

# Tailoring Digital Privacy Education Interventions for Older Adults: A Comparative Study on Modality Preferences and Effectiveness

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## ABSTRACT

Although older adults are increasingly adopting digital social technologies, a lack of knowledge and experience makes them vulnerable to digital privacy and security threats. It is, therefore, crucial to build digital privacy education interventions that empower older adults to take more control over their digital privacy. Most tutorials and support materials are designed for the younger generations and are not necessarily as effective for the older population. In this paper, we explore the development of education interventions suited to the learning styles of the older adult population. We particularly develop interventions that span a variety of modalities (text, videos, audio presentations, infographics, comics, interactive tutorials, and chatbots) and evaluate these interventions in a focus group study, gathering feedback from both older and younger adults regarding the education interventions and how to improve them. Our findings demonstrate that there are distinct differences in modality preferences between older and younger adults. In this paper, we discuss our findings and contribute to the development of digital privacy education interventions that are tailored to the specific needs and preferences of older adults.

## KEYWORDS

Digital privacy, education interventions, focus group study, older adults

## 1 INTRODUCTION

Over the past decade, older adults have increasingly adopted new technologies [18]. For instance, they use social media to keep in

touch with family and friends, which improves their social connections and alleviates loneliness [42, 61], and might lead to other desirable impacts on their well-being [61]. However, research shows that the use of digital technologies imposes more privacy threats to older adults (vs. younger adults) due to their relatively lower digital literacy and familiarity with technology [7, 43, 72, 80]. In addition, research shows that older adults, despite their sincere efforts, are less likely to take real active measures to protect their privacy than younger adults, due to their different level of knowledge of privacy protection measures [7, 80]. Despite the importance of privacy education for older adults, little is known about how to train older adults to use privacy features and protect themselves, and how they respond to various teaching interventions. While prior studies have investigated privacy decision-making and policy formulation for older adults [22, 35, 63], our unique contribution is to the under-explored area of privacy education and communication for older adults.

In this paper, we focus on the design and implementation of digital privacy education interventions that are specifically optimized for older adults. We designed these interventions to span a variety of modalities: textual instructions, chatbots, interactive tutorials, videos, comics, audio recordings, and infographics. This paper presents two primary objectives: 1) to gather user feedback to further develop our digital privacy education modules, and 2) to understand how the characteristics of the different education modalities differently influence the preferences and perceptions of older and younger adults. Our research questions are as follows, with the first two questions serving to motivate the third:

- (1) How do perceptions and approaches to digital privacy differ between older and younger adults?
- (2) What are the differences between older and younger adults' responses to various privacy education scenarios?
- (3) What are the features of different education modalities that are favored or disliked among older adults? How is older adults' perception different than younger adults' on this?

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To address these research questions, we conducted a focus group study with both older and younger adults to gauge their perceptions and reactions toward the developed digital privacy education interventions. This methodology was motivated by the formative and qualitative nature of our goals and research questions, as it allowed us to explore the less understood aspects of privacy education modality preferences from the perspectives of both older and younger adults [55]. We then applied a thematic analysis method to the qualitative data to understand the strengths and weakness of the seven presented modalities, compare the differences between older and younger adults in terms of preferences for privacy education, and identify areas for improvement and tailoring the interventions to better meet the needs and preferences of older adults.

Our analysis revealed that older and younger adults have distinct preferences and learning strategies when it comes to digital privacy education. Both populations showed unique opinions on what makes privacy education more appealing, such as visual design and content depth. Our research suggests that older adults benefit from a multi-faceted approach to communication in order to maintain focus and concentration. They prefer a personable experience, akin to their current reliance on family members for privacy advice. Moreover, they prefer in-depth explanations, with the ability to revisit certain sections of the explanation if needed. Hence, a combination of a personable audio-visual presentation, augmented with opportunities to revisit and further explore the materials, would be ideal for this demographic. In contrast, younger adults prefer privacy education experiences that are fast-paced and use a combination of interactive visuals and animated presentations. They value the flexibility to skip or navigate through information and may also benefit from having a chatbot assistant to answer any questions they may have.

Our paper presents valuable contributions to the field of usable privacy by providing a comprehensive understanding of how to develop optimal digital privacy education interventions that cater to both younger and older generations in the scope of social media, communication and digital privacy.

## 2 RELATED WORK

In the following subsections, we situate our work within the relevant research on the implications of digital technology and privacy among older adults. Then, we survey the literature on age variations in learning and cognitive functioning. In our final subsection, we focus on the key privacy concerns of older adults and the content and design guidelines of older adult privacy interventions.

### 2.1 Older Adults' Digital Technology Use and Privacy

The digital divide, or the gap in digital technology use between older and younger adults, has shrunk dramatically in the past decade. The proportion of adults aged 65+ who use the internet has increased by 32%, and cell phone ownership has grown by 50% in the past ten years [18]. As older adults' internet adoption and smartphone ownership have increased, so has their social media use. For example, since 2010, social media users aged 65+ have increased about fourfold [18].

This increased adoption rate creates a unique opportunity for technology providers to support older adults to age-in-place [42]. Social media platforms like Facebook provide accessible and affordable means of communication, thereby helping older adults improve their social connections and receive social support [61, 73], independent of time or location [15]. While social media interactions are no replacement for real-world interpersonal interactions, they allow older adults to keep up with news and information, share experiences, and engage with family and friends, which can help combat social isolation [61, 80] and slow the rate of cognitive decline [15].

However, there are also downsides to social media use, particularly related to security and privacy. For instance, online advertisers and social media companies collect huge amounts of personal information [59, 78], and it can be challenging for inexperienced social media users to protect themselves against scams and phishing attacks [21, 59, 60]. These drawbacks are exacerbated for older adults, who are generally more concerned about privacy risks but also take fewer precautions [5, 51, 72]. Research shows that the latter may happen because older adults are less aware of the technical aspects of online data protection, and thus less capable of implementing methods for privacy control and data protection [70, 72]. Specifically, compared to younger individuals, older adults find it more difficult to locate and comprehend privacy settings on social media [7]. This makes them less confident about data management and less certain of their abilities to avoid the inappropriate use of their data [7, 51].

Older adults' privacy concerns may be the main barrier preventing them from adopting new digital media [37]. Even the older adults who do adopt technology and are eager to protect their privacy often lack the necessary knowledge to effectively implement privacy protection measures [80]. It is, therefore, crucial to develop means of education that can help older adults access, understand, and manage their privacy [34, 53]. However, such privacy education tools must be tailored to older adults' learning styles, due to well-studied age differences in learning and cognitive functioning—a topic we turn to in the next subsection.

### 2.2 Age Differences in Cognitive Functioning and Learning

In most people, the cognitive abilities essential for maintaining one's functional independence, including the ability to learn new skills, reading recognition, processing speed, and memory, are known to change with age [12, 61]. As people get older, changes in working memory can interfere with daily tasks [66]—for instance, it takes older adults longer to process information, which may make it more difficult to recall instructions or pay attention [6, 17].

When it comes to learning, these changes in cognitive functioning reduce older adults' ability to acquire new information, to form new memories [12], and hence, to retrieve information that was recently learned [36, 53]. Learning is more affected in older adults if the task includes mental manipulation of the content to be learned or if the participants are required to accomplish several tasks while learning [53].

Given these limitations, in this paper, we investigate the development of educational materials that are compatible with older

persons' learning abilities. We also aim to tailor the materials to seniors' learning *preferences*, as research shows that older users are more likely to engage with learning materials that are tailored to their preferences [52].

## 2.3 Developing Privacy Education Interventions for Older Adults

In this section, we outline the primary privacy issues that older individuals are concerned about, as well as the information that should be included in a set of online privacy education tutorials for older adults relating to social media networks. Furthermore, we describe key parameters for designing education interventions for older adults that serve as the foundation for the primary structure of our privacy education interventions.

