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“Warn Them” or “Just Block Them”?: Investigating Privacy Concerns Among Older and Working Age Adults

Abstract: Prior work suggests that older adults are less aware of potential digital privacy risks compared to younger groups. We seek to expand on these findings by using drawmetrics with 20 older adults (60+) to visualize their experiences with digital privacy via drawing sessions. We further compared older adults with 20 adults of working age (18-59) with the goal of identifying both overlapping concerns and key differences that may be missed when viewing each group in isolation. We extended our evaluation with a survey with questions and themes derived from open-coding of the drawn images and confirmed three key differences between the age groups. These include older adults perceiving a greater threat from using online banking and e-commerce compared to working age adults, older adults exhibiting greater levels of concern about global scale threats, and working age adults showing more privacy-related concern regarding social media. Our findings can be used to potentially tailor applications to better accommodate privacy concerns for older adults.

Keywords: Older Adults, Privacy, Internet

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1 Introduction

While researchers have examined privacy among a wide range of users [1, 28, 38, 44], there has been less focus on the perceptions of older adults, whose attitudes towards privacy may differ from their younger counterparts [35]. Older adults present an interesting popula-

tion from the perspective of privacy for a number of reasons. While known to contribute to and gain from technological advancement, older adults have been found to be more disconnected from information and communication technologies compared to individuals in other age groups [34]. Researchers also suggest that technology exposure and education varies by age group [22]. As a population, older adults are also known to be less informed of both possible online privacy violations and the protective measures they can take against those attacks [21]. This leads to negative outcomes, including victimization in scams and data breaches [8].

There is much to gain from studying the privacy and security concerns of older adult populations, such as determining requirements to better tailor interface design to the needs of this community [18] and developing stronger, more targeted security guidance [11]. However, there has been less effort in directly comparing the privacy beliefs and concerns between older and younger adults. Here, we focus on isolating these differences through the use of a *drawmetrics* approach (using picture-drawing sessions to understand mental models) [36]. Through a qualitative analysis of the drawings and discussion, we first present a reflection on the opinions of working age adults on older adults' perceptions. We then describe the design and deployment of a survey administered with a larger sample to validate our findings. We were able to find significant differences that could explain some differences between privacy models for older and working age adults.

In more detail, we describe two studies to explore the perceived privacy risks of *older* (60+) and *working age* (18-59) adults that follows a protocol loosely adapted from Oates et al. [30] where mental models were discerned via picture drawing sessions. We refer to the methods used in these sessions as drawmetrics, which relates to the phenomenon of reproducing an image. The first study involved interviews with both age groups, where participants were asked to represent their experiences diagrammatically and/or comment on others' drawings. Those drawings and discussions were analyzed qualitatively and new hypotheses were developed.

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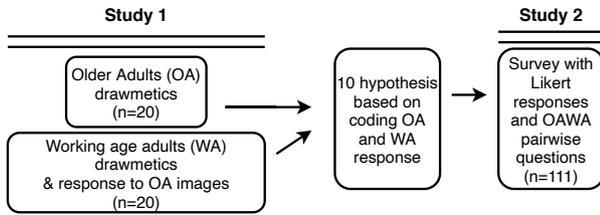


Fig. 1. Flowchart of the study design

The second study was conducted online with a larger sample of individuals from both age groups. In this study, we tested the hypotheses through a set of Likert responses, as well as having participants select between carefully chosen pairs of images diagrammed in the first study (one from an older adult and one from a working age adult). A flowchart showing the procedure of these studies can be seen in Figure 1.

We identified several differences and similarities between the age groups, and overall the two groups share many of the same concerns. This included the desire among both groups to control the flow of their private information and the access others have to it. The groups differed, however, in that older adults were more concerned about worldwide access to information, providing private information to strangers, and showed particular concern for online business and mobile applications. In comparison, working age adults were more concerned about being unable to control the sharing of their private information on social media.

In summary, we make the following contributions:

- We show that there is a significant overlap in the characteristics of the two age groups, suggesting that these populations should not always be studied in isolation.
- We find that older adults express greater concern about global-scale privacy threats, specifically from online businesses or mobile applications, and that older adults were against providing private information to strangers even while implementing protective measures;
- We find that working age adults express greater levels of concern about their inability to control the dissemination of their private information through social media, and feel resigned when dealing with privacy threats, specifically third-parties and companies selling their private information.
- We present emergent themes that encapsulate the main viewpoints of older adults that can be used to improve design and guidance for this community.

2 Related Work

Online Threats and Privacy Attacks. Threats to privacy and technology users’ related attitudes have been researched from numerous perspectives [6, 16, 23, 33, 43]. For example, Grimes et al. [16] examined perceptions of spam email, identifying age as a significant predictor of attitude. Older adults are also less likely to engage in online activities [6, 13] compared with other groups because of apparent barriers to engaging with Internet services. These barriers are usually in the form of inaccessible technologies, which hinder their ability to interact with devices efficiently. Hill et al. [19] examined the ways in which digital technology can be used to enhance the life activities of older adults by increasing their social network. While technology offers considerable promise to older adults, threats to privacy and security can cause challenges. Researchers have identified susceptibility among the community towards targeted phishing attacks [24] by determining possible effects of age and email content as persuasive techniques. Das et al. [5] investigated the user experience of two-factor authentication among older adults of ages above 60 and found that users did not understand the risk implications of certain privacy attacks (such as a compromised email account). Elueze et al. [7] found that spam, unauthorized access to personal information, and information misuse were the most pressing issues for older adults regarding online privacy. Frik et al. [10] highlighted that older adults expressed a desire for control over their personal information and data flows.

The Importance of Mental Models. In terms of identifying mental models relating to privacy and security among older adults, Wu et al. [43] and Schomakers et al. [33] examined issues relating to privacy protection and encryption, suggesting that mental models are a “driving force” in the user-centered design process and have important design implications. Spero et al. [36] successfully implemented drawmetric methods to examine mental models related to malware and regular software, showing clear distinctions between the two on the basis of control and risk. This reinforces our motivation for using mental models for privacy perceptions.

