questions, and configuration of AT (2) *Mobile interaction*, consisting of the three in-app tasks, sign-up, intermediate feed interaction, and account deletion and (3) *Post-study reflection*, which included the interview, Likert-scale statements and debriefing. This structure allowed participants to gradually familiarize themselves with the device and the SocialGram app. To avoid overload, participants were allowed to take short breaks between phases as needed, and the session pace was adapted to individual accessibility needs. At the same time, this structure enabled systematic observation of participant behavior under controlled interaction conditions.

At the beginning of each session, participants received a short verbal overview of the study's purpose and were reminded of their rights, including voluntary participation and the option to withdraw at any time. After providing informed consent, they were asked to adjust the smartphone's accessibility settings to their preferred configuration (e.g., check if TalkBack or magnification was activated). The researcher ensured that the device was set up correctly and confirmed that participants felt comfortable using it before starting with the first task. Following this preparation, participants completed the study tasks in the fixed order described in 3.2. Screen recording and external observation were used throughout to capture interaction behavior. Participants were encouraged to verbalize their thoughts when possible, but the researcher limited intervention to neutral clarifications to avoid influencing their choices. If a participant encountered accessibility barriers, brief support was provided to ensure that frustration did not interrupt the session while maintaining the integrity of the task.

After completing all tasks, participants completed a short likert-scale questionnaire adapted from Mathur et al. [38, 39] to assess perceived difficulty and recognition of dark patterns. They were then invited to a semi-structured interview lasting approximately fifteen minutes. The interview covered participants' overall task experience, perceived manipulation strategies, the role of the AT used, accessibility barriers encountered, and comparisons to similar experiences in everyday app use.The entire protocol can be found in the appendix A. Participants were also invited to suggest design improvements and reflect on situations in which similar patterns had affected them outside the study. Each complete session lasted approximately 40–60 minutes. At the end of the study, participants were fully debriefed regarding the purpose of the mock app and the dark patterns integrated, and they received financial compensation for their participation.

3.5 Recruitment & Demographics

To recruit BLV users for the study, we contacted and called various local and regional advocacy organizations, schools, and rehabilitation centers across [anonymized region for peer reviewing], Germany. Only participants who self-reported a level of vision impairment that meets the legal criteria for blindness or severe visual

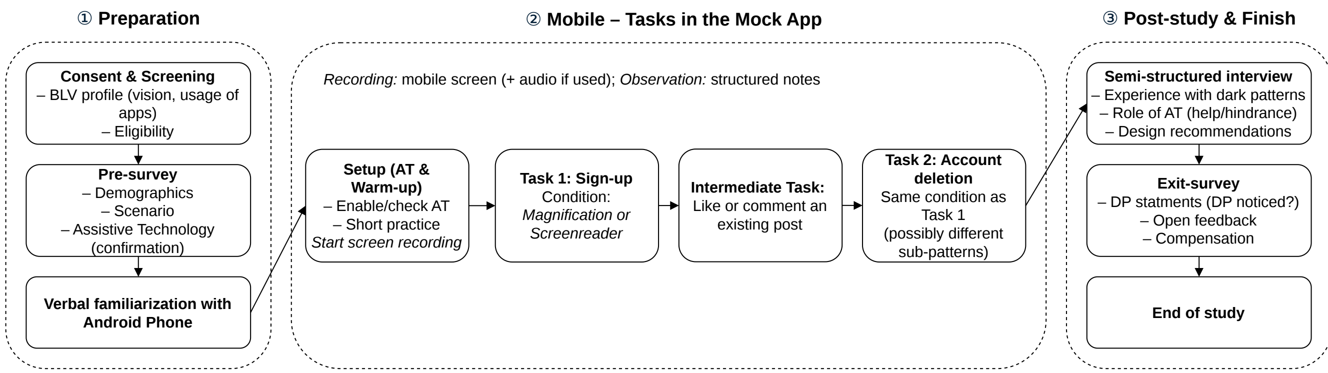

Figure 2: Overview of the experimental procedure showing the three main study phases.

impairment in Germany were eligible to participate. No medical documentation was requested or verified, and all demographic information was collected via self-reporting. To ensure participants felt comfortable and informed prior to the study, we scheduled short introductory meetings with each organization and participant. These sessions were used to explain the study, introduce the researcher, and answer any initial questions. This step helped to build trust and ensure informed participation. The study sessions lasted between 40–60 minutes and participants received an hourly rate of €25, which corresponds to the average hourly wage in Germany.

In total, we obtained complete data from 18 BLV participants (nine blind and nine low-vision; seven male and 11 female participants).[4] Their occupations included four students and 14 employed individuals, with four participants part-time employed. To provide contextual grounding for task duration, a small group of sighted participants (n = 8) was invited to perform the same tasks without ATs. This group was not recruited under the same conditions as the BLV participants (e.g., no compensation, no controlled sampling) and was not intended as a comparison group. Instead, it serves only as an exploratory baseline to contextualize interaction effort and is not intended as a controlled comparison group. The study was approved by our institute's Ethics Review Board (ERB). Participants received detailed information about the purpose, procedure, and their rights, and provided informed consent before the start of the study. Table 2 provides an overview of the demographic composition of all included participants, including age, gender, self-reported vision level, AT used and occupation type.

3.6 Groups

Participants were categorized into two groups based on their primary AT: a *screen reader group* (e.g., TalkBack) and a *magnification group* (e.g., Zoom, font or contrast adjustments). Rather than assigning technologies, participants used their own preferred accessibility settings throughout the study, resulting in naturally varying group sizes. We did not balance these groups experimentally, as doing so would have required assigning participants to ATs they do not normally use. The resulting group sizes therefore reflect participants' real-world AT preferences rather than an intended comparison design. Participants included both blind and low-vision individuals with differing levels of residual vision. While classification was based on self-reported level of vision, the analysis distinguishes between functional AT use (screen reader vs. magnification) and vision level groups (blind vs. low vision). Several blind participants with residual sight occasionally relied on magnification, while some low-vision participants preferred screen readers for efficiency. In one case, a participant combined multiple technologies (e.g., TalkBack together with Voice Access). In this case, the participant was assigned to the group corresponding to the primary technology used during the task, with combinations noted for later discussion in the qualitative analysis.

3.7 Data Analysis

We used a mixed-methods approach to analyze the collected data. For the task-based component, screen recordings of participants' interactions with the custom-built app were recorded. These were analyzed qualitatively to identify obstacles and navigation strategies. Particular attention was paid to the dark patterns implemented. To complement this analysis, observation notes and task completion times were also analyzed.