**2.3.1 Key Privacy Concerns of Older Adults.** Martinez-Alcala et al. argue that education interventions to improve digital inclusion in older adults must specifically address their personal and social needs [50]. To determine the most pressing privacy topics that concern older adults while using digital technologies, we investigated the prominent privacy concerns highlighted by older adults in previous studies:

- **Publicly shared personal information:** Xie et al. found that disclosing personal information publicly, receiving private messages from friends that may be viewed by everyone, and the amount of time personal information remains on social media are considered as crucial privacy issues that act as barriers for older adults to adopt digital social technologies [78]. Likewise, Gibson et al. [23] revealed that the majority of elderly believe that all content uploaded on social networks is public and that privacy options are limited. Moreover, Quan-Haase and Elueze [59] observed that older persons regularly expressed anxiety about the sharing of private information with social media providers and the lack of control over who can access shared information. For instance, they found that seniors often wonder whether social media content can be controlled so that only selected "friends" can view it.
- **Tracking and targeted advertising:** According to Xie et al., selling users' private information to third parties was one of the primary concerns, and a key obstacle to the adoption and usage of social media by older adults [78]. Targeted advertising has the potential to offer older adults personalized products and services, but it also raises significant concerns. The lack of regulation in the data marketplace and the extensive tracking of individuals can expose them to risks, particularly older adults [20]. The effects of cognitive aging make older adults more susceptible to deceptive marketing, increasing their vulnerability to the harms associated with online tracking [30].
- **Fraudulent online transactions:** Online shopping has emerged as the most frequently associated with privacy concerns [59]. Older adults are more concerned about fraud because they feel more vulnerable to unknown risks [59, 60]. Indeed, since many older people encounter stories about their peers losing their money because of social media scams, they develop significant concerns about falling victim to such

frauds [59]. Quan-Haase and Ho examined older adults' online privacy concerns and privacy protection procedures and discovered that their main concerns centered on account hacking and credit card data theft [60]. Similarly, Bergström discovered that, due to the necessary involvement of personal and financial information, older persons are more concerned about data misuse during online transactions [3].

- **Location-sharing:** Older adults often have different perspectives when it comes to sharing their location on social media. Some might see it as an opportunity to showcase their activities and increase their social standing among peers. The desire for social enhancement is the most common reason cited for location sharing on social media, this can be seen as a way to increase their value and impress those in their social network. Revealing their location can be a way to establish a sense of importance and value in their social circle [79]. On the other hand, there are also individuals who view their location as a personal matter and prefer to keep it confidential. They may choose to limit their location sharing for the purpose of preserving their privacy and avoiding any potential unwanted interactions. Preserving personal boundaries and maintaining privacy are significant considerations for older adults when it comes to sharing location information on social media. This is due to the desire to protect their relationships and guard against unwanted interactions by carefully regulating the information they make available online [39, 40, 57].

Given the prominence of these four topics in the existing literature, we developed an education scenario for each of them (see Section 3.1). Moreover, given the prominence of social media in today's society and its importance in the lives of older adults (see Section 2.1), we situate these four education scenarios in the context of the Facebook platform—one of the most popular social media platforms among the older population [2, 7].

**2.3.2 Design Guidelines for Older Adult Privacy Education Interventions.** Researchers warn against the stereotype that depicts older adults as dependent and lacking in initiative and determination, which may cause educational programs to be designed with a condescending attitude, preventing the elderly from the freedom to choose priorities and make their own decisions in their learning activities [50, 75]. Martinez-Alcalá et al. [50] argue for *autonomy* as one of the most basic vital components of the educational model for digital literacy among the elderly (with other components being motivation, experience, needs, self-concept, learning value, and learning orientation [25]). To enable autonomy, older adults must actively participate in their education, which means that educational content must be crafted with the elderly's learning preferences, interests, and expectations in mind [50]. Similarly, Wlodkowski and Ginsberg [75] argue that motivation is the key factor that influences the learning process and ought to be the focus of any educational program designed for this demographic. In terms of privacy literacy, this means that one should not only offer older adults the fundamental techniques for privacy protection as a starting point (i.e., the *how*), but that the educational material should also lead with a clear motivation: older adults will want to know upfront *why* they should spend the effort to learn about privacy [19]. As such, we

developed our education scenarios to include both practical and motivational elements.

As the abilities to acquire new information and retrieve recently acquired information decline with age [16, 24, 69], a clear guideline for the development of privacy tutorials for older adults is to minimize cognitive demand and maximize ease of use. A cross-disciplinary team of Facebook researchers and designers has produced seven digital literacy design guidelines, which they apply to make products easy to use for those with varying levels of digital literacy. The findings have helped to enhance Facebook products' privacy experiences [24, 46]. The guidelines include "focus interactions on one thing at a time," "be direct and set a clear expectation," "create consistent and predictable patterns," and "use simple language." We followed these guidelines in designing our education scenarios to ensure that they are accessible to users with low digital literacy [46]. We also followed the guidelines of Xie et al., who propose valuable educational strategies to mitigate the privacy concerns of older individuals, such as explaining the concepts before giving the functions, addressing privacy risks, and making social media personally relevant [78].

It is worth noting that research demonstrates that older and younger adults make decisions in fundamentally different ways [76, 77]. Byrne and Ghaiomy Anaraky found, for instance, that while younger individuals are more motivated to win, older adults are more driven to avoid losing [8]. We considered this finding in the framing of our educational materials.

### 3 METHODS

For our study, we developed privacy education interventions around four scenarios, implementing each scenario in seven different modalities. We then conducted twelve focus groups with 33 individuals (15 older adults and 18 younger adults) to gain insight into the perceptions of participants regarding the scenarios and the modalities, to determine whether older persons' perceptions differed from those of younger generations, and to seek improvements to the developed education interventions. Each focus group lasted approximately 90 minutes, and each participant received US \$40 for participation.

We conducted multiple rounds of focus groups for both older and younger adults, making comparative assessments of the data derived from different rounds. Our approach involved continuous analysis, concluding our data gathering when it ceased to yield new insights. Prior research [9, 10, 49, 55], along with saturation considerations, influenced the determination of our sample size.

We adopted a focus group methodology as it has been proven effective for eliciting specific information from older adults in past research [68]. Moreover, a focus group gives the moderator a chance to ask follow-up questions for a deep understanding of the ideas being addressed [64, 68]. As dictated by our goals and research questions, this ability to gain a deeper understanding through iterative proving allowed us to more deeply examine the underlying reasons behind older and younger adults' preferences for various educational modalities within the context of digital privacy and social media.

#### 3.1 Tutorial topic selection and script development

We created four education scenarios aligned with the four key areas of privacy concerns of older adults outlined in Section 2.3.1:

- (1) the risk of publicly shared information and how to prevent others from posting on one's profile;
- (2) the danger of online tracking and how to control the use of cookies for targeted online advertising;
- (3) the risk of fraudulent online transactions and how to prevent identity theft;
- (4) the risk posed by location sharing and how to manage location disclosure.

In line with Section 2.3.2, each scenario covered motivational elements (i.e., why is this a risk?) as well as practical elements (i.e., what can I do to mitigate this risk?). Because we situated each scenario within the Facebook platform, we drew upon Facebook's Privacy Center<sup>1</sup> for definitions of specific social media terms and step-by-step instructions for adjusting settings on the platform. Several additional sites were used to clarify the risks, benefits, and suggestions outlined in each of the scenarios [21, 38, 62, 67].

Each of the four scenarios followed a similar structure, inspired by the educational materials in Google's Be Internet Awesome program [26]. We adopted this example due to its clear and action-oriented approach, starting with a glossary of new terms, followed by interactive questions and thorough explanations.

Figure 1 shows the general structure of each scenario. Each scenario starts with a description of the **situation** that causes a privacy concern, and asks the participants to think about how they would respond to the situation (e.g., What could happen if a friend posted "Have a great vacation" on your social media profile?). This interactive approach is intended to increase participant engagement and motivation to pay close attention to the material [28, 31].

Each scenario subsequently provides a short explanation of the **core concepts** related to the situation (e.g., Your Facebook profile is where all your Facebook posts show up). These core concepts are explained because we believe that it is important to not only provide practical knowledge on how to protect oneself against privacy risks, but also to impart a fundamental understanding of the underlying phenomena that cause these risks. This approach ensures that the lessons remain relevant and effective in the face of evolving technology.

In a subsequent step, we highlight the potential **benefits and privacy risks** associated with the scenario. The treatment of both risks and benefits avoids an overly paternalistic approach by outlining the potential risks while also acknowledging the potential benefits of social media use.

Finally, each scenario ends with a range of **protection strategies**. In selecting the protection strategies for each scenario, we aim for solutions that are easy to explain. We also make sure that at least some of the strategies are not fully restrictive (i.e., that they still enable participants to enjoy the benefits outlined in the scenario).

