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EDITED BY
Jordi Sánchez-Navarro,
Fundació per a la Universitat Oberta de Catalunya, Spain

REVIEWED BY
Maria Manuela Lopes,
Instituto Politécnico do Porto, Portugal
Elena Bartomeu-Magaña,
Open University of Catalonia, Spain

*CORRESPONDENCE
Raquel Ávila-Muñoz
raquelav@ucm.es

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Visual design and accessibility settings: an exploratory study on their role in technology adoption among older adults

Raquel Ávila-Muñoz[1]*, David Alonso-González[2] and Andrés Arias-Astray[2]

[1]Department of Applied Communication Sciences, Faculty of Information Sciences, Institute of Technology of Knowledge, Complutense University of Madrid, Madrid, Spain, [2]Department of Social Work and Social Services, Institute of Technology of Knowledge, Complutense University of Madrid, Madrid, Spain

Mobile navigation is often perceived as simple and intuitive due to the apparent ease with which users can perform complex tasks. However, it remains a significant source of frustration for older adults, representing a substantial barrier to the adoption and appropriation of digital technologies. This study focuses on users aged 65 and older, a group that faces specific challenges such as difficulty performing certain gestures and interpreting the meaning of icons, with the visual style in which these are rendered being the most important factor. The research explores whether older adults are aware of and use accessibility settings, and to what extent these features enhance their user experience. Data were collected through two focus groups with participants aged 65 and older, with particular attention paid to their understanding of graphical user interface iconography in mobile apps and their ability to configure accessibility options. Findings reveal that activating accessibility features can, in some cases, negatively impact usability and user experience by altering the original visual design of the application. Moreover, many older users struggle to independently configure these settings. The study highlights the pivotal role of family members and close contacts as "warm experts" who assist older adults in the process of technology adoption.

KEYWORDS
accessibility, interface design, mobile usability, older adults, technology adoption, user experience (UX), visual design, warm experts

1 Introduction

Mobile navigation is often perceived as simple and intuitive due to the apparent ease with which users can perform complex tasks. Despite the potential advantages of integrating smart technologies into daily life, this idealized narrative is frequently contradicted by the lived experiences of older adults (aged 65 and above), for whom smartphone technologies often constitute a substantial source of frustration, reflecting a persistent digital divide between younger and older generations (Harris et al., 2022; Jingar et al., 2021; Iancu and Iancu, 2020). In parallel, older adults are increasingly compelled to adopt information and communication technologies (ICT) as these tools gradually become obligatory in virtually all spheres of everyday life. Digital interfaces have become the primary—if not the only—means of interaction with commercial services and public administrations. This widespread digitalization turns ICT adoption from a matter of personal preference into a structural necessity (Helsper, 2021).

Older adults face specific challenges compounded by age-related physical and cognitive changes that become essential factors influencing the design of interactive devices (Johnson and Finn, 2017; Li and Tang, 2025; Xian and Romainoor, 2025; Neves et al., 2015). Loss of visual acuity affects the readability of small texts. Motor limitations, such as hand tremor or inflexible hand joints, directly impact the ability to perform precise motor actions, such as certain gestures like tapping, pinching or swiping. Cognitive aging involves decline in memory, attention, and perceptual speed, leading to slower processing of information. These limitations make interpreting non-intuitive abstract visual cues and understanding icons particularly challenging (Dosso and Chevalier, 2021; Song et al., 2024).

Interface design should avoid the process of "digital design marginalization," which Sin et al. (2021) conceptualizes as increasing the impact of usability barriers among aging populations by engaging in digital interface design practices which exclude certain populations, and thus contributing to marginalization in other areas of their lives. Therefore, the interface should provide perceived affordances or signifiers (Norman, 2008, 2024) which serve as clear cues that enable users to understand how the system works. Likewise, interaction design must adhere to the principles articulated decades ago by pioneers in usability and user experience (Shneiderman, 1987; Nielsen, 1994; Norman and Draper, 1986), including discoverability, consistency, minimalistic design, and keeping users in control, among others, which remain applicable to gesture-based technologies (Norman and Nielsen, 2010; Shneiderman et al., 2018).