In addition, we conducted semi-structured interviews after the tasks. All interviews were recorded and transcribed. A thematic analysis approach was used to code the transcripts, focusing on user perceptions, barriers to accessibility and strategies for navigating potentially misleading elements. Coding was conducted iteratively by the main researcher using MAXQDA[5] qualitative analysis software. In line with current best practices in qualitative HCI research [40], we do not report inter-rater reliability (IRR), as IRR is not an appropriate measure of qualitative rigor for interpretive work because it assumes a single "objective" coding solution. Instead, we ensured analytical robustness through repeated cycles of recoding, memo writing, and peer debriefing with the research team. This process emphasized consistency across analytical iterations.

[4] Data from three participants had to be excluded from further analysis due to incomplete answers or unfinished tasks.

[5] https://www.maxqda.com/de/

ID	Age Group	Gender	Self-reported Vision Level	Daily Assistive Technology	Occupation Type
P1	35–44	Female	Low vision, 20% residual vision (since birth)	Magnification (Android)	Full-time employed
P2	35–44	Male	Blind, 0% vision loss (acquired)	Screen Reader (VoiceOver, iPhone)	Full-time employed
P3	65+	Female	Blind, 0% vision loss (since birth)	Screen Reader (VoiceOver, iPhone)	Full-time employed
P4	45–54	Male	Low vision, 25% residual vision (acquired)	Zoom / Magnification (Android)	Full-time employed
P5	25–34	Female	Low vision, 30% residual vision (since birth)	Zoom / Magnification (Android)	Full-time employed
P6	45–54	Female	Blind, 0% vision loss (acquired)	Screen Reader (VoiceOver, iPhone)	Full-time employed
P7	45–54	Female	Low vision, unknown degree (since birth)	Display Adjustments (contrast, inverted colors) / Magnification (Android)	Full-time employed
P8	25–34	Male	Low vision, 4% residual vision (since birth)	Display Adjustments (contrast, inverted colors) / Magnification (Android)	Part-time employed
P9	25–34	Male	Blind, 2% residual vision (acquired)	Zoom / Magnification (iPhone)	Student
P10	18–24	Male	Blind, 2% residual vision (since birth)	Screen Reader (VoiceOver, iPhone)	Student
P11	25–34	Female	Low vision, 20% residual vision (acquired)	Screen Reader (VoiceOver, iPhone)	Student
P12	45–54	Female	Low vision, 4% residual vision (acquired)	Screen Reader (TalkBack, Android)	Part-time employed
P13	25–34	Male	Low vision, 15% residual vision (since birth)	Screen Reader (VoiceOver, iPhone)	Student
P14	25–34	Female	Low vision, 10% residual vision (acquired)	Zoom / Magnification (iPhone)	Part-time employed
P15	55–64	Female	Blind, 0% vision loss (since birth)	Screen Reader (VoiceOver, iPhone)	Freelance
P16	55–64	Male	Blind, 0% vision loss (acquired)	Screen Reader (VoiceOver, iPhone)	Full-time employed
P17	45-54	Female	Blind, 1% vision loss (acquired)	Screen Reader (VoiceOver, iPhone)	Part-time employed
P18	45-54	Female	Blind, 2% vision loss (acquired)	Screen Reader (VoiceOver, iPhone)	Full-time employed

Table 2: Overview of participant demographics, vision level, daily assistive technologies, and occupational background.

To complement the qualitative analysis, similar to Mildner et al. [41, 42], participants were also asked after the tasks whether they had noticed specific dark pattern features during sign-up and deletion, that corresponded to the definition by Mathur et al. [38]. These items were derived from prior dark pattern literature [38, 39, 41] and were intended to capture participants' reflections on selected interface elements rather than to support inferential claims. Responses were recorded as "Yes," "No," or "Maybe". Given the limited sample size, we report these data descriptively only and interpret them as contextual support for the qualitative findings rather than as statistically representative results. We refrained from aggregating the items into composite constructs, as this would require a larger participant pool and further validation procedures such as confirmatory factor analysis (CFA) or internal consistency measures (e.g., Cronbach's alpha), which was not possible in this study.

4 Results

This section is organized along the two research questions, encompassing the participants' perceptions of dark patterns (RQ1) and the role of ATs in shaping these experiences (RQ2). Within each subsection, we first describe recurring experiential themes and then illustrate how these differed across assistive modalities.

4.1 Perception and Interaction with Dark Patterns (RQ1)

This subsection addresses RQ1 by examining how participants perceived and experienced dark patterns during sign-up and account deletion. It describes how these patterns were experienced in practice, combining participants' qualitative accounts with recognition data and highlighting differences between screen reader and magnification use. We organize the findings around three recurring experiential dimensions: (i) obstruction as a compounded barrier (§4.1.1), (ii) false hierarchy as a source of misdirection (§4.1.2), and

(iii) the broader cognitive and emotional reactions that emerged while navigating these flows (§4.1.3).

4.1.1 Obstruction as a Compounded Barrier. Obstruction refers to design strategies that deliberately make certain actions difficult to complete, often by introducing unnecessary steps, delays, or hidden options [28, 38]. Prior work has shown that obstruction is frequently used in account management flows, particularly to discourage cancellation or deletion [27, 43]. In our study, obstruction emerged as one of the most dominant and consistently experienced dark patterns across participants.

Across almost all participants, obstruction appeared as a recurring and compounded barrier. Account deletion required multiple confirmation steps, an uppercase text entry and concealed navigation points or design choices that challenged both blind and low-vision users. Low-vision participants described how visual obstructions and unnecessary text input turned an easy task into a frustrating search.

P9, for instance, explained that *"The delete field was well hidden, and you had to type 'delete' in capital letters to actually delete it. I find it better when the process is not made so complicated, and this one definitely was."* Others confirmed this experience. P5 called the step *"strange, that you have to type the word 'delete' in capital letters,"* while P4 admitted, *"I didn't see that you had to write in capital letters ... Normally it's much easier."* Similarly, P1 commented while completing the step: *"Okay ... D-E-L-E-T-E"* illustrating how even a simple confirmation becomes hard when magnification obscures parts of the interface. Another low-vision participant (P7) failed to locate the option altogether, stating *"I couldn't find it ... There was something there, but it didn't work the way I wanted. That was really annoying."*

These remarks reveal how small textual or positional obstacles, combined with limited visual context, create a sense of being stuck. For blind users, *obstruction* showed differently but with comparable consequences. P6 described the hidden deletion field as intentionally buried: *"First finding that delete field, that was difficult. It's hidden on purpose, because they really don't want you to do that."* The participant then reported a similar experience from everyday life with his cloud storage, where multiple confirmation steps made it difficult to delete files. P15 described the multi-step deletion flow as both exhausting and risky: *"There are so many steps that you almost end up tapping the wrong thing because you get tired or lose concentration. Or that you suddenly tap "'I have changed my mind' by mistake before you even know what you are doing."* This highlights how *obstruction* not only delays progress but also increases the likelihood of accidental compliance.