We developed each of the four scenarios according to this general structure and used several rounds of design-and-critique within

<sup>1</sup><https://www.facebook.com/help>

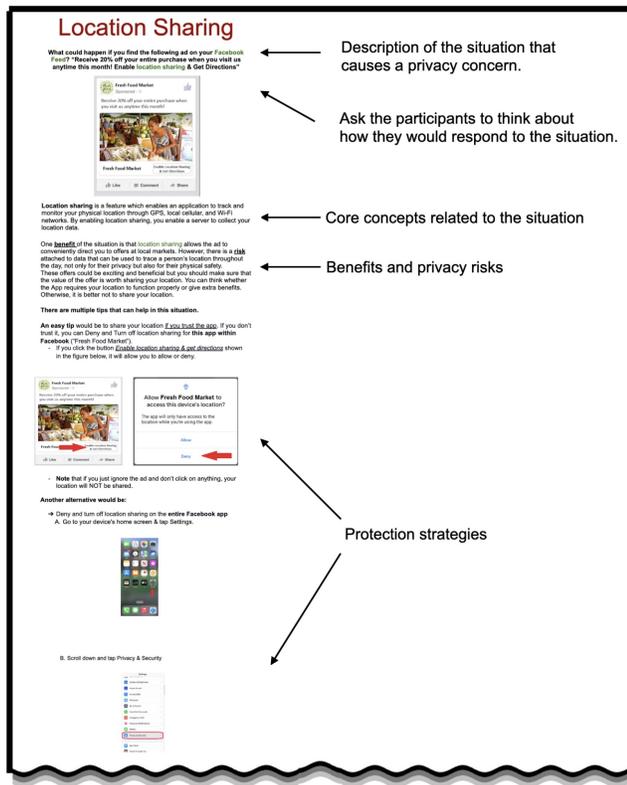


Figure 1: General structure of the tutorial.

our team (an age, gender, and culturally diverse group of experts on privacy, HCI, psychology, and gerontology) to iteratively improve the scenarios. The final scenarios represent the “Text” version of our education interventions; other modalities were developed to minimally deviate from the content of the text version. The development of the different modalities is described in detail in the next section.

### 3.2 Tutorial Modalities

Several studies have shown that people have different modalities of choice when engaging with educational content [45], and this is equally true for older adults [14]. Hefter and Berthold investigated the impact of text and video as presentation modes on learning processes and outcomes. Similarly, they assessed the usefulness and efficiency of acquiring argumentation knowledge via text, visual novels (like infographics), and video in another study conducted with their team [14, 32, 47]. Ghaiumy Anaraky et al. studied the potential benefits of using comics rather than text as a method of privacy communication [1]. Kramer et al. designed and evaluated the effectiveness of online interactive tutorials to teach science process skills [41]. While these studies found significant differences between education modalities, no clear “best” modality emerges from the existing literature.

Consequently, we converted each of the four privacy education scenarios into the following seven modalities: text, videos, audio presentations, chatbots, interactive tutorials, infographics,

and comics. We produced the original version of each scenario as a text document and used several software tools to produce the other six versions of each scenario. In creating each modality, we ensured that their contents deviated as little as possible from the text version. Below we describe each modality in more detail:

**Text:** The text versions were written and presented as a Google Doc. We intentionally used simple language and avoided or carefully explained jargon. Note that although the primary format of this modality is text, we did include annotated screenshots to illustrate the steps involved in the protection strategies, so as not unduly to reduce the clarity of the presented instructions. The same screenshots were included in all modalities (except the audio presentations).

**Videos:** The videos were created with Adobe Premiere Pro<sup>2</sup> and featured an on-screen presenter reading the script, interwoven with visual instructions narrated by the same presenter off-screen. An on-screen narrator was used to make the video more personable. Existing work has found that older adults have difficulties following standard educational videos when the narrator commonly speaks too quickly, and when there are no subtitles [78]. We addressed this issue by asking the narrator to speak slowly and to carefully enunciate each word, and by providing subtitles, on-screen textual instructions, and visual aids like annotated screenshots when appropriate. Figure 1 in Appendix A is a screenshot from the video produced for the first scenario.

**Audio presentations:** Adobe Premiere pro was also used to create the audio presentations, by separating the audio track from the video version. To make the narrative easier to follow in the absence of visual aids, we slowed down the narrator’s voice (without lowering the pitch).

**Interactive tutorials:** The interactive tutorials required participants to actively engage with the scenario content by clicking through the script step-by-step, and by actively imitating the steps involved in the protection strategies on the provided screenshots. The interactive tutorials also allow users to decide in which order they wish to learn the various protection strategies. The tutorials were produced as websites using Expo React native<sup>3,4</sup>. The tutorial websites provide clear guidance to assist older adults in interacting with the tutorial and following its procedures. Figure 2 of Appendix A is a screenshot of the interactive tutorial for the first scenario.

**Infographics:** The infographics were developed using the Adobe Creative Cloud app “Express”<sup>5</sup>, which enables users to design vertically-scrolling infographic pages. The content of each infographic is equivalent to the text version, but with a more “PowerPoint-like” presentation and additional visual aids. Figure 3 in Appendix A is a snapshot of the infographic for the first scenario.

**Comics:** The comics were developed with Figma<sup>6</sup>, an online vector graphics editor and prototyping tool. The primary distinguishing feature of the comics was that a cast of cartoon characters

<sup>2</sup><https://www.adobe.com/products/premiere.html>

<sup>3</sup><https://expo.dev/>

<sup>4</sup><https://code.visualstudio.com/>

<sup>5</sup><https://creativecloud.adobe.com/>

<sup>6</sup><https://www.figma.com/>

carried out the motivating events and interventions of each scenario. Figure 4 in Appendix A is a screenshot of the comic version of the first scenario.

*Chatbots:* We created the chatbots using the Juji platform <sup>7</sup>, which presents a virtual character that narrates the scenario script through speech bubbles with written text in a conversational style. The character intersperses the narrative with questions for the user, who can respond with a request to provide additional clarification or to repeat instructions. Like the interactive tutorial, the chatbot also allows users to decide in which order they wish to learn the various protection strategies associated with a scenario. As such, the chatbot combines the interactive aspect of the tutorials with the personable aspect of the videos. During the development process, the chatbot was designed to ensure that all users receive equal access to information, regardless of their prior experience with this interactive modality. Figure 5 in Appendix A is a screenshot of the chatbot version of the first scenario.

The text version of each scenario, along with examples of the remaining six modalities excluding text, are available for review in the supplementary materials<sup>8</sup>.

### 3.3 Participants

With the approval of our university’s Institutional Review Board, a total of 33 participants were recruited to participate in 12 small focus groups. Small focus groups were held because smaller groups are easier to recruit and host, as well as more comfortable for participants, especially for older adults [44]. Each focus group contained either all older adults or all younger adults (i.e., no mixed groups).

The younger adults (N=18) were recruited through flyers posted in various locations around our university’s campus and comprised of individuals aged 20 to 35. The older adults (N=15) were recruited through a local retirement community and local neighborhood mailing lists and included individuals aged 63 and above. Table 1 presents the demographics and personal characteristics of our participants.

**Table 1: Demographics of our study participants.**

Variables	Value	Older adults	Younger adults
Gender	Male	10	11
	Female	5	7
Age group	21-31	0	15
	63-93	18	0
Frequency of Social Media Use	Daily	3	7
	Weekly	1	3
	Monthly	1	1
	Few times a year	1	4
	Once a year	2	0
	Few times ever	0	1
	Never	3	0
	Stopped using	2	2

<sup>7</sup><https://juji.io/>  
<sup>8</sup><https://osf.io/hy943/>

### 3.4 Procedures

During the focus group, participants were shown two of the four scenarios. This ensured that each scenario and modality combination was presented at least once for both age groups. For each scenario, we first showed them the text modality, followed by two of the other modalities (video, audio, comic, infographic, or chatbot). We chose the text version as the baseline since text-based learning has historically been a foundational element in education. As such, our text version served as a yardstick against which participants could compare the other presented modalities.

The decision to limit each focus group to two rounds (i.e., 2 scenarios) with three modalities (text + 2 others) per round was based on a pilot study; we found that incorporating more scenarios and/or modalities was overwhelming and made it difficult for participants to maintain focus. Conversely, testing only one scenario and/or one modality per scenario would have required an impractical increase in the number of focus groups. As an added benefit, starting each round with the text modality gave participants a common ground for comparison (the text version is particularly useful for this, since it allowed participants to first focus on the content before considering alternative presentation methods), allowing them to compare the three modalities for each scenario, and make comparisons across scenarios (based on the text versions).

The focus groups began with an introduction of the study purpose, expectations, and basic rules (see Appendix A for the focus group script). All focus group attendees signed a consent form to participate and to agree to the recording of the meeting. After collecting informed consent, the moderator presented a brief description of the study’s methodology, objectives, and discussion guidelines. Participants were requested to first share their own thoughts and experiences individually, and then to react to each others’ comments, if desired. They were informed that the purpose of the focus group was to evaluate and improve the presented digital privacy learning materials based on their feedback.

Upon presenting the text version of the first scenario, participants were asked to share their prior experience in a similar scenario (“Have you or anyone you know encountered a situation like this before? If so, what happened?”), their opinion about the presented risks and benefits, and their opinion about the presented protection strategies. Then, for each alternative modality, participants were asked to share their opinion about the modality (“What do you like about this learning modality? What don’t you like? What is one thing you would do to improve it?”), and to explicitly compare it against the text version (“Do you like or dislike this presentation more than the text? If yes, why?”). Finally, after seeing all three modalities, they were asked to select their preferred modality (“Which of the learning modalities did you like the best? Why?”). This procedure was repeated for a second scenario. The focus group meetings lasted a total of 90 minutes on average.