Older Adults’ Online Activities and Behaviors. To understand older adults’ online behaviors, Nurgalieva et al. [29] and Madden et al. [25] focused specifically on examining online activity of older adults, showing that older adults’ lack of awareness and knowledge

of online privacy results in the unintentional distribution of personal information. Prior work also describes the impact of various dimensions of digital literacy on online behaviors related to privacy [31]. Turow et al. [39] concluded that adults over the age of 65 show ignorance and fear, as well as naivety and idealism, regarding their private information when engaging in online activities. Grimes et al. [15] proposed design suggestions to address issues causing frustration among users (e.g., presence of spam), which can better support older adult users. Community-based approaches by Wan et al. [41] and Mendel et al. [27] explored how close social contacts can assist older adults with privacy and security management on their mobile devices, and the assistance providers’ motivations, contexts and procedures in doing so.

Using the Internet as a Communication Tool.

Prior work has looked towards studying older adults’ usage of technology and the internet as a communication tool. Gatto et al. [12] studied the perceived benefits and barriers of using computers among older adults and found barriers linked to frustration, physical and mental limitations and issues with trust. Sum et al. [37] studied the effect of internet use on loneliness and a sense of community among older adults. The researchers found that greater use of the internet as a communication tool resulted in lower levels of loneliness among older adults and a higher positive effect on a sense of belonging to an online community. The impact of internet usage on loneliness and social contact among older adults was also studied by Cotten et al. [4] who reported that older adults felt that using the internet made it easier to reach people, meet new people, and increase the quality of communication with others and helped them feel more connected to friends and family.

Picture-Drawing Sessions. We loosely adopted the approach used by Oates et al. [30] to better understand privacy concerns via picture drawing sessions. While Oates et al. studied participants spanning different age groups, our study focuses *specifically* on older adults (60+), their specific mindset with respect to the concept of privacy, and how their beliefs differ from a younger demographic (18-59) on the basis of age. The reflection of working age adults on older adults’ images and examination through a larger sample, extends work by Ray et al. [32] who used drawmetrics to identify basic attitudes.

Older Adults’ Perceptions of Privacy. Our study is also closely related to work described by Frik et al.

[11], who elicited perceptions of privacy and security of older adults through a set of semi-structured interviews. The authors classified their findings using the pre-existing principle of Solove’s Taxonomy while focusing mainly on older adults, whereas our studies aim to offer new perspectives of differences between older adults and those of a younger demographic.

3 Methodology

In this section we describe the procedure of the initial study (Study 1), where we conducted interviews to explore privacy perceptions with both older adults and working age adults through diagramming exercises (drawmetrics), as well as the follow-up study (Study 2), where we used a survey instrument which was informed by themes and qualitative feedback that emerged from Study 1. The interviews in Study 1 were exploratory in nature, to understand a larger spectrum of privacy issues and concerns. Working age adults were selected, as this group offers an interesting point of comparison with older adults, and to further determine the impact of age factors on privacy perceptions. Researchers have well documented working age adults’ utilization of various technologies and diverse attitudes towards privacy and security [9, 28]. We recruited both older adults (60+) and working age adults (18-59) to participate in our study. We used closely-related methodologies with the working age and older adult participants, to collect data to support comparison of the two groups, with the objective of studying working age adults’ reflections upon illustrations drawn by older adults. The findings from Study 1 (see Table 4) were evaluated using a survey instrument used in Study 2. The survey consisted of Likert scale questions, followed by pairwise image comparisons of carefully selected image pairs drawn by our participants in Study 1.

3.1 Recruitment

For Study 1, we recruited 20 adults aged over 60 at a local state-operated senior center and 20 adults of working age (18-59) from public community venues (e.g., local libraries, universities) for purposes of the study. The senior center and public community venues were specifically targeted, as they were located in an area comprising of individuals from diverse socio-economic and educational backgrounds, attracting clients with varying

levels of technical and security knowledge. The study was advertised using recruitment flyers, which were positioned in public venues around the local area. Interviews lasted between 20-45 minutes, and participants received \$10 for their participation. We recruited 10 male and 10 female older adults with an average age of 68.5, and 10 male and 10 female working age adults with an average age of 32.4. Detailed demographics are provided in Table 1.

For Study 2, we conducted an online survey to broaden our participant pool. We recruited 111 participants (83 working age adults and 28 older adults), using a combination of mailing lists, flyers, and snowball sampling. The average age of the participants was 67.2 for older adults and 31.2 for younger adults. There were 38 male, 37 female, and 8 non-disclosing working age adults, and there were 17 female and 11 male older adults. Due to difficulties described above in recruiting older adults to perform a web-based survey, we conducted in-person sessions at two local senior centers. Older adult participants were guided through filling out the online survey questions using a tablet device. Each in-person study ran for an average of 10-20 minutes and participants were paid \$5 for their participation. More details on participant demographics can be found in Table 2.

3.2 Procedure

Older Adults Interview (Study 1). All the older adults, after providing informed consent, were interviewed by a researcher from the team and asked to draw an image representing their privacy risks.

We began by asking participants a series of demographic questions, as well as asking about their level of experience with technology and any identified disabilities (see Appendix A for full details). In the main part of the study, participants were prompted with a simple phrase: “what does privacy mean to you?” in both a digital and non-digital context. The question was intentionally open-ended to provide room for interpretation. Participants were then instructed to illustrate their response to the question and label or annotate the parts of the drawing. They were also asked to verbally describe both the visual elements of the drawing and their intent behind choosing the imagery. These drawmetric methods were used for data collection to effectively encapsulate their understandings, beliefs and concerns about the intangible and fairly abstract concept of privacy. We

asked each participant to produce two drawings (one in a digital context and the other non-digital), and if they were not comfortable or required assistance drawing, there were asked to explain what they envisioned to the researcher who would assist them. Participant approval was needed based upon diagrammatic representation developed by researchers. Participants’ thoughts and concerns were audio recorded and a total of 35 images were collected. Five participants did not wish to draw pictures or to describe visuals for the researchers to diagram.