Although inconsistent results suggest the need for further research, some aesthetic trends and stylistic approaches may be more suitable than others for older adults. Some studies show better performance in visual search tasks and identifying clickable objects when using traditional skeuomorphic interface design, where the design of icons maintains a visual analogy with real-world referents (Urbano et al., 2022; Chen et al., 2020). For older users with relatively little experience interacting with graphic user interfaces, cognitive load is lower for skeuomorphic concrete icons (Liu et al., 2023). In contrast, their performance is at its worst with icons rendered in flat design, which present simplified shapes and lack of shadows, especially in the absence of accompanying text (Wu et al., 2022). Arbitrary symbols require a certain degree of digital literacy to interpret the interface correctly. As noted by Dosso and Chevalier (2021), differences in the level of concreteness and abstraction of icons affect the time users need to select them during navigation tasks, and this effect varies by age group. However, modern design trends favor abstract and flat icons, due to space limitations and expanded functionalities, in a design paradigm optimized for younger and digitally fluent users.

The notion of digital ageism in UI design helps explain how implicit assumptions about aging can shape interface aesthetics and design decisions. As noted by Mannheim et al. (2023), older adults are frequently excluded or only minimally involved in design processes, and studies often rely on samples biased toward relatively active, healthy, and technologically experienced older users. Their analysis of 60 studies found that 71.7% contained ageist discourse or design assumptions, including stereotypical categorizations and design decisions grounded in simplified notions of older users' capabilities. The authors highlight the need for more authentic inclusion of older adults in design processes and greater awareness of how ageism may influence the development of digital technologies.

Older adults are far from a homogeneous group. The population aged 65 and over encompasses substantial variability in health status, cognitive and sensory abilities, digital literacy, and life trajectories (Llorente-Barroso et al., 2023; Johnson and Finn, 2017; Schlomann et al., 2022). Researchers often distinguish between subgroups such as the "young–old" (approximately 65–74), "old–old" (75–84), and "oldest-old" (85+) adults (Neugarten, 1974; Suzman and Riley, 1985), which may present different patterns of technology use and support needs. Despite this heterogeneity, many actively seek to engage with mainstream devices rather than age-specific technologies. The design of accessible technologies has become a central focus of research, driven by the need to address the diversity of users' abilities, limitations, and usage contexts. Approaches such as usability, universal accessibility, universal design, and inclusive design—although rooted in distinct conceptual traditions (Obrenovic et al., 2007)—converge on the shared goal of facilitating access to and adoption of technology, ensuring that any individual, regardless of their age, cultural background, expertise or capabilities, should be able to use a technological device. Accessibility settings are frequently presented as a solution capable of reconciling universal design aspirations with individual differences. Mobile operating systems provide options to enlarge text, increase contrast, simplify layouts, or modify interaction modalities, among many other alternatives. However, the effectiveness of these features depends not only on their availability, but also on their visibility, comprehensibility, and integration into the overall interaction design.

Accessibility guidelines, checklists and frameworks addressing age-related needs are established in the literature (Petrovčič et al., 2018; Gomez-Hernandez et al., 2023; Mi et al., 2014; Ruzic et al., 2016; Song et al., 2024). However, a persistent gap remains between these guidelines and their real-world implementation, as the current design trends in market rarely account for the specific demands of older adults (Xian and Romainoor, 2025; He et al., 2025; Juliá-Nehme and Rosell, 2025). Managing information density through the appropriate selection and layout of interface elements, such as icon size and positioning, is crucial (Zhou et al., 2022; Hou and Hu, 2023) but, in contrast, bloatware remains a persistent trend in contemporary devices (Baecker, 2022; Baecker and Grudin, 2024). The tendency of operating systems and applications to accumulate excessive features results in interfaces that are misaligned with user's actual needs and cognitive capacities of everyone, particularly among older adults (Czaja et al., 2019; Thompson et al., 2005).

Drawing on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), one of the most comprehensive proposals among the Technology Acceptance Models (TAM), and more specifically the Senior Technology Acceptance Model (STAM) (Chen and Chan, 2014), this study examines critical factors—namely performance expectancy, effort expectancy, and facilitating conditions—in relation to interface design and the user experience of older adults (Mitzner et al., 2010; Czaja et al., 2019). According to Venkatesh et al. (2003), performance expectancy denotes the degree to which an individual perceives that the use of a given technology will improve productivity, performance, or the ability to achieve a goal. Effort expectancy refers to the user's perceptions of how easy a technology is to operate, while facilitating conditions describe their beliefs regarding the availability of organizational and technical resources necessary to enable effective use.

For older adults, the perceived benefits of mobile applications—such as connecting with family or accessing medical information—are often significant. However, these benefits may be undermined by complex interfaces, the inability to interpret visual cues and the lack of

knowledge to autonomously configure accessibility settings. These factors have direct implications for whether users feel empowered or excluded in digital environments, playing a decisive part in shaping processes of technology adoption.