Descriptive responses from the post-task questionnaire align with these qualitative observations. Participants more frequently reported noticing patterns that directly impeded progress, such as *obstruction* and *forced action*, while visually subtle or emotionally framed patterns, such as *bad defaults* and *confirmshaming*, were less commonly identified. These patterns suggest that participants were more likely to recognize manipulations that directly affected interaction effort, whereas more subtle visual or affective cues were less salient in the study context.

Together, these accounts illustrate that what may seem like a minor task for sighted users represents a systemic barrier for BLV users. Requiring users to type or navigate through obscured steps introduces friction not as protection but as persuasion, effectively blending dark pattern design with accessibility failure.

Recognition of dark patterns was captured using a post-task questionnaire administered after participants completed all study tasks. Participants were presented with a set of statements describing specific manipulative design features (e.g., preselected options) derived from prior dark pattern taxonomies [38, 39, 41]. For each statement, participants indicated whether they had noticed the corresponding pattern during the sign-up or deletion process by selecting *Yes*, *No*, or *Maybe*. In line with previous work, only explicit *Yes* responses were counted as recognition, while *No* and *Maybe* responses were treated as non-recognition. Table 3 summarizes the proportion of participants who reported recognizing each dark pattern overall and by AT.

4.1.2 False Hierarchy and Visual Misdirection. A second recurring theme concerned *false hierarchy*, which describes design strategies that manipulate users' decisions by visually or structurally emphasizing certain options while downplaying others, for example, through color, size, placement, or ordering [28, 38]. Prior work has shown that such hierarchies are commonly used to direct users toward preferred actions, particularly in consent and account management flows [43]. In our study, false hierarchy emerged as a more subtle form of manipulation than obstruction, yet one that still caused confusion and misinterpretation across assistive modalities.

P9, blind participant who used magnification, highlighted the unintuitive layout during registration: *"The most confusing part was that the checkboxes were placed underneath the main registration button. That was very unintuitive, I would design it differently."* P9 further reflected on the deletion flow, where visual color cues contributed to misdirection: *"The 'I changed my mind' option was in some blue, which normally looks like the confirmation field. Below that, there was another one, I'm not sure what color it was, maybe gray."* This description illustrates how conventional color semantics, such as blue buttons signaling confirmation, can mislead magnification tool users into reversing their intended decision.

Other magnification users reported similar experiences. P4 stated that critical options were literally out of his viewport: *"That's what I said before, this deletion process requires you to write a word to be deleted in capital letters. It was all the way at the bottom in very small blue letters, and I didn't see it at first but found it later."* For participants using screen readers, *false hierarchy* was not shown through color but through structural and auditory inconsistency. P2 explained, *"Some of it is very confusingly arranged. Sometimes you have the switch first and the label underneath, or sometimes it's the other way around. That's quite difficult."* P2 also noted that *"some graphical elements were not really read out, everything to do with images or their descriptions is missing."*

Without consistent order or semantic labeling, blind users lose the relational information that sighted users rely on to infer importance, effectively erasing the cues that reveal manipulation. Taken together, these comments show that an incorrect hierarchy relies on two types of deception: for users of magnification tools, it is a visible but misleading signal that diverts attention, and for users of screen readers, it is an invisible structure in which highlights, contrasts, and groupings disappear completely. In both cases, decisions

Dark Pattern	Yes (n=18)	Screen Reader (n=11)	Magnification (n=7)
Forced Action	17	10	7
Obstruction	16	10	6
Nagging	13	9	4
False Hierarchy	7	5	2
Confirmshaming	11	7	4
Bad Defaults	6	4	2

Table 3: Number of participants who reported recognizing each dark pattern ("Yes" responses only), overall and by AT based on post-task self-reports. Valid participants completed both core tasks and the post-task questionnaire.

are made without full context and guided by design asymmetries rather than user intent.

Participants' responses indicate that false hierarchy was less consistently identified compared to more direct forms of obstruction. While some participants were able to recognize inconsistencies in layout or structure, others interpreted these issues primarily as accessibility barriers rather than intentional manipulation. This suggests that false hierarchy may be particularly difficult to detect when visual or structural cues are altered through assistive technologies.

4.1.3 Cognitive Reactions and Emotional Load. Beyond specific interface barriers, participants reported a persistent sense of cognitive load and emotional frustration while navigating the sign-up and deletion flows. In both groups, users expressed moments of uncertainty or hesitation. These reactions could not be attributed to a single task or dark pattern but rather to the overall effort required to check and confirm each step.

Blind participants frequently expressed fear of making irreversible errors. As P2 put it, *"I was afraid to swipe or try something. If I'm unlucky, I'll have to start all over again."* This anxiety illustrates how limited overview and high interaction costs turn exploration into risk, making users cautious and slowing down the interactions.

Several participants described moments of confusion and disorientation when confronted with unclear or unexpected feedback. P3 recounted a situation where the speech-to-text feature on the keyboard was activated by accident: *"It said something about voice input, but I thought, what should I do now? Should I talk to it or what? It was all confusing for me."* P3 added, *"I didn't really know how to respond . . . It's always a bit difficult."* Such statements highlight the cognitive load required to interpret ambiguous system states when assistive tools, instead of clarifying interaction, introduce another layer of uncertainty.