After the drawing session, we asked follow-up questions to further gauge the older adults’ experiences with technology. This included questions about the participants’ online experiences, and their confidence in maintaining privacy in those actions. We also asked questions about their non-digital behavior in maintaining privacy, as well as if they had any past experiences with privacy violations. Finally, we asked them to envision how other groups, both older and working age, maintain their privacy both on- and offline.

Working Age Adults’ Reflections on Older Adult Images (Study 1).

The working age adults, after also providing informed consent, viewed the images previously developed by older adult participants, and described agreement and disagreement. Working age adults were also given an opportunity to draw images. As we were concerned with comparing working age and older adults, we wished to identify differences that we could use to build hypotheses for testing in Study 2. Working age adults completed similar tasks, with some additions aimed at understanding differences in concerns between the two age groups. First, the working age adults were shown ten images from the older adults that were carefully selected by the researchers based on thematic coding, and asked to freely offer their reaction and reflections to the content to support direct and specific comparison of the opinions of the two groups. The ten images selected for this purpose encapsulated the most prominent concerns and beliefs held by the older adult participants, as identified through thematic analysis. Two such examples of images included feeling personally targeted/frustrated by privacy invasion (Figure 2) and restrictions for maintaining privacy control (Figure 3). At no point were working age participants told that older adults had created these images. Every working age adult was shown the same set of ten drawings. The order was randomized for each participant to reduce the likelihood of an order effect.

Table 1. Study 1 Participant Information

	<i>n</i>	Avg. Age	Gender Distribution			Disabilities		IT Experience	
			Male	Female	Not Disc.	Yes	No	Yes	No
Working Age Adults	20	32	50%	50%	-	15%	85%	50%	50%
Older Adults	20	69	50%	50%	-	25%	75%	55%	45%

Table 2. Study 2 Participant Information

	<i>n</i>	Avg. Age	Gender Distribution			Disabilities		IT Experience	
			Male	Female	Not Disc.	Yes	No	Yes	No
Working Age Adults	83	31	46%	45%	9%	5%	95%	18%	82%
Older Adults	28	67	39%	61%	-	25%	75%	14%	86%

The working age adults were then directed to select the images that they related to the most, and those that they related to the least. These participants were asked to speak aloud through this process, which we recorded with permission, transcribed, and used in our analysis. From the subset of images that the working age participants most and least related to, we asked a series of follow up questions to better explain their choices, including pointing at and discussing specific aspects of each of the images. Finally, at the end of the session, we asked the working age participants to optionally draw their own image. Eleven working age adults provided images.

Survey Instrument using Likert Questions and Pairwise Image Comparisons (Study 2). The survey used in Study 2 was developed to test hypotheses derived directly from Study 1. This includes Likert response questions to compare five codes identified from the working age adults’ interviews, seven from the older adults’ interviews, four codes from the older adults’ illustrations, and four codes identified from analysis of the working age adults’ diagrams. The codes were represented in the form of 5-point Likert scales. For example, to verify whether older adults consider abandoning technology to protect their private information, we asked a question relating to frequency: “How often do you consider abandoning the use of mobile devices to safeguard your private information?” Open-ended questions were also asked regarding privacy protection measures. The set of Likert questions can be found in Appendix B, while responses are shown in Figure 8.

In addition to Likert response questions, participants were asked to review pairs of images from Study 1. Each image pairing was selected **based on thematic**

coding to contrast two thematically related illustrations depicting a personal view (i.e., mental model) of the meaning of privacy. Figure 7 shows one such example where the images contrast with respect to the concern of the distribution of private information online. Each pair (seven in total) was comprised of one drawing from an older adult and one by a working age adult. Participants were asked to select one image they most related to, or to select none if they did not relate to either. If participants indicated a relationship to an image, they were directed to identify the specific parts of the image to which they did or did not relate. The descriptions of the pairwise images are provided in Table 4 with responses, and the entire survey instrument is provided in Appendix B.

3.3 Limitations

Study 1. Since we did not attempt to completely replicate the procedures between age groups in Study 1, there are slight differences, specifically in the order of tasks. This was done in order to facilitate further responses from the working age adults on older adults images, but the working age adults were not informed of who drew the images. This opportunity provided direct reflections offered by working age adults that we could use to develop hypotheses for Study 2, but this also limited the working age adults images as they may have been primed. To mitigate this limitation, we focused more on the narrative and think-a-loud aspects when developing hypotheses for Study 2, rather than directly on the themes within the images. We elaborate on how these hypotheses were developed in Section 3.2.

Using drawmetrics offers considerable promise for eliciting perceptions of complex phenomena such as privacy. However, when used as a sole method of gathering data, it does not always succeed in providing awareness of the depth of issues faced by participants. Further probes and follow-up questions were required to connect the image drawn to privacy issues or concerns. Additionally, the intent behind the illustrations may not be conveyed completely either due to difficulties with drawing content, or drawing quirks of participants. These end up subject to the interpretation of the coders. Two illustrations were drawn by the researchers on behalf of the older adult participants due to some physical constraints or discomfort. The instructions provided to the researcher by the participant were fairly simple (“draw a box”, “draw an arrow pointing outwards”, “draw a stick figure”) and left little room for incorrect interpretation.