The lack of intuitive design often translates into a lack of facilitating conditions for older users, compelling them to seek assistance for activation and configuration. This external reliance introduces the critical role of "warm experts" (Bakardjieva, 2005), family members, friends, or close contacts who provide personalized, non-institutionalized assistance during the technology adoption process, translating jargon to overcome the lack of familiarity with digital technology terms and acronyms and configuring devices on behalf of older users (Johnson and Finn, 2017; Díaz-Catalán et al., 2024). Although this informal support goes beyond the infrastructure or support systems initially described in the original UTAUT model, it may be essential in influencing the intention and ultimate use of digital technology-based devices and services (Hänninen et al., 2023; Hänninen et al., 2021).

While support from warm experts can facilitate initial adoption, it may also reinforce dependency and limit opportunities for autonomous learning. Moreover, these warm experts, often the youngest family members (Díaz-Catalán et al., 2024), may themselves be unfamiliar with complex accessibility controls, leading to lost opportunities to provide necessary support and guidance to adapt the device to the specific challenges faced by users aged 65 and older.

Within this theoretical landscape, the present study aims to examine the fundamental role of visual design practices in how the aging population interprets, accesses, and engages with information, shaping older adults' interaction with ITC. The research presented here, conducted as part of the Research Project "Technology adoption, warm experts and digital education in older adults (ADOPTIC65+)," explores whether older adults are aware of and use accessibility settings, and to what extent these features enhance their user experience. By focusing on mobile interface iconography and on whether external assistance is required for proper installation and configuration of accessibility settings and common applications, the study examines how visual design can function as a key lever for overcoming barriers to digital inclusion. We pose that the reliance on "warm experts" can be understood as a direct indicator of the failure of the interface design to meet accessibility standards. It is important to note that this situation is not limited to older users, but may affect individuals of any age who require assistance to configure accessibility settings.

2 Method

2.1 Research design and participants

This exploratory study employed a qualitative research design based on data collected through two focus group sessions involving a total of 16 participants, most of whom were aged 65 or older (average age = 73 years, standard deviation = 7.94 years). The research was conducted under the auspices of the Complutense University of Madrid, and all participants provided informed consent, acknowledging that their personal data were collected anonymously for research purposes.

The first session took place on 15 October 2025 at the María Moliner Public Library. Under the title *A vueltas con el móvil* ("Struggling with cell phones"). The event was conceived as a space to share experiences and to explore ways in which mobile technologies could better adapt to the needs of individuals aged 65 and over. Participants were recruited through the Service for the Prevention of Unwanted Loneliness among Older Adults, part of the Department of Social Services in the Villaverde district of Madrid, Spain. Seven individuals participated: six men between 68 and 80 years of age, members of the traditional game group known as *Peña del Chito*, and one woman aged 82 years. The mean age of the group was 76 years. Regarding educational attainment, two participants reported having completed primary education, one secondary education, two had no formal education, and two did not provide this information.

The second session was held in an area characterized by substantially higher socioeconomic status. The meeting took place at the premises of the neighborhood association *Casa de Cultura y Participación Ciudadana de Chamberí*, whose representatives were responsible for recruiting participants from among their own members and other local associations. Nine individuals participated, including seven women and two men. Although the call for participants targeted individuals aged 65 years and older, one subject was 58 years old, while the oldest was 91 years old, yielding a mean age of 71 years. Six group members had university degrees, two had completed primary education, and one had vocational training. The inclusion of the 58-year-old participant, despite the initial call for individuals aged 65 and older, was justified by her proximity to the target demographic. The participant was already retired and shared similar life circumstances with the rest of the sample. Given the exploratory nature of the study, this inclusion was considered appropriate.

Participants in both sessions were regular users of digital technologies with varying levels of digital confidence and, in most cases, more than 5 years of experience with digital technologies. All participants, except one in each session, reported owning a smartphone. Detailed information regarding device type, operating system, or applications versions was not systematically collected, as several questions explicitly invited participants to reflect on their first experiences with such technologies, which may have involved different devices and operating systems.

2.2 Instruments and data collection

Before the start of each session, participants were asked to complete a brief questionnaire designed to collect demographic information and several items related to mobile phone use. A multiple-choice question assessed whether they had begun using mobile phones autonomously, with the help of family members or friends, or by attending courses and workshops. Additionally, participants were asked whom they typically seek help from when experiencing difficulties, again through a multiple-choice question (family members, friends, retail or service staff), including the options "No one, I try to solve the problem on my own" and "Other." Regarding emotional responses when something does not work as expected, the questionnaire offered the following options: frustration and anger; curiosity or willingness to learn; indifference; and other.