### 3.5 Data Collection and Analysis

A web-based service was used to transcribe the audio recordings from the focus groups, in compliance with IRB requirements. The transcripts were manually coded and evaluated to extract themes and trends. The analysis was conducted in accordance with a conventional thematic analysis method, which involved reviewing the

text, creating codes, and identifying categories and themes [48]. First, one of the authors coded the transcripts using an open coding strategy. Next, codes were put into categories, and categories were grouped into themes. Table B in the Appendix outlines the themes, categories for each theme, and sample participant quotes for each category.

Upon establishing the categories and themes, a second author re-coded a random sample of the transcripts using the established categories and themes. The results were then compared, and a percentage of agreement was calculated to be 94% for themes and 90% for categories, respectively. In addition, Cohen's Kappa was calculated to assess inter-rater reliability and determine the degree of agreement between the two coders in assigning categories to the set of data [13]. The results showed a strong agreement with a Cohen's Kappa of .808 ( $p < .0001$ ) for categories and .884 ( $p < .0001$ ) for themes.

## 4 ETHICS

This study received approval from our university's Institutional Review Board (IRB). We meticulously adhered to data anonymity, collecting information without identifiers whenever feasible and anonymizing focus group transcripts where necessary. We preserved privacy by securely storing any contact information separately from the study data.

Participants were made fully aware of their rights to retract personal data either during the study or afterwards. We highlighted that opting to withdraw from the focus groups would result in no negative repercussions. Furthermore, we prioritized participant comfort by allowing them the freedom to discontinue their participation or withdraw from the study at any time. In addition, we ensured confidentiality in transcribing audio recordings by carefully eliminating all information that could potentially identify individuals.

## 5 RESULTS

This section presents the findings from our qualitative analysis. We present the results along the dimensions uncovered in our thematic analysis. First, we cover older and younger adults' general perceptions and approaches to privacy. This analysis highlights older adults' current strategies around privacy and technology use, which provides important context to their evaluation of the education interventions. Second, we analyze older and younger adults' engagement with the different education modalities (RQ1) and their preferences regarding the modalities (RQ2). In this analysis, we aim to go beyond individual modalities to evaluate what *features* of the modalities are favored or disliked (RQ3).

Throughout this section we present quotes from the focus group discussions to demonstrate areas of interest, highlight key ideas, and identify broad patterns and frequent themes. Our findings demonstrate differences and similarities between older adults (referred to as OA) and younger adults (referred to as YA) based on this analysis. Each quote is labeled with a participant ID (OA-# or YA-#) followed by the coded category and/or the presented modality.

### 5.1 Older vs. younger adults' perceptions and approaches to digital privacy

The older adults in our focus groups expressed their privacy concerns and limited understanding regarding digital privacy as they use social media platforms and the Internet in general. Along with concerns, they demonstrated different levels of trust while engaging with the Internet:

*I am so skeptical of digital privacy since I do not really know what it is. I do not really know what it means or how to protect it.* — OA-2, privacy concerns

*I am so concerned that if I click down to enable sharing and give directions, that not only are they getting my location, they are also going to get my visa card, my debit card and my social security.* — OA-2, privacy concerns

*I do not understand how to protect my privacy on social media. But I think that I just did not know how to use it.* — OA-26, lack of knowledge

*I do not like putting my credit card online. I do not like any of that because I do not trust it. I do not trust Google. I do not trust anything. I have lost trust in almost everything, [...].* — OA-3, privacy concerns

Even more, given their different level of knowledge, many older adults in our focus groups indicated low self-efficacy and confidence in performing tasks to protect their privacy or learn how to do so.

*I do know what privacy is and how you can limit what is happening on your Facebook page. I am well aware of all of that, I just do not know how to do it myself because I am not on it enough.* — OA-1, lack of self efficacy

*I am clear about my personal lack of knowledge, so I am not sure if I can do that.* — OA-1, lack of knowledge

*I think there are ways of controlling and protecting my privacy, but I do not use social media enough to be fully aware of what those controls are and how to use them.* — OA-2, lack of self efficacy

*I keep wondering when are we ever going to get smart enough to realize the features and steps. Because they keep getting better, and we can not catch up* — OA-3, lack of self efficacy

The older adults in our focus groups mentioned using several strategies to address their privacy concerns and level of knowledge. For instance, many of them had made the decision to fully avoid using the Internet and social media as a result of a negative past experience or after learning about unfortunate circumstances and difficulties from friends or relatives.

*I do not trust the internet. All these open ended backdoor things that people can get into to find out numbers [...] if you are savvy they can pretty much get into anything they want to get bad [...].* — OA-5, privacy concerns

*Friends that have been ripped off that have gotten emails and they pay money... and oh my gosh, I mean, I have a lot of people that has happened to [...]. So I do not trust any of this.* — OA-4, past experience

As another strategy, most older adults in our focus groups would ask assistance from the younger generation to install apps or set up social media platforms. Some older adults would even consult with younger adults regarding ads and offers before taking any action.

*I have to admit that taking care of protecting my computers is in the hands of one of my granddaughters. So I rely heavily on that granddaughter for getting me out of any problems.[...]— OA-20, older adults seek help from younger adults*

*I do use Amazon but what I do is call my daughter and granddaughter, [...]and they have my credit card, so they handle all things delivered to the door and they know how to protect my information, so I really rely heavily on them to keep me safe online. — OA-20, older adults seek help from younger adults*

*What both my sons said when I got on Facebook, they said be very cautious of what you send out exactly because once you put it out, as you can't take it down[...]. — OA-4, older adults seek help from younger adults*

Likewise, the younger adults in our focus groups would offer older adults in their lives tips on how to use social media, and help them protect themselves against fraud and manage their privacy while using the Internet.

*I actually do that on all of my grandparents' phones, like all the older adults in my life. I actually go through and turn those settings on, and then they don't ever argue about it. [...] I also show them where they can turn it on themselves [...] it's just to protect them from like a targeted ad where someone could be phishing for them like this.[...] — YA-12, younger adults help older adults*

*With my mom, I have to physically show her everything, she can not do it alone. I walk her through the steps [...] the visual aids help a lot. [...] — YA-17, younger adults help older adults*

A third strategy taken by many older adults in our focus groups was to limit their engagement. For example, they would follow others' social media posts (i.e., they would read posts and look at photos to keep up with local news and the lives of friends and family), but never actively participate themselves, thereby reducing their exposure to privacy threats.

*On the Facebook, I do not ever post, I do not even remember sending anything out. I enjoy seeing what the kids are doing on everything. And so I would say that every day I do check in Facebook and see what is on there. — OA-22, do not interact but observe*

*Using the Internet now; I am not the perpetrator. I am the receiver. — OA-20, do not interact but observe*

Finally, we found that many older adults in our focus groups considered the social media platforms' defaults regarding privacy settings to be the most reliable, assuming that these would be selected by individuals with more expertise.

*I do very low settings. I stay with the default. I have never gone in and changed it [...]. — OA-22, use of default settings*

*Because I might not even be aware, there must be a default setting right in this situation. — OA-2, use of default settings*

In contrast to the older adults, the younger adults in our focus groups expressed lower privacy concerns and more confidence in managing their privacy or learning new protection strategies. As evidence of their confidence, they would even, unprompted, suggest solutions to the privacy issues described in our scenarios.

*On my laptop, I have an ad blocker so I do not care about the cookies. — YA-10, confidence*

*I know that if I want to find something quite cheaper [...] I know that they have always suggested something on my social media or like, I get emails and stuff like that. And so I feel like I can use it to my advantage too. — YA-9, confidence*

*I would not use a third-party app that tracks location. I only use the one that comes strictly with Find My. — YA-12, confidence*

## 5.2 Older vs younger adults' reaction to the different scenarios

Our observations on the educational scenarios have revealed distinct variations in the responses, level of interest, and overall engagement of older and younger adults. We were expecting that older and younger adults would pay attention and be interested in targeted advertising and personnel information misuse and also how to protect themselves from that and deal with cookies. Although both age groups showed interest in scenarios involving sharing personal information and targeted online advertising, our findings showed that older adults exhibited a particularly strong interest in the topic of cookies. They expressed a strange feeling that their smartphones were spying on them. In contrast, we observed a relatively careless attitude among younger adults towards cookies, suggesting that they already knew how to manage them. Therefore, our initial expectations were confirmed.

*Yes for a fact, we were sitting in class one day we were joking around about McDonald's fries, and I swear on everything. My classmates sitting next to me so I saw her phone pulls up her phone she goes I just got a 20% coupon from McDonald's.— YA-12, past experience*

*Alexa, it is like somebody who is listening to everything from somewhere [...].— OA-7, past experience*

*So I know what it is.— YA-12, cookies*

*I know other risks.— YA-17, cookies*

Moreover, older adults in our study had previous experiences with online frauds and scams, or knew someone who had. This resulted in a higher reporting of perception of threat from online transaction fraud. Conversely, younger adults reported a greater sense of control over their usage and believed they could protect themselves from scams.