There is also a limitation in our choice to divide the population between 18-59 year-olds and 60+ year-olds. We chose a slightly younger age breakdown than what one may anecdotally expect as a definition of an older adult, but we argue that this division offers insights into our aging populations. Of course, even younger older-adults will age into older older-adults. Moreover, while we grouped older adult participants at 60+, the average age of older adult participants in Study 1 is 68.5 and 67.2 for Study 2. To further support our age distribution, the data exhibits a wide gap between age groups, as noted the average age for the working age adults is 31.2 and for the older adults is 67.2 (a gap of 36 years). Moreover, if we were to more strictly separate the groups by enforcing a 10 year age gap, only 5 participants in Study 2 fall between the ages of 50-59. Removing these 5 participants from the set of 83 working age adults would not significantly affect any conclusions. Furthermore, since this study was exploratory in nature, the sample size was deemed sufficient. While we did not use a scale to collect demographic information related to technical experience, we did collect participants’ self-reported background in I.T. There are limitations around our recruitment via snowball sampling and selecting areas around a university, including a public library and two senior centers (one from an urban area and the other from a suburban area).

We also do not report an IRR score since we conducted an exploratory analysis via independent open coding with two researchers resolving differences collaboratively until consensus was met. This identified emergent themes from Study 1 that we later validated as part of Study 2. While we do mention frequency of codes in parentheses in discussing these themes, we do not

argue that the findings hinge on frequency counts nor performed statistical analysis based on the qualitative data. We also do not use comparisons of the frequency of codes in the analysis. Support from these methods comes from McDonald et al.’s [26] discussion on inter-rater reliability.

Study 2. Using an online survey to evaluate mental models comes with some limitations. For one, there is no opportunity to ask follow-up questions. To address this issue, we provided a number of places for free-form responses and clarification. There were some limitations with respect to recruiting specific populations (e.g., such as older adults), who were less likely to participate in an online survey. To address this, we went to them to help assist in completing the survey (see Section 3.1).

Finally, in selecting our pairwise images we sought to find contrasts, but selections of images may be made based on other features that are non-contrasting. For example, a pair of images were chosen based on their contrasting portrayal of how private information can be leaked. The first image showed a mobile phone captioned, “Just having a phone leaks info,” with arrows pointing to family and friends. The second image showed multiple devices and was captioned, “Avenues through which hackers/privacy threats enter.” However, even though participants may be in stronger agreement that privacy can be leaked through multiple avenues, they may select the first image, relating more to the singular privacy risk of mobile phones. We attempted to mitigate this limitation by asking participants to identify the specific regions of the images to which they did or did not relate. Furthermore, the sample size for Study 2 is not large. However, 28 participants is still sufficient for drawing statistical conclusions. In a categorical power analysis, we should be able to detect large differences with a power of .75 (not considering that we have roughly 80 working age adults as part of our comparisons).

4 Findings

4.1 Findings for Older Adults (Study 1)

Visual constructs for privacy concepts. While reviewing the drawings and their descriptions, several types of common visual constructs became evident. These included different types of barriers for protecting privacy, such as padlocks and bathroom stalls, and mes-



Fig. 2. P01's drawing of their sense of digital privacy, captioned, "Woe is me in a digital privacy sense." It depicts her beset by privacy threats (e.g., criminals, her own vulnerable data, technology companies, etc.)



Fig. 3. P10's illustration of his frustration in dealing with spam emails, being forced to delete them repeatedly or resorting to cleaning up his computer or installing new antivirus software.

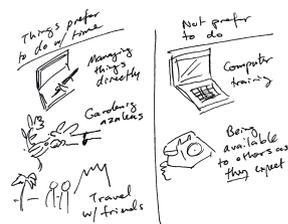


Fig. 4. P12's drawing of their sense of personal privacy, showing on the left-hand side, the interests they prefer (managing a checkbook, gardening, travel) separated from (on the right-hand side) tasks they wish to avoid (learning technology and answering sales calls).

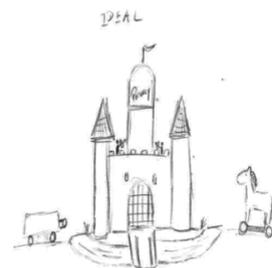


Fig. 5. "And then the castle just falls..." P27's drawing of their depiction of ideal privacy, showing a well-guarded castle with threats (battering ram and Trojan horse) waiting to strike.

saging devices for warning away interlopers such as stop signs. These constructs aligned with the findings from Oates et al. [30]. Participants drew shredders and delete buttons and also drew piles of documents to show their preference towards paper-based record keeping over untrustworthy online practices. They also vividly depicted the activities they preferred to do rather being occupied online, such as trimming azalea bushes in their garden (Figure 4).

Key Codes for Older Adults. Coding was completed independently by two members of the research team, with differences resolved collaboratively via consensus. The key axial codes that emerged included frustration and anger towards perceived privacy attacks (n=18), suspicion towards phone calls/emails when they are not from known sources (n=12), and barriers for privacy protection (n=17). Three participants also described avoiding technology as much as possible, as evasive practices were thought to be more manageable than dealing with the consequences of compromise. Other codes involve the equivocation experienced regarding privacy, such as identifying both legitimate or exploitative privacy invasions by society in general (n=6) or the positive and negative privacy implications of family members being involved with online interactions (n=6). This describes the perceived positive uses of private information in society (such as requesting personal health information in a medical setting), as opposed to negative uses of privacy invasions in society (such as fears related to "the government spying on the public").

Views of personal versus general privacy. One important distinction was whether drawings were meant to describe the *personal* feelings and experiences of the participant, or instead offering their view of how privacy functions in *society*. The comparison of this concern between individual privacy and society's privacy led to the development of Hypothesis H1 (Refer to Table 3). Perceptions of both of these features were mostly, but not exclusively, negative. P12 described her aversion to using web services for financial transactions, fearing she "might hit the wrong button and not be able to undo." Similarly, P06 stated,

"Lord knows what they have [personal data held by third parties]... who knows how they got it."

In contrast, other participants described positive feelings towards facets of online interaction, noting easier family communication (n=5) and access to information. P19 contrasted the "joy" he felt when he first accessed online libraries, with his "sense of real fear" that his personal information could be compromised online.