To facilitate the comprehension of abstract concepts, a PowerPoint presentation displaying a variety of smartphone screens was used to illustrate the topics discussed during the session. To promote participation, examples based on common tasks in WhatsApp were selected, as it is one of the most widely used applications.

The sessions were semi-structured, and combined hands-on exploration of participants' own mobile devices with guided discussion by an established script to cover the following specific domains:

1. Interpretation of mobile iconography: Understanding of abstract symbols, identification of confusing visual cues, and expectations of functionality based on iconography.
2. Configuration of Accessibility Options: Awareness, use, and assistance required for configuring adaptive features such as text enlargement.
3. Learning and troubleshooting: Learning methods and problem-solving strategies.

2.3 Data analysis

Both focus groups were audio-recorded and transcribed verbatim using TurboScribe. After a thorough review of the transcripts, the two datasets were analyzed separately and then synthesized using an inductive thematic analysis approach. The analysis of the focus groups' transcripts aimed to identify common trends related to the effectiveness of design elements, interaction difficulties, and challenges encountered configuring accessibility features. Furthermore, special emphasis was placed on understanding problem-solving strategies, with a particular focus on learning approaches and reliance on external support. Coding was conducted inductively and independently by two researchers, allowing themes to emerge directly from participants' accounts. After independent coding, researchers compared codes in discussion meetings; discrepancies were resolved through deliberation, with a third team member consulted when needed. To support this process, a mind map of each session was generated using NotebookLM to locate emerging patterns from the data, while all interpretive decisions remained with the research team. Initial codes were grouped into candidate themes and iteratively refined against the full dataset to ensure coherence and distinctiveness. The resulting six themes were validated against the transcripts before being reported.

3 Results

The analysis of the focus group transcripts revealed several core themes that illustrate the friction between current mobile phone design and the experience of older adult users, providing substantial insights into key dimensions of technology adoption. Participants' quotes have been marked with a code indicating whether the subject participated in the Villaverde (V) or Chamberí (Ch) group.

3.1 Visual design and icon interpretation

The lack of clarity and consistency in visual cues and interaction methods emerged as a significant source of frustration. While icons with clear real-world referents were readily understood, such as the telephone symbol to place a call, others were described as unclear. One participant noted that the only way to determine the function of many symbols is to try them out or to have someone explain them. Ambiguity also surrounds common symbols used to indicate contextual menus (Figure 1). The three vertical or horizontal dots (kebab or meatball menu) and the three horizontal lines (hamburger menu), are all used to signify "more options," a meaning that is not perceived as obvious and must therefore be learned.

Even within highly used applications, design choices introduce confusion. Participants identified ambiguity between two microphone icons that appear close to each other when the keyboard is displayed in WhatsApp, particularly on Android devices (Figure 2). The gray microphone activates speech-to-text dictation, whereas the one with a green circular shape is used to send voice messages. This ambiguity exemplifies how minor design flaws lead to errors, as the symbols are perceived as practically the same.

While basic functions such as sending text and voice messages in applications like WhatsApp are commonly used, more complex features, such as sharing location, are often unknown, unused or approached with fear when the icon does not clearly convey the associated function.

Unsolicited interface changes were perceived as intrusive and destabilizing. Many participants were unaware of the functionality of the blue circular icon for Meta Artificial Intelligence Chabot in WhatsApp, and its unrequested appearance was a major source of complaint. Users perceived it as an intrusive element that "is deeply annoying" (Ch_S04). Their primary intention was to remove it; however, when participants were informed that it could not be eliminated, their reaction was one of outraged indignation. This forced placement exemplifies a design choice that violates user control, hindering interaction by occupying valuable screen space and overlapping text input areas.

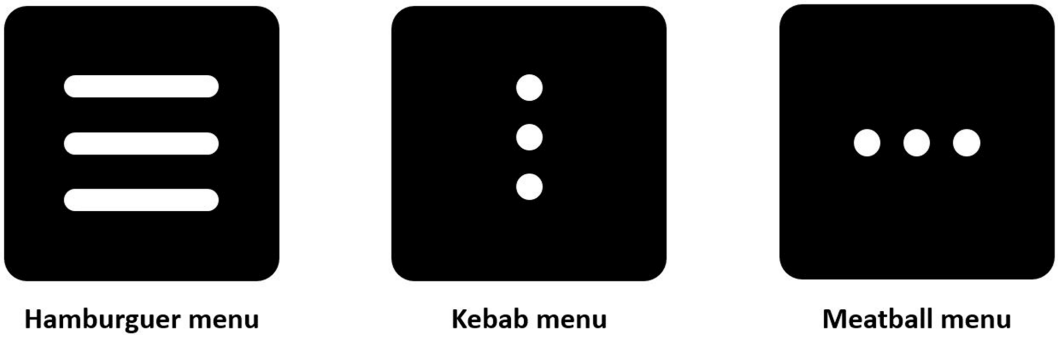

FIGURE 1
Examples of icons for contextual menus. Source: authors' own elaboration.