Participants using magnification reported comparable effort and frustration. P9 described the experience with the sign-up as *"cumbersome . . . It might also be because of the assistive tool, but overall, I wouldn't rate the user experience as particularly good."* P8 confirmed this view, stating *"It wasn't easy, but I managed."* Even short remarks such as P1's comment, *"I can't find anything here,"* during the deletion task underline the overall frustration and declining confidence over time. Finally, P10 summarized the experience as *"The only negative thing I could mention is that it was a bit time-consuming because there were so many options."*

When dark patterns coincided with accessibility barriers, participants reported not only functional difficulty but also emotional exhaustion. They did not primarily describe feeling deceived in the traditional sense of dark pattern research, but rather drained and uncertain. Deception was experienced as a sustained cognitive and temporal burden, rather than as a single manipulative event. These findings address RQ1 by demonstrating how BLV users perceive and interpret dark patterns differently depending on their assistive modality. Participants were more likely to notice manipulations that directly affected interaction effort, while more subtle visual or emotionally framed cues were less salient. The qualitative data extend these patterns by showing that the resulting frustration and cognitive effort shaped not only how manipulation was recognized but also how it was emotionally experienced.

4.2 Assistive Technologies as Amplifier (RQ2)

This subsection addresses RQ2 by examining how ATs shaped participants' ability to recognize and navigate dark patterns. We distinguish between ATs as transparency amplifiers (§4.2.1), ATs as amplifiers of deception (§4.2.2), and the role of prior familiarity with ATs and dark patterns in shaping resistance (§4.2.3).

Although visual ability and AT use were not strictly aligned, we structure the analysis in this section primarily by assistive modality. This decision reflects our focus on interaction mechanisms rather than medical categories. Where relevant, we explicitly note differences related to blindness or low vision, but we do not treat these categories as mutually exclusive or deterministic. Table 4 summarizes the average task durations across modalities and highlights substantial performance differences, particularly during multi-step deletion.

AT	Sign-up	Deletion	Total
Screen Reader (n=11)	14.26 ± 3.93	13.36 ± 3.06	29.21 ± 7.82
Magnification (n=7)	11.05 ± 3.49	7.81 ± 2.51	20.97 ± 5.77

Table 4: Average task durations in minutes by assistive modality. The table provides descriptive context for differences in navigation effort across modalities, particularly during multi-step deletion.

4.2.1 Assistive Technologies as Transparency Amplifiers. Several participants described moments where ATs helped them to see, or rather hear, through deceptive design. Screen readers in particular revealed hidden states and default selections that might have gone unnoticed by sighted users. P10 recounted how TalkBack explicitly announced a preselected subscription option: *"It said that the button was not on 'free', that's how I noticed it."* From a visual perspective, it was not possible to determine whether the subscription plan text could be selected. However, the screen reader indicated that it was a button. By surfacing such information, the screen reader temporarily acted as an accessibility driven countermeasure against manipulative defaults. Similarly, magnification tools enabled participants to read fine print and confirm option states. P7 noted that *"the font size was great . . . I was satisfied with the size."* These examples demonstrate that ATs can temporarily invert the direction of manipulation by providing clear and complete semantic information.

4.2.2 Assistive Technologies as Amplifiers of Deception. Participants reported far more frequently that ATs amplified manipulative interface behavior. Both screen readers and magnification tools intensified dark patterns that hindered task completion. Table 5 illustrates how ATs interacted with specific dark patterns. Although both ATs strongly amplified *obstruction* and *false hierarchy*, screen readers also reinforced *forced action* due to their linear navigation focus, while magnification primarily intensified visual deception and repetition (*nagging*).

Task duration data provide additional context for these observations. Participants using screen readers generally required more time to complete both tasks than those using magnification. As shown in Table 4, on average, screen reader users (n = 11) spent about 14 minutes on sign-up and 13 minutes on deletion, resulting in a total average of roughly 29 minutes per session. In contrast, magnification users (n = 7) completed the same tasks in around 11 minutes for sign-up and 8 minutes for deletion, averaging 21 minutes overall. These differences reflect the increased navigation effort associated with sequential navigation, where each element must be accessed in order, compared to the more flexible navigation enabled by magnification. However, these observations should be interpreted as descriptive patterns rather than as generalizable performance differences. While magnification users could visually skim and jump between options, they reported repeated loss of layout orientation and additional time spent repositioning or zooming after visual shifts. These patterns align with the qualitative observation that ATs, although designed to improve accessibility, can amplify the effects of dark patterns by increasing navigation effort and cognitive load. Figure 3 visualizes average completion times for all three participant groups. To provide additional context, a small group of sighted participants (n = 8) also completed the tasks without ATs. These data serve as an exploratory baseline and are not directly comparable to the BLV sample due to differences in recruitment and study conditions.

The observed differences in task duration should therefore be interpreted descriptively, illustrating variations in interaction effort rather than establishing generalizable performance differences between groups. The results suggest that interaction through ATs changes how users engage with interface structures, often increasing the effort required to navigate multi-step processes. Compared to sighted interaction, these patterns point to prolonged engagement with interface elements, which may intensify the practical impact of manipulative design.

Dark Pattern	Screen Reader	Magnification
Obstruction	●	●
Forced Action	●	◐
False Hierarchy	●	●
Bad Defaults	○	○
Nagging	◐	●
Confirmshaming	◐	●

Table 5: Assistive technologies as amplifiers of deceptive interaction. The table summarizes cases where assistive technologies increased the effort, confusion, or likelihood of unintended actions associated with dark patterns. Transparency-enhancing effects are reported separately in 4.2.1. ● indicates strong amplification of deceptive impact, ◐ moderate amplification, and ○ no amplification.

Screen Readers Amplify Obstruction Through Sequential Navigation. Linear navigation forced screen reader users to go through every intermediate step in multi-step deletion processes. This turned an already obstructive design into a tiring sequence. P11 explained, *"TalkBack read everything, but I didn't know if I was already on the button."* Because the focus order did not align with the visual hierarchy, users lost orientation of their position on the screen, and also whether their choice was confirmed. As a result, *obstruction* and *forced action* patterns became more influential; every added dialog or checkbox multiplied the effort to verify what had been selected. Sequential reading also suppressed an overview of available actions, effectively converting a local problem into general disorientation.

Screen Readers Remove Hierarchical Cues and Obscure False Hierarchies. False Hierarchy was acoustically marked by a lack of emphasis. Elements that were visually emphasized by color or contrast were announced in the same tone and tempo as all other controls. This removed any indication of their relative importance. P15 described this effect explicitly: *"Everything sounded the same to me. I couldn't tell what was important and what was just information."* Blind users were therefore faced with a contradictory form of manipulation based on the omission of highlights rather than their excessive and intentional use. Unlabeled icons and shortened alt texts further obscured semantic context, making *false hierarchy* even more misleading.