*I am not even comfortable ordering anything over the computer because I am not sure wherever my name and address is going from that company.[...] How much I can trust that[...]. — OA-5, privacy concerns*

Regarding location sharing, both generations found the tutorial helpful, and they noted that they sometimes used location-sharing apps for safety purposes, such as being able to locate someone in need of rescue or to keep track of their loved ones in case of emergency.

*I myself use an app called my 360 to keep track of my location at all times for me and my girlfriend. It is very helpful, just in case something happens. It is just a safety thing. It gives you peace of mind for your safety.*—YA-6, location sharing

### 5.3 Older vs younger adults' reaction to the different modalities

We found contrasts between older and younger adults' engagement with the different education modalities, which resulted in large differences in their preferences for the various modalities.

Younger adults in our focus groups appreciated **interactivity** as a means to alleviate boredom that might creep up while paying attention to the education materials. According to their feedback, interactivity had a positive influence on their interest, and motivation to engage with the education interventions. For example, the developed chatbot modality was one of the most preferred modalities for younger adults, who considered it to be more interactive and attractive. The requirement to communicate with the chatbot not only kept them attentive but also made the materials more fun and engaging. They reported that this modality also provided them with control over the flow of the educational materials, which many younger adults mentioned they appreciated.

*This looks lively and kind of interactive* —YA-10, chatbot

On the contrary, the same interactive modalities were the least preferred by the older adults in our focus groups. For example, they struggled to communicate with the chatbot, as they had difficulties determining the right questions to ask. Although some older adults liked the idea of interactivity as a means to accomplish tasks faster, and they were eager to know the process behind these interactive modalities, they ultimately preferred to interact with a real person rather than a machine.

*I want a real person, chatbots are fast and finish the tasks fast but they do not teach me the detailed information.* —OA-23, chatbot

*Chatbots do not answer the question, instead they asked another question. Depends on what you are asking.* —OA-25, chatbot

Furthermore, the interactive tutorial incorporated various interactive features, and received similar responses from both younger and older adults. Although younger adults found the tutorial to be attractive, engaging and helpful, older adults reported experiencing some difficulty with navigation and becoming disoriented within the tutorial.

*I think it is very user friendly and it is better than reading only text so it is very attractive.* —YA-11, attractive

*It is very attractive.* —YA-7, attractive

*It may be distracting and might lose your train of thoughts.* —OA-23, distracting

For younger adults, **visual elements** played an important role to draw their attention. For instance, the younger adults in our study found the infographics clear and visually appealing. They also mentioned that this modality made the content easier to skim, which improved their ability to grasp the content rapidly.

*It is more visually appealing without being overwhelming or overstimulating. I also like the scrolling aspect, it is just really satisfying and engaging and it makes me want to look at it other than just the text version.*—YA-10, infographic, visually appealing

*It is a text but in a fun way, you feel more control.* —YA-6, infographic, visually appealing

In contrast, the older adults in our focus groups sometimes found the visually-rich modalities distracting. For example, contrary to the younger adults, they did not find the infographics engaging, since they did not prefer diagrams or other pictorial representations for learning. Also in contrast to younger adults, they found the infographics hard to understand and follow. Indeed, we found that older adults needed more time to understand the sequence of the presentation and to locate the important information in the infographics.

*I would react as far as age is concerned. The younger the age the quicker they can visualize and absorb it. The older you are, you want to know as much information as possible in your language and your understanding. So depends on the audience that you are directing as far as which of these would be the best. Well, being older is the most outlandish and yet possible. If I were a high school kid, I would probably do it in five seconds. Whatever you says they saved immediately.* —OA-21, infographics, very hard

Another difference between older and younger adults was their opinion regarding the video modality. Most older adults expressed a preference for the video modality over the other modalities. They found the video to be clear, simple, and easy to understand and follow. As a result, they believed that this modality was more effective than the others in conveying the educational materials. Furthermore, the presence of a person who is talking and explaining the scenario in the video makes them feel that this modality is more **personable**. This aligns with the observation in Section 5.1 that older adults often asked for help from younger adults. Our video modality imitates how a younger adult would show them step-by-step instructions in real life (or would even show them a video with instructions). The personable nature of the videos made older adults feel that they can better relate to—and thus understand more about—the topic presented in the scenario.

*In the video there is a person talking and explaining it. The person, it seems more personal.* —OA-4, personability

*It is just easier to watch someone else doing the task step by step.* —OA-2, personability

*I think it is good to see a person's face and makes it more relatable.* —OA-9, feel relatable

*I like the person who talks. It seems personable.* —OA-3, personability

*Yeah, and having a human face there rather than an off-camera voice I think is helpful.* — OA-32, feel relatable

Younger adults in our focus groups, on the contrary, reported that the video was too slow, not engaging, and a waste of their time. They expressed a preference for modalities that allowed them to consume content at their own pace, rather than being dictated by the narrator’s pace.

*I would never use something like this. I can basically read faster than the voice is going [...] I think it is a bit time wasting.* — YA-9, waste of time

*Obviously, the videos have been too long, I have a really hard time just sitting there like watching* — YA-10, not engaging

*The video is not keeping me engaged, because it is slow and too long* — YA-10, not engaging

Although we designed a comic to also have visual appeal, both older and younger adults in our focus groups found the flow of the comic confusing.

*That is confusing in this way of showing it to us.* — OA-32, comic, confusing

*I am not sure which way to move. The illustrations look like low budget.* — YA-19, low quality

Another distinction we observed between generations was the need for **content depth**. To prevent potential boredom, the younger adults in our focus groups wanted the education interventions to be concise and straightforward, with no unnecessary details. In contrast, the older adults in our focus groups preferred a slower pace with clear, simple examples. They also expressed a desire to go into more depth, as they were curious to know about the default and recommended options, and the reasons behind certain recommendations. For instance, one of the older adult interviewees mentioned that the scenarios were presented “at the level where I could follow everything. You could do even more, to know why. But a lot of younger adults I work with don’t want to know why. They just want to know the answer.” The ability to repeat certain instructions (as was possible in several of the modalities—either explicitly or implicitly) was also mentioned as being very important for older adults.

*I do not understand it because I just did not know how to use it, spending more time with it be helpful or having more explanation as my grandchildren do.* — OA-23, repetition and ability to go back

*You might lose your train of thought. This way it gives you smaller bits of information and you can think about that before you go on. But I like the idea that you can also go back [...].* — OA-24, repetition and ability to go back

Furthermore, we find that **the appeal of text** differed per participant, but this difference was not related to age. In our focus groups, there were both older and younger adults who exhibited a strong preference for the text modality. While many participants had a preferred modality other than text, some expressed a higher comfort level in learning about privacy through text than any other modality. These individuals argued that the text was clear, simple, and easy to understand.

*It would be much quicker and more efficient just to read something.* — YA-18, appeal of text

*I like the text the most because it is easier to follow* — OA-25, appeal of text

Finally, we found that **the audio modality was consistently the least preferred** by almost all participants of our focus groups, regardless of age. Participants indicated that it was less engaging and more challenging to follow. During the presentation of this modality, we observed participants quickly becoming bored and losing concentration.

*Audio is not as engaging, you know, it is harder to follow.* — OA-5, audio, hard to follow

*I like what we were doing with text. What could you do to stop it and we do not lose it. With the voice you stop it, you lose everything.* — OA-24, audio, lose concentration and get lost

*I think you can get lost* — YA-8, audio, lose concentration and get lost

*For me concentrating at audio and just audio is difficult* — YA-13, audio, lose concentration and get lost

*I just like do not have to listen and pause to do it. That would irritate me.* — YA-12, audio, irritating

*frustrating and inefficient and boring* — YA-14, audio, inefficient (*The audio modality is*)

Note, though, that a few older adults preferred the audio modality because their vision problems made them depend more on hearing than on vision.

*because I have wet eyes* — OA-22, audio, like (*I like the audio modality*)

*I need all the help I can get to hear every bit.* — OA-21, audio, like

Some of the modalities, for instance video, were somewhat effective in conveying information and affecting the actual behavior of older adults.

*Very helpful, let me know even some information about what to do in this situation.* — OA-7, video, helpful

*I appreciate that. I understand what cookies are and stuff but knowing exactly benefits risks, what it is, is helpful for me to make a decision then.* — OA-32, video, helpful

## 6 DISCUSSION AND DESIGN IMPLICATIONS

While a significant portion of existing research concentrates on privacy decision-making and policies concerning older adults [22, 35, 63], there seems to be an insufficient focus on how to educate this demographic on utilizing privacy features and protecting themselves, as well as understanding their responses to various teaching interventions. Consequently, it’s crucial to extend our studies to include privacy education specifically tailored for older adults, considering the unique requirements this group may have.