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3.2 Gestures and interaction patterns

A frequent practical barrier is the lack of clarity regarding how to distinguish between actions requiring a simple tap and those requiring a swipe or drag gesture: "How can I tell whether I need to drag it or just click on it?" (Ch_S09). This lack of perceived affordances was reported as especially confusing when switching to a new device or following a software update, as the interaction methods may change without notification. Such inconsistency forces users to rely on error-prone trial-and-error strategies to determine the correct input.

3.3 Complexity and bloatware

Bloatware resulted in a general feeling that there are too many options and unnecessary features. Participants reported that their phones were filled with application icons they did not use or symbols whose purpose they did not understand. This information overload "wastes time, drains energy, is annoying, irritating" (Ch_S07) In contrast, the details that matter to them, such as distinguishing whether an app is free on the PlayStore, are not clearly displayed.

Several participants expressed strong interest in learning how to uninstall applications, manage the flood of notifications and daily emails, delete content, or quit social media. Participants generally showed little interest in unfamiliar or unused options. However, their attitude became extremely active and positive when the WhatsApp dictation tool was explained, as they recognized its usefulness for sending messages without having to type on the small on-screen keyboard.

Security requirements demanding complex passwords that combine numbers, uppercase and lowercase letters, and symbols, were described as "impossible to remember" (Ch_S02). This complexity compels users to break security best practices by writing passwords down in vulnerable locations, such as storing them in their phone contacts. Participants also questioned the necessity of such stringent requirements for non-banking applications, noting the inconsistency with debit card Personal Identification Numbers (PIN) that require only four digits.

3.4 Use and configuration of accessibility settings

Features specifically designed to enhance accessibility often fail due to implementation flaws or complex access methods. Most participants were unaware of the existence or location of accessibility options prior to the sessions. When these features were discovered, they were frequently perceived as confusing, with participants expressing uncertainty about their purpose or how to configure them: "I go in, I say, let us see, accessibility, and then I get lost" (Ch_S05). To begin with, the icon for accessibility settings itself —a human figure reminiscent of the Vitruvian Man (Figure 3)—was unfamiliar to all participants. Moreover, many reported struggling to independently configure accessibility settings, as access pathways varied significantly across devices. On some phones, accessing these features required non-obvious gestures, such as swiping vertically twice. In addition, non-intuitive labels and messages further complicated understanding of the available options and hindered efficient configuration.

Some participants' phones had been adjusted to increase text size, but they reported that they had not configured these settings themselves. This is probably the most common adjustment, often made to compensate for age-related vision changes such as presbyopia. However, during the sessions, it was observed that the implementation

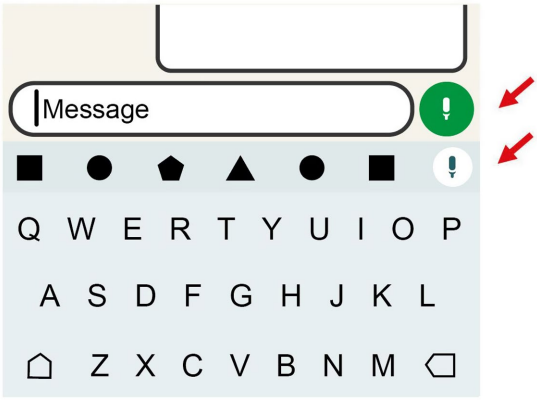

FIGURE 2
Schematic diagram showing the placement of microphone icons with different functions in the WhatsApp interface on Android. Source: authors' own elaboration.

of this option is often poorly executed: when the text size is increased, the interface layout frequently fails to adapt, resulting in words being cut off, with only two or three letters visible in truncated labels (Figure 4). This defect renders the phone even more unusable. Furthermore, when the increased text size is applied system-wide, the adjustment often fails to affect third-party applications, requiring users to configure each application individually.

Apart from text enlargement, the only accessibility option used by a participant (female) was the hearing aid adjustment, which she reported had been set up for her by a younger and more tech-savvy friend.