4.2 Findings for Working Age Adults (Study 1)

Of the images provided by the working age adults, imagery included different types of barriers for protecting privacy, such as "Do Not Disturb" signs and detailed flowcharts with guidelines. Participants also drew various devices to show avenues through which violators can attack private data. In order to convey acceptable

levels of privacy, a beaker with measuring lines was represented to symbolize varying levels of privacy threats and their consequences. Lower levels of content in the beaker were explained to be equivalent to false advertisements on websites, whereas higher levels were considered to be equivalent to credit card fraud. In response to privacy violations, methods of attack were also represented (e.g., spying using webcams, attacks spanning the globe, and searching mailboxes and trashcans).

A coding strategy was used for the working age adult images and verbal responses that was very similar to that used with the older adult content, and a range of codes were identified independently by the two researchers. After discussion of codes to reach consensus, key codes were formulated. These included issues surrounding privacy threats, which involved widespread usage of mobile devices accompanied by in-depth concerns such as the various methods and media used by privacy invaders. Others described their beliefs and opinions of what constitutes an “ideal world” of privacy (n=2), depictions of the level of threats which can occur (n=4), the global scale of potential threats to privacy (n=2), and methods to protect themselves from privacy attacks (n=3).

Working Age Adults’ Views on Privacy Risks.

One of the distinctions found within the mental models for working age adults was the increased awareness of various types, methods and consequences of privacy attacks. P22 described various ‘levels of deception’ stating,

“It is more important to increase awareness for higher-level threats like credit card fraud. At lower levels, you know that you aren’t gonna win a free iPhone from those online ads.”

Working age adults also expressed feeling resigned that attacks are going to occur and are challenging to stop. From P26:

“But they [corporations] are not evil. My emotion would be frustration more than depression or anger. I feel resigned and I pretty much accept it at this point.”

When asked about attitudes towards sharing online information, three working age adults expressed concerns regarding practices employed by organizations who store data from transactions,

“My [personal] info should be between me and the business. But unauthorized people can get my info. They [Businesses] can just give [or] sell info to these people. Just like that.”

Views of Ideal Privacy. Three participants visualized ideal levels of privacy as having control over their environment. P27 described that a castle would be able to keep others out (Figure 5). However, he was aware that no solution was perfect.

“This is ideal-ish privacy. But even though it is a castle, it can be breached by a battering ram or like a Trojan horse if given the time. If the guards are not paying attention, the ram and horse can break in. And then the castle just falls.”

Related discussions with other participants (P07, P34), lead us to believe that some individuals feel that ideal levels of privacy cannot be achieved if it includes a large number of people, similar to classical definitions of privacy, e.g., from Westin [42].

Working Age Adults’ Views on Older Adults’ Images.

The opinions held by working age adults clearly differed in several respects from those held by the older adult group. Four working age participants suggested that humans are dependent on phones and prefer convenience. Even if privacy attacks occur, they are aware of what needs to be done. Other older adults, on the other hand, mentioned that they would rather not learn how to use smartphones and online banking and that privacy threats can come from anywhere at any time (n=2). This strongly indicates that concern towards privacy compromise contributes to some older adults’ fear and avoidance of technologies. This conclusion is reinforced by older adults who mentioned wanting to never share their private data with anyone with whom they were unfamiliar, even if they had safeguards in place. The identification of this theme led to the development of Hypothesis H3 (Refer to Table 3). They expressed their disinterest in using “that stuff [new technology].” Most working age adults strongly opposed this view, however, saying that avoiding technology is just running away from the problem (n=11). Older adults’ higher inclination towards abandoning the use of technology led to the development of Hypothesis H2 (Refer to Table 3).

Working Age Adults’ Accommodations of Privacy Risks.

We identified that more practical measures were adopted to prevent infringements of privacy. For example, when targeted by phone scammers, most working age adults did not feel the need to get angry and instead highlighted that they “block them [unrecognized numbers by Caller ID]” (n=12). Some older adults felt more targeted and frustrated by it, and stated that they “just warn them [their family members]” to be wary of

the threat (n=4). Online personas (such as friends on Facebook) were only considered as “technology friends” by a few working age adults and were not provided with any personal information by them (n=2). A number of older adults, however, did divulge personal information with their friends on social media but wished for more control over who had access to it (n=4).

Some older adults mentioned that they would like to give access to their family and friends for practical reasons (e.g., receiving help if sick, etc.) (n=3). However, unknown parties or those outside family/friend circles could not be trusted. Most working age adults were a bit more skeptical, and were against giving personal information to anyone at all (n=9). A few older adults trusted identity theft protection services and believed themselves to be safe from threats as long as they had similar safeguards in place (n=3). A majority of working age adults felt this to be naive and firmly expressed that they would never give any personal information to anyone, especially over the phone, irrespective of any subscribed protection services (n=16).

When asked about an ideal world of privacy, an older adult visualized a world of doors that can be opened or closed with the keys they possess, giving them freedom and control (n=1). Some working age adults were, once again, highly skeptical of this (n=5). They mentioned that, while freedom and control sounds inviting, one must think of the consequences. If one can look through doors, chances are that those on the other side can look at you. There may also be others who have a set of keys similar to the ones that you possess.

4.3 Differences Between Groups

The mental models drawn by each age group showed privacy concerns and the various measures they would take to protect their privacy. However, there were vast differences in the messages conveyed through these illustrations. These differences were studied and contrasted against one another to reveal the lenses through which these two age groups view the concept of privacy. Differences were observed along the dimensions of approaches to evade privacy, leaking private information, measuring privacy attacks, sharing private information online and reaction to privacy attacks.