In our study, we emphasized the delivery and effective communication of educational material to older adults, alongside a comparative analysis with methods used for younger adults. Our qualitative analysis of the focus group recordings reveals interesting differences between older and younger adults in terms of their

perceptions and approaches to digital privacy, their engagement with our education scenarios, and their preferred learning modalities. These insights hold substantial potential for shaping tailored educational materials within the scope of social media and digital privacy.

In the discussion section, we reflect on these findings, providing insights for the design of future privacy education initiatives. We present a set of design guidelines for privacy communication and education, which, though derived from our specific scenarios and modalities, have wider applicability based on our qualitative understanding of why older and younger adults favor specific modalities. This nuanced understanding could only have been achieved through a qualitative research approach.

### 6.1 Perceptions and approaches to digital privacy (RQ1)

Younger adults often display substantial confidence in their ability to comprehend and control privacy settings on social media [4]. However, the spotlight should shine brightly on older adults, who bring a diverse range of knowledge to this domain. It's not about a deficit in knowledge, but about the degree of self-efficacy as highlighted by older adults in our focus group study. Some older adults may not feel fully confident in their ability to manage online privacy or to acquire the necessary skills, a fact that's in harmony with existing research [7, 22, 54, 71, 80]. When using online services, older adults display varied levels of trust and often exhibit increased concerns around privacy. These concerns might lead some older adults to reduce their interaction with social media platforms, or even leave these platforms entirely. While this might inadvertently augment the generational digital divide due to social disenfranchisement [58], it's crucial to highlight that many older adults remain actively engaged with social media platforms. Nevertheless, many older adults are successfully engaging with social media and maintaining their online privacy, often with the support of family members and peers – a point consistently emphasized by participants in our study. This aligns with studies highlighting intergenerational learning, where younger individuals act as mentors to older ones in the domain of internet and technology [11, 43]. Furthermore, research shows that older adults often prefer learning from familiar sources like spouses, children, grandchildren, neighbors, and friends. It's these supportive relationships that can help foster greater digital engagement and online safety among older adults [52].

### 6.2 Responses to various privacy education scenarios (RQ2)

When engaging with our educational scenarios, we noticed some unique perspectives between the age groups. Both older and younger adults acknowledged the threat posed by publicly shared personal information and targeted online advertising. However, older adults perceived a significantly higher threat from online transaction fraud, whereas younger adults considered it less of a concern.

### 6.3 Preferences in Various Digital Privacy Modalities (RQ3)

Our participants exhibited distinct levels of engagement with various educational modalities. Audio presentations posed a challenge for most participants; however, older adults found videos to be quite engaging. The affinity of older adults for video modality aligns with findings from Hetzner et al., suggesting that older adults greatly benefit from a learning experience enriched with personal connection [33]. Similarly, Graham et al. have shown that personalized digital coaching programs enhance the engagement of older adults [27]. This underscores the relevance of a personal touch in the design and delivery of e-learning programs aimed at this demographic. It's noteworthy that our videos didn't resonate as well with the younger generation. Today's younger adults tend to favor shorter, concise videos that demand less attention span. Our attempts to truncate the video length didn't seem to align with the rapid consumption pace set by platforms like TikTok, which showcases extremely brief content [74].

Privacy explanations that are detailed enough to be informative often run the risk of being too elaborate or extensive for the average reader's attention span. As noted by Nissenbaum, privacy notices that are detailed enough to influence privacy decisions often exceed the readability comfort zone for many, owing to their length and complexity [56].

Our findings reflect a common transparency paradox: young adults indeed enjoy videos, but they prefer exceptionally short ones. Our videos, while shorter than traditional formats, couldn't be condensed to the extent of a TikTok clip without losing essential information. Hence, the apparent contradiction arises: despite being part of the 'video generation,' younger adults found our videos less appealing. This highlights the delicate balance we must strive for between brevity and comprehensiveness when developing educational content for younger audiences.

Meanwhile, younger participants gravitated more towards chatbots and infographics, appreciating their visual appeal and interactive nature. While these modalities didn't resonate as well with the older group, it doesn't imply an inherent limitation, but rather points to a difference in preference that can guide the design of educational interventions.

Interestingly, both groups found the text-based modality appealing, albeit for unique reasons. Younger adults appreciated the ease with which they could skim for important details, while older adults valued the ability to learn at their own pace and revisit information as needed. This observation is consistent with Murman's research [53], which emphasizes the need for learning modalities that offer flexibility and accommodate the slower pace of learning often preferred by older adults. Furthermore, this corresponds with the Speed of Processing theory of aging, suggesting that as cognitive processes decelerate with age, older adults often benefit from setting their own pace to maximize their learning [34, 65].

As we move forward, these insights should inform the design and delivery of educational interventions across different age groups, offering a more personalized, inclusive, and effective learning experience.

## 6.4 Design Guidelines for Privacy Education Interventions

Our study underscores the necessity of accommodating the distinct preferences of different generations when designing privacy education interventions. Tailoring the learning experience to the needs of both older and younger adults is essential for fostering engagement and efficacy.

We extensively investigated the effects of various modalities for presenting privacy-related content and how they influence learning outcomes. Designers of education materials who aim to optimally support older adults should create materials that contain personal, animated presentations that are neither highly interactive nor excessively visual. Such a format allows older adults to sustain focus and comprehension. Designers should also prioritize the significance of providing detailed explanations and incorporating the option to revisit specific sections in education materials.

On the other hand, education materials that target younger adults should be designed to be interactive and visually dynamic. The option to navigate through content at will and the availability of a chatbot assistant to address queries are highly recommended.

To design educational content that resonates with all age groups, we identify a potential for unifying their divergent needs through an interactive video presentation. This module would start with an on screen human offering a warm welcome and introducing the scenario, a personal touch favorably received by older adults. The presenter would provide shortcuts to specific content sections, catering to the younger audience's interactive preferences. The module will offer the flexibility to revisit specific segments or explore deeper details, providing older adults with the opportunity to tailor their learning pace to their preferences. The module would conclude with a chatbot that can answer specific inquiries and offer additional information or repetition enhancing interactivity for younger adults and offering depth for older ones.

We propose that such an interactive video presentation would strike a balance between older and younger adults' preferences. It delivers necessary information while simultaneously offering a customizable learning experience, making it a promising approach for privacy education interventions across generational divides.

## 7 LIMITATIONS AND FUTURE RESEARCH

In this section we discuss the limitations of our research and propose suggestions for addressing them in future work. This study was conducted with older and younger adults who all live in the same rural area in one of the southern United States. We conducted the study in a rural area because research shows that rural older adults may face greater challenges with both social isolation and support for privacy management [29]—this allowed us to test the education interventions in a more challenging environment. Given that rural and urban older adults have different lifestyles and challenges, our findings may not be generalizable to urban populations. Future research should include a more diverse sample from both rural and urban areas.

Another limitation is that our sample of younger and older adults is comparatively more highly educated, with around 87% of our participants holding or in the process of getting graduate degrees.

Future work should focus on having participants with different levels of education, to test whether our interventions suit individuals with lower levels of education and technology skills, or whether such users would require interventions that are specifically designed for them.

Another limitation arises from our chosen methodology. We selected a focus group approach based on its proven effectiveness in gathering specific insights from older adults. This format encourages the exchange and development of ideas through interactive discussions. However, it's important to note that this approach carries certain drawbacks. For instance, participants engaging in discussions with one another might introduce influences into their opinions, particularly when addressing questions such as preferred modalities. To counter this potential influence, an alternative qualitative method like one-on-one interviews could be considered.

Furthermore, our selection of the text version as the baseline was deliberate. This choice offered a foundational point of comparison for participants to assess the other presented modalities. Since the text condition consistently took precedence and was introduced first, it might cause an inherent ordering effect.

Finally, while our study design allowed us to get an in-depth qualitative understanding of participants' perceptions of and engagement with the various scenarios and modalities, it did not allow us to test which of the privacy education interventions most effectively increased participants' objective understanding of the privacy scenarios and the associated interventions. For this, one would have to conduct a controlled experiment to quantitatively compare the effect of digital privacy education interventions on older adults' objective (and perceived) learning. Such a study could also verify our findings regarding the usability and user experience of these interventions across multiple age groups in a quantitative manner.