3.5 Learning patterns and reliance on external support

The participants' learning process is characterized by a strong dependency on external support from family and friends, combined with autonomous learning and, to a much lesser extent, attendance at courses and workshops.

Family members—primarily younger relatives such as children (biological or in-law), grandchildren and nieces and nephews—serve as the primary support system for configuration, installation, and problem resolution. Participants frequently rely on them to install essential apps, such those for health services, and for complex troubleshooting, such as restoring settings after updates. While participants valued this support, they also reported feelings of being overwhelmed: "They tell me so many things that I get saturated with information" (V_S07).

Even when seeking help, users sometimes encounter skepticism or dismissiveness from the helper, including discouraging questions such as "What do you want that for?" (V_S04) when requesting certain functionalities or even when asking to own their first smartphone. This was the case of a participant (male), aged 80. Despite having no formal education and the reluctance shown by his close family, he proved to be one of the most advanced users in the group and was proud of having taught himself.

Several participants indicated that the internet, particularly YouTube videos, serves as a source of information, where they can find guidance for almost any task. Nevertheless, the lack of manuals and a preference for personal, one-on-one explanations often leads participants to seek assistance from retail store staff when familial help is

FIGURE 3
Accessibility icons similar to those used in Apple's iOS and Android. Source: authors' own elaboration.

unavailable or insufficient. In addition to store employees, pharmacists and bank staff were cited as occasional sources of support.

While reliance on others is common, six participants reported learning to use their devices through autodidactic methods, with this being the sole learning method for three participants. This self-directed learning often involves constant trial and error, sometimes resulting in frustration: "mess around until exhausted" (Ch_S07), which may lead them to temporarily abandon the task before returning. The need to actively test every button—"I touch it and see what happens" (V_S04)—is a direct consequence of the lack of explicit guidance in interface design.

3.6 Emotional impact and self-perception

Most participants rated mobile phones as "very useful" in their daily lives on the initial questionnaire. None reported feeling indifferent when something did not go as expected: 12 of 16 participants expressed feelings of frustration or anger, while eight participants selected "curiosity or eagerness to learn."

The struggles encountered during mobile phone use affect the users' emotional state and confidence. When technology fails, feelings of frustration or anger can quickly transition into self-doubt. There is a tendency to internalize these failures, feeling "a little bit dumb" (V_S07) or lacking ability. Frustration—often expressed through anger ("One of these days I'm going to smash it on the floor," "I hate it, I hate it!") (V_S07)—can also manifest as curiosity, motivating users to persevere in solving the problem: "I get angry, and then I say, 'Well, let's see what exactly is happening'" (V_S01).

Participants also expressed fear of breaking or misconfiguring their devices, leading to cautious and selective use. The pervasive fear of making errors—such as accidentally publishing content, transferring money incorrectly, accepting unwanted charges, or falling victim to fraud—causes many users to avoid complex or unfamiliar functions entirely. For example, one participant avoids financial transfers despite knowing how to initiate them, preferring to have his son nearby for reassurance.

4 Discussion

The results indicate that the perceived benefits of mobile applications are frequently undermined by information overload and the lack of clear, intuitive visual cues, reinforcing perceptions of difficulty and negatively affecting effort expectancy. Ambiguous abstract iconography and insufficient differentiation between gestures reduce performance expectancy by weakening users' confidence in their ability to navigate interfaces and complete tasks effectively. The recurrent need for external assistance to activate or configure settings further reveals shortcomings in facilitating conditions, suggesting areas where technology adoption models may require refinement.

Findings related to visual design and icon interpretation are consistent with experimental research demonstrating that icon comprehension depends on concreteness, complexity, and distinctiveness. Icons with clear real-world referents reduce cognitive load and lend themselves to immediate interpretation, whereas abstract or convention-based symbols require prior learning and familiarity (McDougall et al., 2000; Isherwood et al., 2007; Dosso and Chevalier, 2021). In line with Li and Luximon's (2020) work, older adults in this study reported difficulties interpreting icons and distinguishing them from visually similar elements, even when aware that each icon represented a specific function. This uncertainty often led to avoidance behaviors driven by fear of making irreversible errors.

Difficulties related to gestures and interaction patterns further compound these challenges. Gesture-based commands with weak or invisible affordances—such as swipe, drag, or long press—require prior knowledge and provide limited perceptual feedback, increasing both cognitive and motor demands (Norman and Nielsen, 2010). Age-related changes in motor control, perception, and procedural memory intensify uncertainty (Czaja et al., 2019; McLaughlin and Pak, 2020). As our study shows, this occurs particularly when interaction conventions vary across devices or change as a result of software updates.