Magnification Distorts Layout and Reinforces Obstruction. Magnification users experienced a different amplification effect. Zooming frequently disrupted the layout of the custom-built app. P4 noted that *"when I zoomed in, the whole display moved, and I couldn't find what I was looking for."* This motion compounded the effects of *obstruction* and *false hierarchy*. Because buttons and confirmation

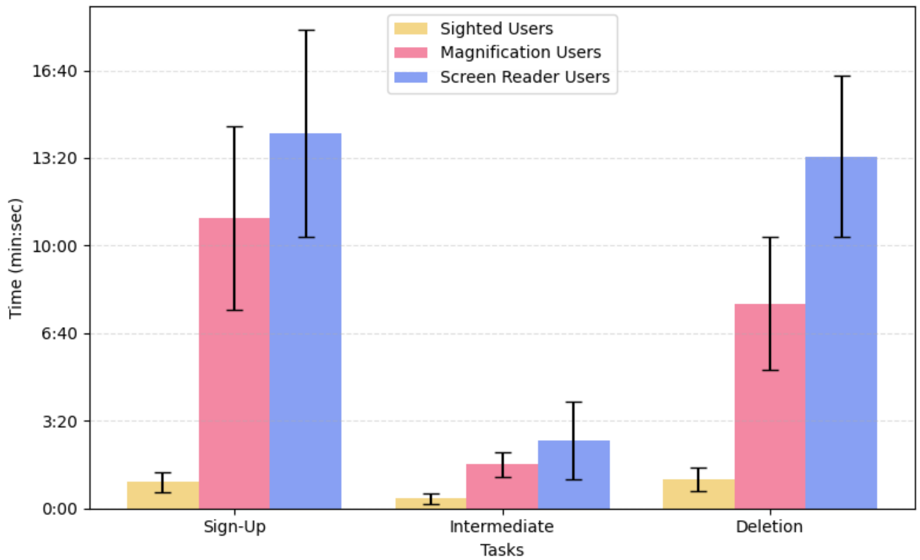

Figure 3: Average task completion times for sighted, magnification, and screen reader users across tasks. Sighted data are included as an exploratory baseline and are not directly comparable to the BLV sample due to differences in recruitment and study conditions. Error bars show standard deviations.

prompts shifted out of the viewport, required steps (e.g., typing 'DELETE'), alerts, or pop-ups appeared to vanish. Even subtle color contrasts became unreadable, strengthening the effect of dark patterns and making non-default options practically invisible.

Magnification Reinforces Interaction Fatigue During Nagging and Confirmshaming. Magnification also worsened *nagging* and *confirmshaming*, like repetitions. Pop-up warnings during the login process, which were easy to close, required a complete repositioning of the viewport each time they reappeared. Participants described this repetition as physically and cognitively exhausting. P7 explained that each repeated dialog required renewed spatial effort: *"Every time it popped up again, I had to zoom and search all over again."* Another participant noted that the repeated need to reposition the viewport made them less attentive to the content itself and more focused on simply progressing through the task. Screen reader users tended to skip the wording that prompted them into *confirmshaming*. They were so focused on the task at hand that they only reacted when they heard the words *"continue to delete."*

4.2.3 Familiarity With Assistive Technologies and Dark Patterns Shapes Resistance. The degree to which participants could mitigate or even recognize dark patterns strongly depended on prior experience with ATs. Experienced users navigated more confidently, while unexperienced users expressed uncertainty and fear of failure. P8, a participant using magnification, reflected: *"It wasn't easy, but I managed."* Conversely, less experienced blind users hesitated to explore, P2 said, *"I was afraid to swipe or try something. If I'm unlucky, I'll have to start all over again."* P6 described how structured training improved performance: *"The iPhone course I took really helped, before that, I didn't know how to switch between screens properly."* These comments suggest that AT experience functions as an important factor; the more users internalize AT interaction patterns, the better they can detect when a design deviates from accessible logic.

Familiarity did not only relate to ATs but also to dark patterns themselves. Some participants described being used to manipulative interface behavior due to repeated exposure in real-world applications. P15, for example, noted that the deletion flow did not surprise them at all: *"Today I noticed that I already know these tricks unfortunately, so nothing really surprised me."* The participant also described actively scanning for specific defensive cues, such as cancellation buttons, stating: *"I always look for a close or cancel button on purpose because I know these kinds of things happen."* They further connected this familiarity to previous training experiences: *"I even had training from my employer so that I would not fall for these things."* This suggests that recognition is partly shaped by learned expectations, where repeated exposure to manipulative patterns helps in identifying them. Familiarity does not eliminate deception, but it changes how users attempt to defend against it.

5 Discussion

Our findings reveal a structural paradox at the intersection of accessibility and dark patterns. ATs are intended to remove barriers, yet in practice, they can amplify the impact of manipulative mechanisms that dark patterns rely on. While participants occasionally experienced ATs as transparency tools that surfaced hidden options or defaults, amplification effects dominated across both modalities: screen readers and magnification tools made obstructive, hierarchical, and emotionally charged patterns more effortful to resist and harder to escape.

We argue that this amplification is not an incidental side-effect of poor implementation, but a systemic property of how current

ATs influences interaction. Sequential reading, viewport reduction, and altered hierarchy fundamentally reshape how dark patterns are perceived and navigated. This has two key implications. First, accessibility compliance alone is insufficient to guarantee equitable interaction; interfaces can meet technical guidelines and still disproportionately burden BLV users with additional uncertainty, and cognitive load. Second, dark pattern research that focuses only on sighted users risks underestimating manipulative impact when interaction is filtered through ATs.

In the following, we unpack these insights by (1) defining *assistive amplification* as an accessibility gap, and (2) extending dark pattern ontologies with accessibility-specific manipulative mechanisms that account for interaction with ATs. We then (3) discuss implications for design and accessibility practice.

5.1 Assistive Amplification as an Accessibility Gap

Prior work conceptualizes dark patterns primarily as intentional strategies that exploit cognitive biases, time pressure, or incomplete information [28, 38]. More recent accessibility-centered research has begun to show that dark patterns can be intensified when such designs are encountered through ATs. Lewis et al. [37] describe how accessibility barriers themselves can be experienced as deceptive, while Shi et al. [61] demonstrate that accessibility mechanisms may inadvertently increase users' exposure to manipulation. Building on this body of work, our findings show that *assistive amplification* emerges as a systematic interaction effect between manipulative flows and the interaction logic of ATs, even in interfaces that are technically accessible and compliant with prevailing accessibility guidelines.