## 8 CONCLUSION

In this paper, we explored the design and implementation of digital privacy education interventions to promote privacy autonomy among older adults, and studied the perceptions and responses of older and younger generations to the designed interventions in a series of focus group sessions. Our results indicate that older adults perceive and react to these interventions differently than younger adults—arguably due to differences in cognitive functioning, preferences, and level of experience and familiarity. The findings highlight the importance of specifically addressing the privacy education needs of older adults, but also suggest that an intervention that includes a combination of interactive video, animated presentations, and personalized (agent-based) support might be suitable for both older and younger individuals. These findings present an important step in our quest to democratize privacy by developing privacy education interventions for a broader audience of learners.

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## A FOCUS GROUP SCRIPT

### (1) Meeting Purpose:

- (a) The purpose of this focus group is to improve our digital privacy learning materials and study design based on your feedback. There are many benefits to using Internet websites and platforms like social media and online shopping. But, sometimes using these websites can pose risks to a person's privacy, and so we are trying to develop materials to help people across the lifespan understand how to protect their digital privacy. We want the materials we use and the findings from the study we launch using these materials to be as impactful, engaging, and clear as possible, and so we need your feedback in order to accomplish that.
- (b) Today I am going to show you two different online scenarios that are specific to the Facebook app that involve both benefits and risks to one's privacy. For each scenario, I will then show you the materials we've developed like videos, audio clips, comics, and chatbots to help people protect their privacy in these scenarios. We want to know your opinion on all of them. So, you'll share your opinion on what you like and dislike about each learning tool, what might be unclear, and then other comments you have on how to improve them.
- (c) So, today we really want to hear from you. Your input is critical to help us refine these materials. The more feedback you have, the more it will help us.
- (d) A couple of things to note: Firstly, there are some pics that we will show that may be different depending on whether you have an iPhone or Android. So, some of the pics you will see in this focus group may be different from your phone.
- (e) Secondly, this focus is being audio-recorded, so please refrain from using each other's names for privacy purposes. If a name is said, we will redact it from the recording. The recording will not be shared with anyone except the research team.

### (2) Scenario 1

- (a) Read/Show just the scenario:
  - (i) Have you or anyone you know encountered a situation like this before?
  - (ii) If yes, what happened?
  - (iii) Is this a situation you are concerned about?
  - (iv) Is there anything unclear about this scenario?
  - (v) What would you do in this situation?

- (b) Show risks/benefits:
    - (i) What are your initial thoughts on the risk and benefits?
    - (ii) Follow-up:
      - (A) what do you like?
      - (B) What do you dislike?
      - (C) Is anything unclear?
  - (c) Show protection strategies:
    - (i) What are your initial thoughts on the tips to protect one's digital privacy in this situation?
    - (ii) Follow-up:
      - (A) what do you like?
      - (B) What do you dislike?
      - (C) Is anything unclear?
  - (d) Show Modality 1
    - (i) What do you like about this learning presentation? What don't you like? What is one thing you would do to improve it? Do you like or dislike this presentation more than the text (if yes, why)?
    - (ii) Follow-up: Do you find it useful (what part(s))?
  - (e) Show Modality 2
    - (i) What do you like about this learning presentation?
    - (ii) What don't you like?
    - (iii) What is one thing you would do to improve it?
  - (f) Which of these 3 learning presentations did you like the best? Why?
  - (g) Which of these 3 learning presentations do you like the least? Why?
- (3) Repeat Steps (b) – (g) for one other scenario
- (4) Follow-up prompts:
- (a) Can you say more about that?
  - (b) If one person likes something, ask the others: what did you think about that? Did you also like this?

## B QUALITATIVE ANALYSIS SUMMARY

Theme	Categories	Quotes
Perception and approaches to digital privacy among older vs. younger adults	privacy concerns	I am also concerned that if I click down in enable sharing they getting my location, my visa card, my debit card and my social security.
	lack of knowledge	So I do not know enough to do all that and I have to depend on others.
	low self-efficacy	I keep wondering when are we ever gonna get smart enough to realize that doing to us because they keep getting better that you know.
	lack of confidence	I feel like I'm in kindergarten with this computer basis.
	past experience	This happens a lot. Sitting with family or friends, talk to you about something and then someone will go online and see an ad directly targeted.
	don't interact (post, share, comment) but observe	Using the Internet now I'm using it; I'm not the perpetrator. I'm the receiver
	getting assistance from the younger generation	Well, I have to admit that like taking care of protecting my computers in the hands of one of my granddaughter, Cracker Jack, I'm checking to see anything you want.
	Confidence	I know that if I want to find something quite cheaper or if I'm looking for something and I can't find just by my own searching, I know that they've always suggested something on my social media or like, I get emails and stuff like that. And so I feel like I can use it to my advantage too.
	suggest solutions to avoid privacy-related issues	On my laptop, I have a ad blocker so I don't care about the cookies.
	default	I do very low settings. I stay with the default.
Insights about older vs younger adults reaction to modalities (In general)	interactivity (engagement)	This looks lively and kind of interactive
	bored	I'm so bored to read a whole long page.
	Confusion	it might confuse somebody, especially if they have to review a link every time
	Enjoyment	actually, really enjoy the content of this one because they also underlining
	Dislike	I actually don't like it. I think it looks really disorganized. It's like too busy. Yeah, there's too much stuff going on. It's not lined up.
	More control	You feel more control
	Pay attention	The younger the age The quicker they can visualize and absorb it. The older you are, you want to know as much information as possible in your language and your understanding.
	Unclear	If we can, if they can explain it more like for younger people. Since they're more familiar with social media and everything. They might know the risks compared to the older people. So if you can, like explain risk much more. In a better way
	Don't trust	The question that I asked. They don't have an answer for okay. I'm not asking the right questions, I guess but I don't know what the right question.
	Didn't learn anything new	I didn't feel like both of them were too much information for me, but I could also see how it could be.
	Likability	I also liked the text (over audio) because it showed you like the other like, all the different options to not only I know what the graphics it said, like you can just change it to only me. I kind of liked to see all those options because I don't use Facebook so I just learned something about that.
	Easy to understand and follow	were for easier to follow.

Insights about older vs younger adults reaction to modalities (In video)	Enjoy	I enjoy like watching videos.
	Easy to understand and follow	It's just like easier to watch someone else also do it.
	Effective	On its own it's been effective, because while you're going to see what you're doing.
	Dislike	I would never use something like this. I mean I can basically like read faster than your voice is going and I know you have to use like a clear voice for everyone to understand. Or like I think it's a bit time wasting.
	Waste of time	I would never use something like this. I mean I can basically like read faster than your voice is going and I know you have to use like a clear voice for everyone to understand. Or like I think it's a bit time wasting.
	Not engaging	The video is not keeping me engaging, because it is slow and too long.
	Helpful	would be very helpful for me and for older adults.
	Engaging	I think it was engaging.
Insights about older vs younger adults reaction to modalities (Interactive Tutorial)	Feel relatable	I think it's good to see a person's face and makes it more relatable.
	Interactive and engaging	When you access a website and you get the tutorial every day we do it like interactive is kind of like a PowerPoint that you can press Next.
	Attractive	It's very attractive.
	Useful	I think it's useful.
	Distracting	Might lose your train of thought because this way gives you smaller bits of information.
	Easy to follow and focus	This is easier for me to focus.
Insights about older vs younger adults reaction to modalities (audio)	Not engaging	Hard to engage in
	Overwhelmed with info	It's a bit like too much.
	Hard to follow	It's very hard to follow.
	Lose concentration and get lost	I think you can get lost
	Irritating (Frustrating)	I just like don't have to listen and pause to do it. That would irritate me.
	Inefficient	Frustrating and inefficient
	Boring	It is boring.
	Like	I think I got more to this than I did the other two. As I listen to NPR. I listen to BBC.
Insights about older vs younger adults reaction to modalities (chatbot)	Clear	Quick and clear. I like it
	Quick	easier, faster, less time involved
	Not engaging	this is just somebody perspective I could it's not potentially as engaging
	Feel more control	you feel more control
	Limited control	I think that the chat interface you use some control is very sequential steps if you want to go backwards I don't know that you're able to now can't go back into chat know what did you can ask the question again,
	Interactive	kind of interactive
	Likability	I actually really, really like this.
	Too long	still a lot of reading
Insights about older vs younger adults reaction to modalities (infographic)	Annoying	kind of bothered me that all of that was just so much stuff
	Very hard	by far the most cumbersome hardest way to read something because I don't take even at the whole screen to look at
	Very hard	The hardest to kind of all
	Difficult to follow	i've got a lot of scrolling down i'm not remember what steps would you rather region by foot type fine find this the most difficult gotcha that's a lot of flipping back and there's a lot of flipping back and forth yeah.
	Confusing	There are too many colors, that's confusing.
	Clear	I thought it was much more clear, the graphics helped me.
	Engaging	I think one of the main reasons why I prefer this is that it's like more engaging

Chaotic	Visually appealing	It's more visually appealing without being overwhelming or overstimulating, but also like I like the scrolling aspect like it's just really satisfying and engaging and like it makes me want to look at it other than just like the other page.
	Disorganized	The flow of it is disorganized and chaotic
	It's like too busy. Yeah, there's too much stuff going on. It's not lined up	
Insights about older vs younger adults reaction to modalities (comic)	Too many words	There's too many words
	Confusing	I'm not sure which way to move. You know, the first one seemed to have a couple of cross here that you had one that was here, you know, so, so just as I if you know if it's a web if it's a PowerPoint that I'm clicking through, then I go to each screen, but I'm not sure again I see the real break between page to page to page and then I think so clearly what I'm looking at,
	Hard to read	too small
	Clear	I think it's genuinely clear and I think it's still straight to the point.
	Low quality	Some picture not good

**C FIGURES**

The screenshots are examples from the different scenarios, the full text version of each scenario can be found in the supplementary materials.