Consistent with previous research, findings on complexity and bloatware highlight perceived usefulness as a key determinant of technology adoption among older adults (Czaja et al., 2019; Lee and Coughlin, 2015). Participants engaged with mobile technologies primarily to achieve clear, meaningful outcomes and tended to avoid features whose benefits were not immediately evident. Unused applications, persistent notifications, and poorly differentiated interface elements not only increased information overload but also reduced perceived usefulness and sense of control. In contrast, positive engagement with clearly beneficial functions underscores the primacy of perceived relevance and effort reduction over feature richness, echoing evidence that older users selectively adopt technologies that support everyday goals while actively avoiding unnecessary complexity (Barnard et al., 2013).

Participants also described a well-documented paradox of digital security: stronger password requirements increase cognitive burden and memorability difficulties, often leading to unsafe coping strategies that ultimately undermine security (Pilar et al., 2012; Vu and Hills, 2013). A similar paradox emerged in relation to accessibility. Features intended to enhance usability frequently remained underused due to poor discoverability, abstract labeling, inconsistent access pathways, and limited transparency in configuration (Newell and Gregor, 2000; Díaz-Bossini and Moreno, 2014; Czaja et al., 2019). Variability across devices, reliance on undocumented gestures, and system-wide inconsistencies—such as layout truncation following text enlargement—further constrained independent use, reinforcing reliance on intermediaries rather than fostering autonomy.

Learning processes described by participants align with research showing that technology adoption by older adults is largely socially mediated, relying on informal support networks rather than formal instruction (Czaja et al., 2019; Quan-Haase et al., 2017). While family members often act as "warm experts," facilitating access and recovery

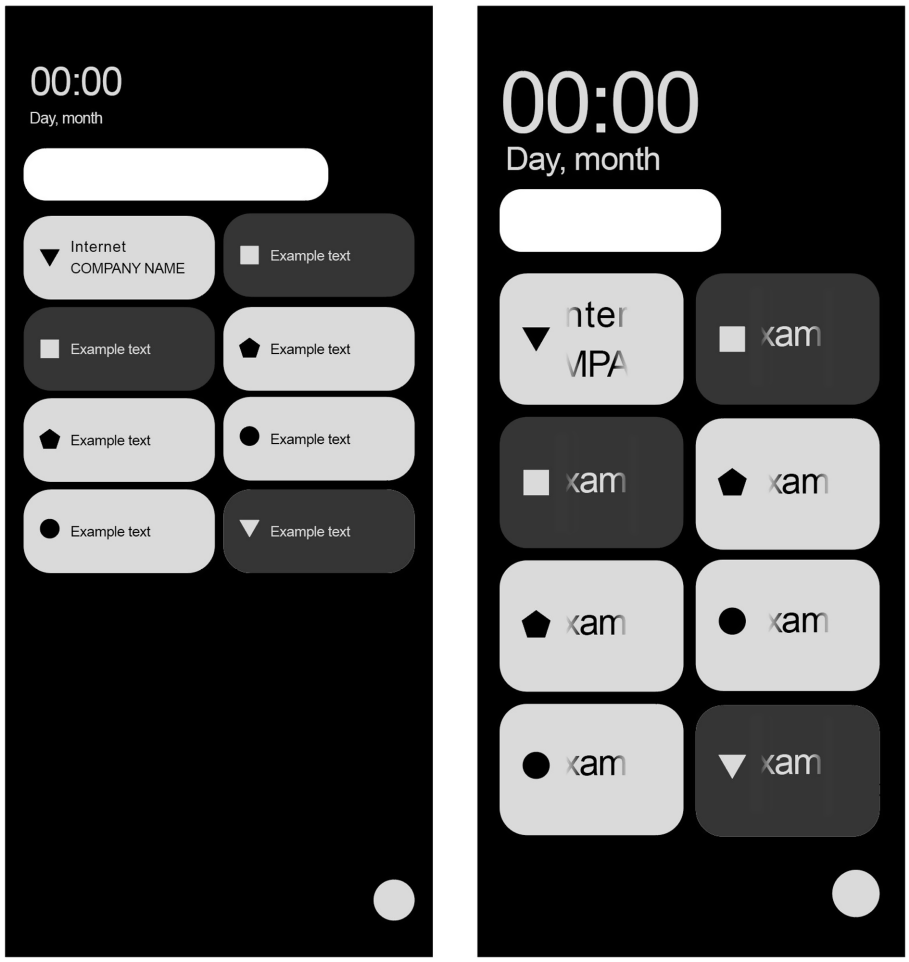

FIGURE 4
Schematic diagram resembling the Android settings screen, showing normal vs. maximum text size. Source: authors' own elaboration.