For screen reader users, sequential navigation turned multi-step deletion flows into long, fragmented procedures in which every additional dialog, confirmation, or alternative path multiplied the effort required to stay oriented and verify intent. Participants described fear of making irreversible errors, hesitation to explore, and a sense of being "trapped" in cyclic flows. For magnification users, zooming restricted the visible area and destabilized the layout: critical options scrolled out of view, buttons shifted position, and color-based cues for primary and secondary actions were cropped or distorted. In both modalities, resisting manipulation required more time, more concentration, and more error-prone micro decisions than for sighted users.

We define the term *assistive amplification* as follows:

Assistive amplification describes the process by which the structural properties of assistive interaction, such as sequential reading or viewport reduction, increase users' exposure to, and effort against, manipulative interface strategies.

Assistive amplification exposes an accessibility gap in current understandings of fair and ethical interface design. If resisting a dark pattern costs substantially more time, attention, and emotional energy for BLV users than for sighted users, then the interface is not only less accessible but less just, even if it passes formal accessibility checks. This shifts responsibility from user skill to design choices: designers and platform owners must account for how manipulative flows behave when traversed via AT, not only via vision.

From a research perspective, *assistive amplification* also offers a diagnostic lens. Large discrepancies in task duration, navigation steps, or error risk between AT and non-AT use can signal manipulative structures that disproportionately affect BLV users, even when no explicit accessibility bugs are present. Detecting such amplification should therefore be treated as a marker of ethical design failure, not only as a usability concern.

5.2 Extending the Dark Pattern Ontology for Accessibility

Gray et al.'s ontology of dark patterns [28] distinguishes between low-level interface cues, meso-level manipulations of choice architecture, and high-level strategies that shape user behavior across interaction flows. This framework has proven valuable for identifying and categorizing deceptive design practices in visual interfaces. Our findings extend this perspective by showing that manipulative effects are not only determined by interface structure, but are co-produced through interaction with ATs. Rather than introducing new visual dark patterns, our data reveal accessibility-specific mechanisms through which existing patterns are transformed during AT use. We conceptualize three recurring mechanisms under the umbrella of *Accessibility-Specific Manipulative Mechanisms (AMM)*, which describe how *assistive amplification* shows during interaction.

(1) Accessibility Induced Deception describes patterns in which interface elements become deceptive not through design intent, but due to accessibility constraints. Missing semantic labels, an inconsistent focus order or incomplete announcements caused participants to misinterpret the system state or attribute errors to themselves. In these situations, the manipulative experience originates from a mismatch between the structure of the interface and the behavior of AT, rather than intentional persuasion. While not intentionally manipulative, these experiences were perceived as deceptive by participants and interacted with existing dark patterns to shape decision-making.

(2) Assistive Amplification of Dark Patterns captures cases in which screen readers or magnifiers intensify the manipulative potential of existing dark patterns. For screen reader users, sequential navigation, where content is announced linearly, transforms multi-step processes into longer and more complex sequences. This increases the persuasive weight of *obstruction* or *forced action*. For magnification users, restricted viewports and shifting zoom levels can misdirect by obscuring alternatives or disproportionately emphasizing certain buttons. This amplification effect only occurs when ATs change how interactions are perceived.

(3) Misaligned Hierarchy refines existing notions of *false hierarchy* by demonstrating that hierarchy is conveyed not only visually, but also technologically. For screen readers users, the order in which elements were read aloud represented a functional hierarchy that differed from the the app's layout. For users of magnification tools, zooming altered the perceived prominence of elements by cropping color cues or grouping them in unpredictable ways. In both cases, the AT dynamically reconstructed hierarchy, creating unanticipated manipulations.

These mechanisms demonstrate how dark patterns show differently for BLV users, highlighting the need for ontologies that incorporate ATs as a part of manipulative design.

5.3 Implications for Design and Accessibility Practice

Our findings show that accessibility and ethical interface design cannot be treated as separate concerns. While ATs are intended to reduce barriers, they can also intensify the effects of dark patterns when interfaces rely on friction or repetition. These effects are particularly pronounced in account management flows, such as account registration and deletion, where multi-step processes and confirmation dialogs are commonly used. Importantly, many of the issues raised by participants do not stem from a lack of accessibility support. Rather, they emerge at the intersection of assistive interaction and manipulative interface structures. The following implications focus specifically on how interfaces can be designed to prevent or mitigate such amplification effects.

Design for Sequential Transparency in Multi-Step Flows. Multistep processes, particularly account deletion, became significantly more demanding when accessed through screen readers. Sequential navigation forced users to process each step linearly, increasing exposure to *obstruction* and raising the risk of unintended actions. Interfaces should therefore make process structure explicit across all steps (e.g., indicating progress, remaining steps, or current position). Reducing unnecessary intermediate steps and avoiding redundant confirmations can help prevent sequential interaction from assistive amplification.

Avoid Reliance on Spatial Separation for Critical Choices. For users relying on magnification, spatial distance between interface elements often translated into functional invisibility. Critical options placed outside the viewport were easily overlooked, reinforcing default or system-preferred choices. Designers should ensure that alternative actions remain in the same location and visible within a single viewport whenever possible. Interfaces that require extensive scrolling or repositioning risk amplifying *false hierarchy* and *misdirection.*

Expose Decision-Relevant Information Across Modalities. ATs can either reveal or reinforce mdark patterns depending on how information is encoded. While screen readers sometimes exposed hidden defaults, they also removed visual hierarchy cues. Interfaces should therefore ensure that decision-relevant information (e.g., default states, consequences of actions) is explicitly provided across modalities, rather than relying on visual emphasis alone. Making such information technically accessible can reduce the likelihood that ATs unintentionally hide manipulation.

Reduce Interaction Overhead That Amplifies Manipulation. Dark patterns such as *obstruction*, *nagging*, and *confirmshaming* became more effective when combined with increased interaction effort. Repeated dialogs, redundant confirmations, and complex input requirements extended navigation time and cognitive load, particularly under assistive interaction. Minimizing unnecessary interaction steps is therefore not only a usability concern but a strategy to limit the amplification of dark pattern effects.

Preserve Structural Integrity Under Magnification. Magnification frequently distorted layout structure, causing elements to shift or disappear from view. This distortion altered perceived hierarchy and made it more difficult to identify relevant actions. Interfaces should maintain stable spatial relationships and proportional scaling under magnification to prevent distortion from reinforcing misleading visual cues.