Figure 2: Screenshot of the video developed for the first scenario.

# If you can not reach out to your friend, you have the following alternatives:

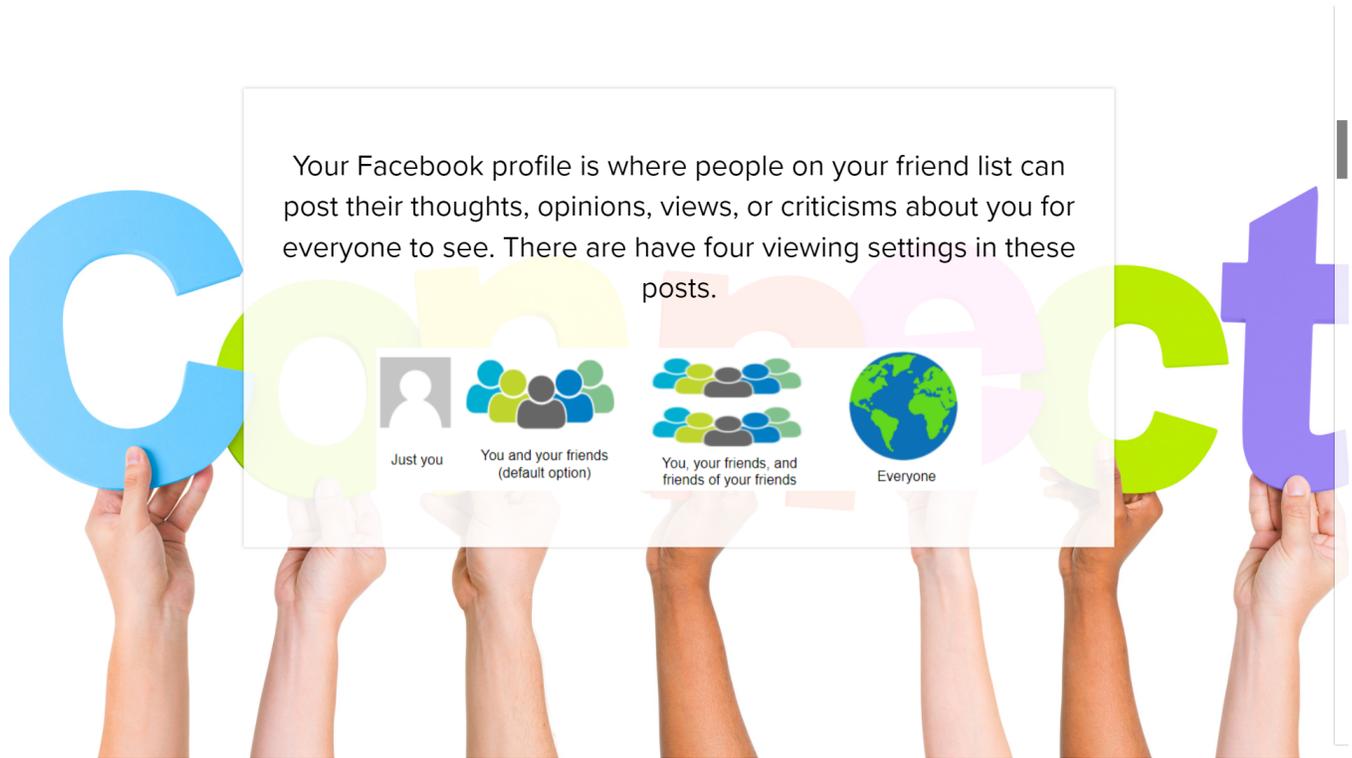
Choose one of the alternatives to start!

You have to explore all the alternatives to continue.

The screenshot displays four alternative actions in rounded rectangular boxes:

- 1- Remove the post altogether by clicking the three dots in the upper right-hand corner of the post** (green box with a checkmark icon below the text).
- 2- Change the settings so that only you can post to your own profile** (blue box).
- 3- Select the friends or group who can see your post.** (blue box).
- 4- Turn on tag/post reviews** (blue box).

**Figure 3: Screenshot of the interactive tutorial.**



**Figure 4: Screenshot of the infographic.**



Figure 5: Screenshot of the comics.

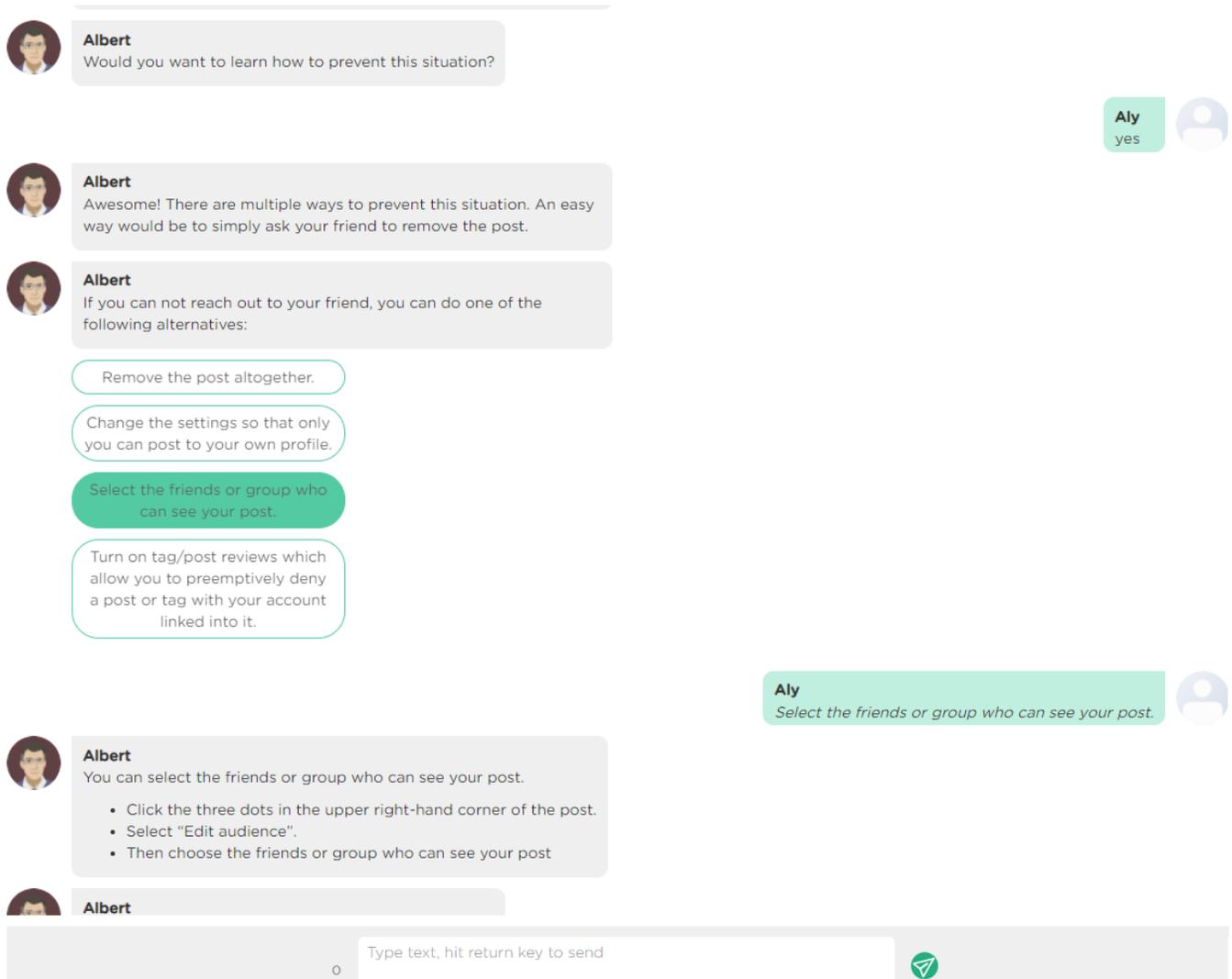


Figure 6: Screenshot of the chatbot.