Direct or Indirect Approaches to Evade Privacy. Some older adults felt that privacy can *directly* impact user activities. Illustrations depicted spam and viruses flooding their inboxes and siphoning away information,

forcing victims to constantly waste time deleting spam. This resulted in older adults being unable to conduct other preferred tasks. A few working age adults felt that privacy attacks also target private lives, but *indirectly*. They portrayed the evasiveness of mobile device’s webcam to spy on the user in the non-digital world (Figure 6). Older adults’ higher concern with direct privacy attacks led to the development of Hypothesis H4 (Refer to Table 3).

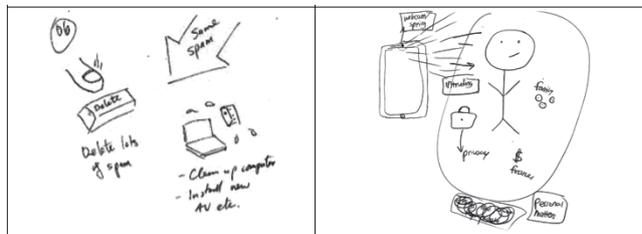


Fig. 6. Direct Attack vs. Indirect Attack

Leaking Private Information. When asked about how private information is leaked, most older adults described threats arising from *mobile phones* where apps can gather personal or sensitive information. In contrast, other working age adult participants stated that private information can be leaked through *any personal digital device*, including desktops, laptops, mobile phones and landline phones. While older adults were aware that threats were present when using other types of device, it was evident a hierarchy was in place where some were “worst offenders” compared to others. Older adults’ greater levels of concern with leaking private information through mobile phones led to the development of Hypothesis H5 (Refer to Table 3).

Awareness of Global Threats Older adults seemed *unaware* of the potential global-scale of privacy attacks, mostly describing local scam calls on their mobile phones. Working age adults appeared to be *aware* of the possibility of being attacked from across the globe, describing how attackers can obtain private information online via public internet services. However, while asked to describe their illustrations, older adults expressed that their lower awareness of global attacks increased their fear of the same. Working age adults felt less afraid of the global attacks they described. The higher level of fear and frustration faced by older adults by global threats led to the development of Hypothesis H6 (Refer to Table 3).

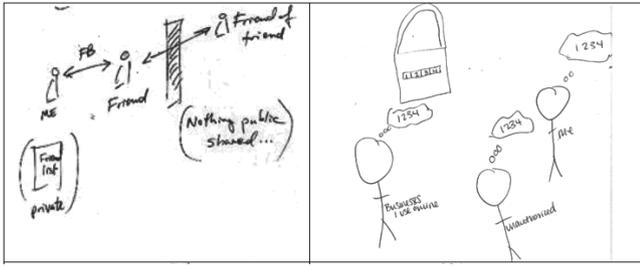


Fig. 7. Social Media vs. Online Businesses

Measuring Privacy Attacks. Privacy attacks were measured by two older adult participants by using a *set of balance scales* or a see-saw/teeter-totter, weighing “good” uses of private data versus “evil” ones. A handful of working age adults saw all types of breach as equally detrimental, depicting images of attacks.

Sharing Private Information. On the topic of online exchange of private information, a few working age adults expressed more concern about controlling the distribution of personal data on *social media* such as Facebook, and felt helpless when their content was being shared by others without their permission. This could be a threat. Some older adults were more worried about sharing their information with *online businesses* and were afraid that unauthorized personnel and third parties would be able to gain access to their information and use it for nefarious purposes (Figure 7). This difference in concerns between the two age groups about sharing private information led to the development of Hypothesis H7 (Refer to Table 3).

Reaction to Privacy Attacks. Almost every older adult participant we interviewed described feeling *victimized and targeted* at some point in their life by constant privacy attacks and harassment. While they felt fairly confident about maintaining privacy outside the digital world, they felt that more threats exist once they start using their digital devices. Their concern was motivated by one specific event (e.g., a data breach) they had experienced. While some older adults expressed the desire to fight back against privacy attacks, others felt cornered and helpless. Older adults’ feelings of being targeted and victimized led to the development of Hypothesis H9 (Refer to Table 3). Most working age adults also acknowledged the presence of privacy threats in the digital world, but were less emotionally affected. They felt more *resigned*, and accepted it for the way it is. They expressed having realized that privacy threats will continue to exist as long as private information exists.

Idealizing Privacy and Importance of Protection.

Some older adults illustrated ideal privacy as having control or ownership over *objects*, such as possessing a set of keys which can open “doors” to their private information. This ownership provided them with a sense of control over their personal data. On the other hand, other working age adults illustrated ideal privacy as having control over the *location and environment* that they are in, such as a well-guarded castle or a deserted island. They also expressed a desire to control who they would like to be present with them at the location, either opting for someone close to them (e.g., a spouse), or a form of security (e.g., guards). Older adults’ preference of ownership over objects led to the development of Hypothesis H10 (Refer to Table 3).

4.4 Similarities Between Groups

While multiple differences were found between the two age groups, there was also important common ground. Both age groups were keen to share experiences and narrate incidents which occurred to them in the past, and these insights help us see the connection between the groups and visualize the extent of the overlap.

Understanding Privacy and its Importance

Both age groups seemed to understand the importance of privacy. They acknowledged the value of their private information and expressed a need for its protection. Working age adults showed a deeper understanding, and were more elaborate in their explanations. Both groups used some form of barriers to illustrate how they would protect their privacy. While older adults found it easier to explain using metaphors and symbolism in their drawings, working age adults preferred to use technical terms and technological aids in their drawings. Both groups used arrows or cross-out symbols in their drawings to depict permissions to access their private data. These symbols were typically used to either allow or deny a certain group of people (e.g., the general public, family and friends) access to their private information. The usage of symbols and metaphors by older adults to explain their privacy illustrations led to the development of Hypothesis H8 (Refer to Table 3).

Personal Experiences and Perception Triggers

Most of the participants, both working age and older age groups, illustrated a depiction of themselves and experiences they had faced or witnessed in the past. These experiences had triggered greater caution, and this cau-

tion had often been voiced to others around them. There was refusal among some members of both groups that acceptable levels of privacy could be maintained. It was evident that these participants would not let go of these worries, even as technologies promoting privacy evolve.