Support User Orientation and Trust in Assistive Contexts and Across Updates. Participants interpreted inconsistent labeling, unexpected behavior, or missing feedback not only as usability issues but as potential indicators of manipulation. Clear and predictable interaction patterns are therefore critical for maintaining trust. Providing consistent semantic structure, reliable feedback, and predictable navigation helps users distinguish between system behavior and potentially manipulative design.

Design Against Amplification, Not Just for Accessibility. Finally, participants highlighted the importance of training and lived experience in mitigating manipulative designs. Familiarity with ATs helped users recognize when interaction flows felt suspicious or unnecessarily complex. Several participants also stressed the value of involving BLV users directly in testing and design processes. Inclusive evaluation goes beyond identifying accessibility bugs. It reveals how manipulative designs behave when filtered through ATs, an interaction that standard usability testing often fails to capture. Many of these recommendations extend beyond traditional accessibility guidelines. While principles such as clarity and consistency remain relevant, our findings show that their violation can actively amplify manipulation when combined with ATs. Designing accessible systems is therefore not sufficient; interfaces must also be evaluated for how ATs may interact with and unintentionally strengthen dark patterns.

5.4 Regulatory Implications

Our findings also raise important questions for current regulatory frameworks addressing dark patterns. Existing regulations, such as the EU Digital Services Act (DSA)[21], aim to restrict manipulative interface designs and protect users from deceptive practices. However, these frameworks typically evaluate compliance at the interface level, without accounting for how interactions are mediated through ATs. Our results suggest that interfaces that are formally compliant with accessibility standards (e.g., WCAG [64]) may still disproportionately affect BLV users when dark patterns interact with ATs. This phenomenon, which we describe as assistive amplification, highlights a gap between accessibility compliance and actual user protection. From a regulatory perspective, this suggests that ensuring accessibility alone may not be sufficient to prevent manipulative outcomes. Future regulatory efforts should consider how design practices impact users across different interaction modalities and explicitly address the intersection of accessibility and dark patterns.

6 Limitations and Future Work

Our study has several limitations that should be considered when interpreting the findings. While this work offers new insights into how BLV users perceive dark patterns when using ATs, its scope is shaped by methodological and contextual constraints that also suggest directions for future research. First, the study was conducted in a controlled laboratory setting using a custom-built social media application. This design allowed us to systematically embed and isolate specific dark patterns and examine their interaction with ATs. However, it reduces ecological validity, as real-world platforms are dynamic, frequently updated, and shaped by long-term user familiarity. Such changes require users to constantly adapt, which particularly affects BLV users who depend on stable and familiar interfaces. Future research could address this limitation and extend this approach to in-the-wild or longitudinal studies to better capture how dark patterns and assistive amplification unfold in everyday contexts and across app update cycles.

Second, participants used standardized devices rather than their own personal configurations. Although participants interacted with their preferred AT (e.g., screen reader or magnification), individual settings and familiarity may influence interaction behavior. Standardizing devices ensured comparability across participants but may have affected interaction patterns. Future work could investigate how personalized configurations shape the experience of dark patterns.

Third, our participant sample was deliberately focused on BLV individuals and two common ATs, screen readers and magnifiers. This focus enabled an in-depth examination of modality-specific amplification but limits generalizability across other disabilities, cultures, or external ATs. Broader investigations, including additional impairments and technologies, could reveal new forms of interaction between accessibility and dark patterns. These findings are consistent with those from comparative studies of different user groups [41, 44]. Cross-platform testing and international samples would further strengthen external validity and contextual diversity.

Forth, the task-based structure of our study, limited to sign-up and account deletion, offered clear behavioral data but restricted the emotional engagement of participants. Because participants created a fictional account, certain patterns such as *confirmshaming* likely had less influence, while structurally driven patterns such as *obstruction* are more prominently captured. This design isolated the mechanics of manipulation, and future longitudinal studies should investigate how emotionally meaningful interactions influence users' susceptibility to dark patterns and whether ATs mitigate or amplify such effects over time. Finally, as noted by Lewis et al. [37], distinguishing between intentionally deceptive design and emerging accessibility barriers remains an ongoing challenge.

7 Conclusion

This study investigated how BLV users interact with dark patterns in social media applications when relying on ATs. By analyzing task performance and qualitative feedback from 18 participants, we showed that ATs not only expose but often amplify manipulative design elements. Screen readers intensified sequential effects in obstructive and forced action flows, while magnification tools magnified spatial misdirection and visual fatigue. In both modalities, the participants described the cognitive and emotional load of navigating through deceptive structures, suggesting that accessibility and manipulation intersect in mutually enhancing ways. Our findings contribute to a growing body of research that connects accessibility, ethical design, and digital manipulation[37, 41]. They demonstrate that amplification is a systemic design phenomenon rather than an individual limitation. Dark patterns exploit the interaction logic of ATs by converting their structural constraints, such as sequential reading or viewport magnification. This challenges the assumption that accessible interfaces are inherently equitable and highlights the need to view accessibility not only as compliance but as a site of potential exploitation. Ultimately, by recognizing assistive amplification as a measurable indicator of design failure, designers and researchers can move toward interaction models that preserve transparency and inclusivity for all users.

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A Interview Protocol

A.1 Section A.1: Introduction

(1) Greeting and self-introduction: Hello, my name is *** and I am conducting this study today. Thank you for participating.
(2) Explanation of study purpose: The aim of this study is to understand how visually impaired and blind users interact with mobile applications. We want to identify challenges and usability problems in order to improve app accessibility. The study will take approximately one hour.
(3) Consent: Before we begin, I need your consent to participate in this study. I will explain the consent form, including what is expected, any potential risks, and your rights as a participant. You may ask questions before signing.
(4) Confidentiality: All your responses will be treated confidentially. Your name or identifying information will not appear in the results. The data will be pseudonymized; participants will be referred to only as "P1", "P2", etc.
(5) Data handling: All collected data, including recordings, will be treated confidentially. Only research team members will have access. You may request deletion of your data at any time. All data will be securely destroyed after the study period.
(6) Video and audio recordings: We record the session to ensure no details are missed. These recordings are stored securely and accessible only to the team. All personal information will be removed during analysis.
(7) Start/Stop of recording: I will notify you when the recording starts and stops. You may request a pause or stop at any time.

A.2 Section A.2: Interview Script

A.2.1 Demographic Information and Background.