after updates, this support may also generate dependency and asymmetrical power relations that undermine confidence and autonomy (Selwyn, 2004). Trial-and-error strategies and reliance on online videos reflect the absence of structured, user-centered guidance, shifting the burden of learnability onto users themselves (Czaja et al., 2019). These patterns underscore that later-life learning emerges from an interaction between social support, individual agency, and design constraints, rather than from deficits in motivation or cognitive capacity.

Emotional responses played a central mediating role throughout these processes. Repeated interaction failures were often internalized as personal inadequacy, reducing self-efficacy and reinforcing age-related stereotypes (Bandura, 1997; Czaja et al., 2006). At the same time, frustration and anger sometimes triggered curiosity and problem-solving, reflecting ambivalent emotional dynamics previously documented in later-life learning (Barnard et al., 2013). Fear of irreversible errors, fraud, or financial loss promoted risk-avoidant behaviors, narrowing use to a limited set of trusted functions or increasing dependence on reassurance from others (Lee and Coughlin, 2015; Heart and Kalderon, 2013).

Taken together, these findings highlight that from a technology acceptance perspective, sustained and confident mobile phone use among older adults depends not only on functional usability, but also on emotional safety, transparency, and perceived control. Design choices that amplify complexity, obscure affordances, or externalize accessibility and security management run the risk of reinforcing disengagement rather than supporting safe, autonomous, and meaningful use.

5 Conclusion

This exploratory study examined how visual interface design and accessibility settings shape smartphone adoption among older adults. The findings show that abstract symbols, the absence of explicit or comprehensible guidance, and information overload significantly hinder understanding, learning and effective engagement with mobile technology.

The study's most critical finding is the paradox of accessibility settings. Although designed to enhance usability, these features are rarely used and, when activated, are largely limited to text enlargement. Most accessibility options remain unknown to users, and access to the settings themselves is perceived as complex and counterintuitive. Moreover, poorly implemented accessibility features—such as those illustrated in Figure 4—negatively impact usability and user experience by disrupting the original visual design of the interface and creating additional barriers.

Even as a mature technology, smartphones continue to be difficult to configure and use for older adults. This reflects a systematic violation of well-stablished principles of usability and interaction design, including discoverability, consistency, and user control. These structural shortcomings directly undermine autonomous use and reinforce dependency on external support, resulting in a strong reliance on warm experts for configuration, troubleshooting, and recovery after update-related issues. The persistence of such dependency indicates that facilitating conditions for independent use are severely lacking, contradicting the principle of universal accessibility: enabling autonomous and effective use regardless of individual capacities.

Ultimately, smartphones will not become truly "smart" until any person can configure and operate them independently. Until that condition is met, warm experts will continue to function as the invisible infrastructure sustaining digital inclusion among older adults. Importantly, the widespread need for warm experts should not be interpreted as a limitation of older users, but rather as clear evidence of a lack of attention to usability and the urgent need for more inclusive, intelligible, and emotionally safe interface design.

5.1 Limitations and future research

Despite conducting focus groups in two neighborhoods with different socioeconomic characteristics, this study has limitations due to the small sample size, particularly given the diversity within the population aged 65 and over. Additionally, in one focus group, six of the seven participants were acquainted prior to the session, a factor that may have influenced group dynamics and individual responses. Future research could focus on older users with shared characteristics and combine qualitative insights with experimental methods —such as usability testing, A/B comparisons of interface variants, or eye-tracking analyses—to systematically assess the impact of specific visual design interventions, such as color choices, typography, motion design, iconograhy or brand-specific visual languages, on older adults' adoption of mobile technology.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Comité de Ética de la Investigación de la Universidad Complutense de Madrid. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

RÁ-M: Writing – original draft, Writing – review & editing. DA-G: Writing – original draft, Writing – review & editing. AA-A: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was used in the creation of this manuscript. The use of AI-based tools was strictly limited to: (i) Turboscribe, for the transcription of the focus groups; (ii) NotebookLM, as a support tool for extracting a thematic trend mind map from the transcriptions; and (iii) assisted translation tools such as NotebookLM and DeepL for translating the draft text from Spanish into English. The final English version was subsequently reviewed and validated by a professional translator.

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