Using Enclosed Spaces to Depict Privacy Both age groups depicted privacy as some form of enclosed space. This included direct representations of physical structures or locations (such as a house with doors and windows, a castle with gates) as well as drawing boxes or circles around personal objects (such as laptops, mobile phones). This may imply that participants perceive privacy as an enclosed environment to enforce denial of access to unsolicited individuals.

4.5 Summary of Study 1 Findings

Study 1 offered a rich, detailed insight into the perceptions, attitudes and beliefs of two groups of users; older adults, and working age adults. Our ten key findings highlight that older adults are often more worried about society’s privacy than working age adults, are more likely to consider abandoning the use of technology to protect their private information, and are less concerned about their private information being shared online through social media. Several others are listed in Table 3.

To further expand our sample and validate our findings, we conducted a second study with a much larger sample size, implementing survey questions to reflect our findings thus far.

4.6 Findings for Study 2

Upon collecting the survey data, we used Fisher’s Exact tests to test the proportions of choices between the images in the pairwise comparisons, and we used Mann-Whitney *U*-tests for the Likert Scale data, as data from Likert Scales is not normally distributed. Holm-Bonferroni Correction tests were run afterwards to account for the large number of hypotheses.

In survey responses, when asked about the specific measures that they would take to protect their own privacy, a number of older adults described receiving scam calls on their mobile devices and blocking unrecognized numbers (n=7). A few others mentioned online banking and its unreliability while advocating the use of paper based statements instead (n=3). A couple of participants also said that they didn’t know how to begin going about protecting their private information (n=2).

Table 3. Hypotheses for Study 2 as derived from thematic coding of Study 1, including if they were confirmed or rejected initially and after applying Holm-Bonferroni corrections.

Hyp. No.	Qualitative Findings from Study 1	
H1	Older adults are more worried than working adults about society’s privacy	Rejected
H2	Older adults are more likely than working adults to consider abandoning the use of technology to protect their private information	Rejected
H3	Older adults are more apprehensive than working adults about giving their private information to strangers if there are safeguards in place to protect them	Confirmed
H4	Older adults are more concerned with direct privacy attacks on their digital information	Rejected
H5	Older adults are more concerned about leaking private information through their mobile phone than any other device	Rejected
H6	Older adults feel more frustrated than working adults by global online attacks as opposed to local scam callers	Confirmed
H7	Older adults are less concerned than working adults about their private information being shared online through social media	Confirmed
H8	Older adults prefer to describe barriers (in order to protect privacy) in the form of metaphors and symbolism	Rejected
H9	Older adults feel more targeted and victimized by privacy attacks than working adults	Rejected
H10	Older adults prefer having power, control and ownership over objects when visualizing ideal privacy	Rejected

Older adults reported being attacked by various privacy threats. These included credit cards being stolen (n=1), receiving fake emails demanding money (n=1), having one’s private information sold without permission (n=1), and receiving text messages in foreign languages (n=1).

Pairwise Image Comparisons. The pairwise image comparisons are presented in Table 4. A larger number of older adults chose the image illustrating the receipt