(1) How old are you? Please select your age group:
- 18–24
- 25–34
- 35–44
- 45–54
- 55–64
- 65+

(2) What is your gender?
- Male
- Female
- Non-binary
- Prefer not to say
- Prefer to self-describe: _________

(3) What is your highest educational attainment?
- No school degree
- Lower secondary degree
- Intermediate school degree
- High school diploma
- Vocational training
- Bachelor's degree
- Master's / Diploma / State exam
- Doctorate
- Other: _________

(4) What is your current employment status?
- Full-time employed
- Part-time employed
- Self-employed
- In training / studying
- Unemployed
- Retired
- Other: _________

(5) What type of visual impairment do you have?
- Blindness
- Visual impairment
- Self-described / Other: _________

(6) If applicable, what is the officially recognized degree of disability? __%

(7) Were you born blind or did your impairment occur later in life?
- Blind from birth
- Visually impaired from birth
- Became blind later in life
- Became visually impaired later in life

(8) What kind of smartphone do you use privately?
- iPhone (iOS)
- Android phone
- Other device

(9) Which accessibility tools do you use in daily life?
- Screen reader (TalkBack, VoiceOver iOS)
- Zoom / magnification tools
- Font or display adjustments (contrast, inverted colors)
- Voice control (Google Assistant, Siri)
- Speech input keyboards
- AI assistants (Gemini, ChatGPT)
- Other: _________

(10) How experienced are you with these accessibility tools?
- No experience
- Beginner
- Intermediate
- Expert

(11) How often do you use mobile applications?
- Never
- Rarely (1–2 times/week)
- Occasionally (3–4 times/week)
- Frequently (daily)
- Constantly (multiple times/day)

(12) Can you describe your general experiences using apps with your accessibility tools? *[Open response]*

(13) What types of apps do you frequently use?
- Social media
- Shopping
- Navigation
- Entertainment
- Health and fitness
- Other: ________

(14) Do you have a technical background or work in IT?
- Yes
- No

A.3 Task-Based Questions

T.1.

(1) How was your overall experience with the registration process?
(2) How was your overall experience with the account deletion process?
(3) During registration, did you notice any features or elements that were confusing?
(4) During the account deletion process, did you notice any confusing features?
(5) Can you explain how your accessibility tool influenced your interaction with the app?
(6) Can you describe how the tool…
- …helped you with the tasks?
- …made the tasks more difficult?

(7) Were there any elements in the app that were difficult to access with your tool? Please describe specific challenges.

T.2.

(1) What experiences did you have using your accessibility tool in the app?
(2) Can you highlight positive or negative aspects?
(3) Can you describe areas of the app that caused problems when used with your accessibility tool, including during different tasks?

T.3.

(1) What improvements would you suggest for the apps and accessibility tools so that people like you can use them more effectively?
(2) What additional features should accessibility tools have to make dealing with deceptive design easier?

(3) What specific changes should app developers implement to improve app use for blind and visually impaired people?

A.4 Additional Questions

(1) Do you recall a situation where you accidentally signed up for a service or subscription? How did you notice?
(2) Are there specific app designs that regularly cause errors for you? Can you give examples?

A.5 Closing Questions

(1) Would you like to share any additional experiences or incidents with apps?

A.6 Dark Pattern Likert-Scale Statements

Dark patterns observed in smartphone sign-up or account deletion processes

(1) **Bad Defaults (Preselected Options)** During registration, a subscription option was preselected.
Options: No / Maybe / Yes
(2) **Forced Action** Proceeding was only possible after agreeing to multiple items (e.g., Terms, subscription plan).
Options: No / Maybe / Yes
(3) **False Hierarchy (Misleading Visual Weighting)** One option was visually more prominent and influenced my selection.
Options: No / Maybe / Yes
(4) **Nagging (Repeated Disruption)** I was repeatedly asked to reconsider or repeat an action.
Options: No / Maybe / Yes
(5) **Confirmshaming** Emotional wording attempted to steer my decision in a certain direction.
Options: No / Maybe / Yes
(6) **Obstruction** Performing an action (e.g., account deletion) required multiple steps or detours.
Options: No / Maybe / Yes

A.7 Ending the Session

(1) Wrap-up of the main points discussed.
(2) Debriefing: Explanation of the dark patterns included in the app.
(3) Ask whether the participant wants to add anything.
(4) Thank the participant for their time and contribution.
(5) Provide contact information.

B List of Codes

We identified the following themes and subthemes from the data based on the thematic analysis of the interview transcripts.

Code	Memo
Cognitive & Emotional Reactions (User Experience)	Users' affective and cognitive responses to confusing, misleading, or inaccessible interfaces.
Overload through Options	
Previous Experience	
Frustration	
External Support	
Learning Curve	
Guidance Dependence	
Failing the Task	
Cognitive Reaction / Uncertainty	
Dark Pattern	
Obstruction (Hurdles / Multiple Steps / Hidden Flows)	
Confirmshaming (Emotional Influence)	
Nagging (Repeated Distraction)	
False Hierarchy (Visual Emphasis / Layout Confusion)	
Forced Action (Agreement Bundling)	
Bad Defaults (Preselected Options)	
Unnoticed Defaults	
Screen Reader	
Limitations	Barriers arising from auditory navigation.
Symbol Navigation Problems	
Gesture Confusion	
Unclear / Invisible Hierarchies	
Overload / Repetition	
Unlabeled Buttons	
Enabling Functions	When screen readers help users recognize or navigate patterns.
Element Detection	Reads hidden buttons or states.
Magnification	
Limitations	
Occasional Disorientation	
Screen Shift / Disorientation	Screen moves unexpectedly.
Cut-Off Elements	Buttons disappear on zoom.
Non-Scaling UI	Keyboard not enlarged.
Benefits	
Engagement	
Task Completion Support	
Improved Visibility	Easier reading of text.

Code	Memo
Recommendations for Accessible// Design	
Clearer Layout / Spacing	
Multimodal Feedback (Audio)	
Inclusive Co-Design & Testing	Involve BLV users early in testing to detect manipulative or inaccessible designs.
Enhanced Visibility & Contrast	Text and options clearly visible without color-only cues.
Stable & Predictable UI Design	Consistency across updates and versions.
Clear Hierarchies	
Human-like, Understandable AT Voice	Natural, clear screen reader voices reduce cognitive effort.
Clearer Labelling & Feedback	Every button or field should be labeled and announced with context.
More Textual Content	
Input Feedback	AT reads letters after a few inputs.
Button Identification	Screen reader should announce "Button" first.
Minimalistic Interface	Fewer structured options reduce confusion.
Training	
Simplified Deletion	