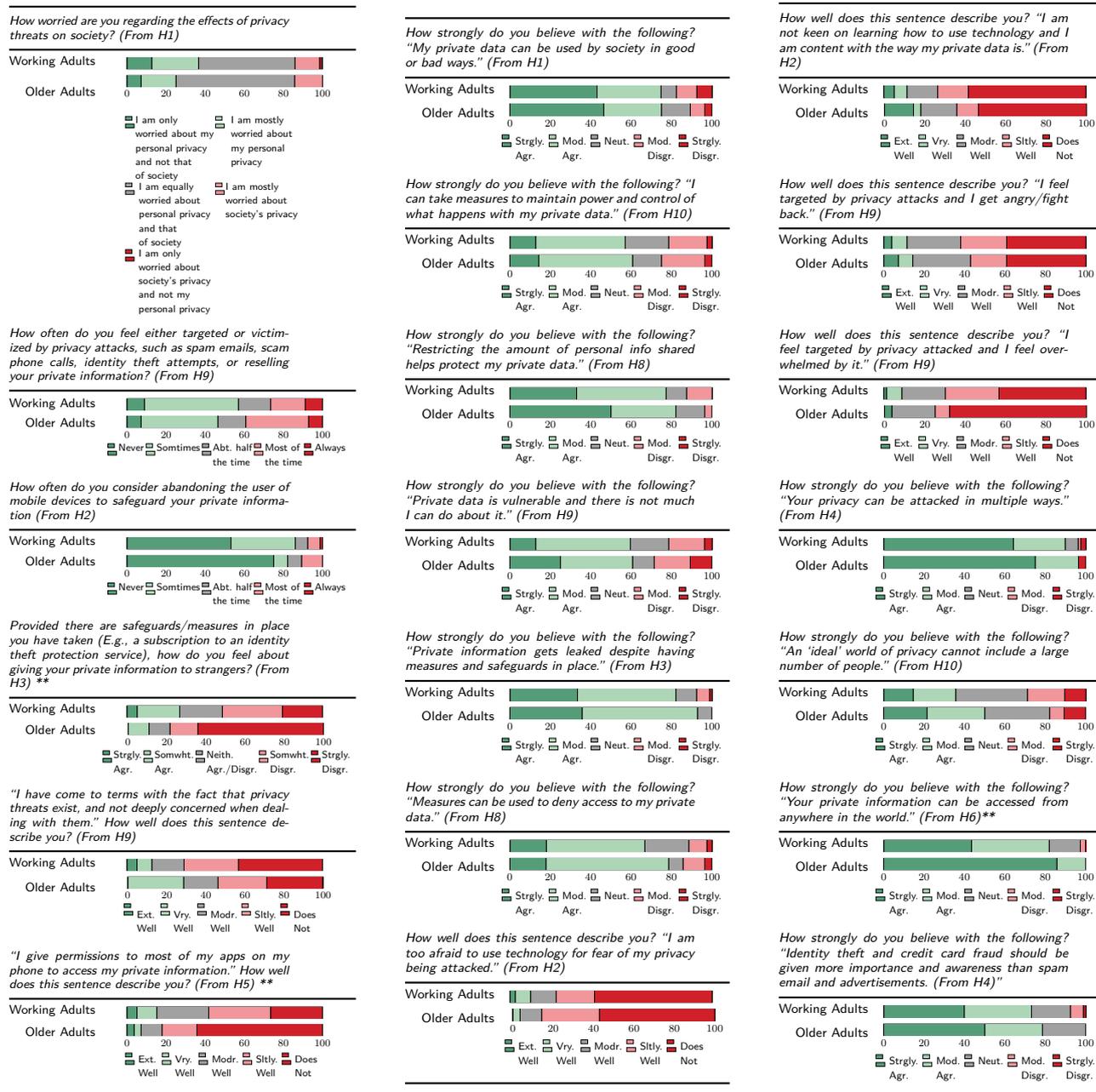


Fig. 8. Likert Responses in Study 2 with ** Marking Significant Differences.

of spam email (n=14) over the image depicting spying through a webcam (n=5). They described incidents which involved suspicious emails appearing in their inbox, which they would either delete or move to the spam folder, with the worry that if it stayed in the inbox, it may be opened by mistake or do harm. The concern of a webcam spying on personal matters seemed a bit “paranoid” to some older adults, while others did not consider it to even be a threat. This initially lends sup-

port to confirming H4 (p=0.032), but was rejected after Holm-Bonferroni Correction (p=0.091).

Older adult participants agreed that all mobile devices are capable of leaking private information (n=17), with seven suggesting that mobile devices are not the only compromising device. However, some felt that private information cannot be leaked through a landline phone (n=4), rejecting H5.

Online businesses, especially online banking, was considered unreliable and a bigger privacy threat (n

= 15) than social media (n=7) in regards to leaking or selling of private information online. A majority of older adults expressed their disinterest in using social media and were unconcerned with it. Older adults felt resigned (n=12) instead of overwhelmed (n=5) when faced by privacy attacks. Findings suggested that participants felt that while privacy attacks are a cause for concern, it does not drive them to feel terribly anxious. They are aware that solutions do exist and do not feel completely helpless.

When faced with two scenarios for “an ideal world of privacy,” most older adults wished to have control over their private information directly by having ownership of objects which symbolized their private data (n=16), rather than have control over the location of the private information (n=6). Metaphorically owning a set of keys which allowed to them to open locked doors containing their private information seemed more appealing to them than being protected by a well-guarded castle with fortifications. This lends support to initially confirming H10 ($p=0.026$), but was rejected after Holm-Bonferroni Correction ($p=0.087$).

Tests confirmed that working age adults are more concerned about private information being leaked through social media, whereas older adults are more concerned about private information being leaked through online businesses, specifically mobile banking ($p < 0.05$) in Table 4, supporting H7, and proved to be significant after Holm-Bonferroni Correction ($p < 0.001$, effect size Hedge’s $g > 0.5$ indicating a medium effect).

Likert Scale Findings. Older adults feel victimized more often than working age adults (initially confirming H9 with $p < 0.005$, but rejected after -Bonferroni Correction with $p=0.145$). This may imply that privacy attackers, especially scammers, target older adults through phone calls, which involve sharing private information or a form of payment. A few older adults also shared the same opinion after exchanging stories of these incidents with their friends. Older adults appear to be less likely to give permission to their apps to access their private information ($p < 0.001$). This is probably due to the fact that older adults often use fewer applications on their mobile devices than working age adults [14]. Older adults are in stronger agreement that an ideal world of privacy cannot include a large number of people ($p = 0.05$). In collecting background information in Study 1, older adults self-reported a higher score of maintaining general privacy than the working age adults. Older adults appear to be content with sharing private information solely with close family and nobody

Table 4. Fisher’s Exact Tests for Pairwise Comparisons. Significance shown by **

Comparison Type	Working Older		<i>p</i>
Older adults are more concerned about direct privacy attacks (A) rather than indirect privacy attacks (B) [From H4]	32A 33B	14A 5B	0.071
Older adults are more worried about private information leaking through mobile phones (A) rather than through any other mobile device (B) [From H5]	29A 30B	7A 17B	0.142
Older adults are more concerned about scam callers (A) than being attacked online (B) [From H6]	33A 27B	13A 12B	0.816
Older adults are more worried about private information being shared via online businesses (A) than via social media (B) [From H7]	25A 35B	15A 7B	0.046**
Older adults are more likely to use metaphors to describe measures used to protect privacy (A) than technical guidelines (B) [From H8]	28A 31B	11A 9B	0.612
Older adults are more likely to feel more overwhelmed when attacked by privacy violators (A) than resigned (B) [From H9]	21A 30B	5A 12B	0.565
For ideal privacy, older adults prefer having control over specific elements (A) rather than having control over an environment [From H10] (B)	37A 21B	16A 6B	0.598

else. Older adults are also in stronger agreement and concerned that their private information can be accessed from anywhere in the world ($p < 0.001$, confirming H6. Effect size Hedge’s $g > 0.8$ which indicates a large effect). While the mental models showed that older adults face a constant barrage of privacy attacks through local scammers calling their mobile devices, they seem to be aware of the global nature of privacy attacks. They are more apprehensive of giving private information, despite having safeguards in place to protect them ($p < 0.001$, confirming H3. Effect size Hedge’s $g > 0.8$ which indicates a large effect). Overall, older adults feel less overwhelmed by privacy attacks ($p < 0.05$).

Correcting for Multiple-Hypotheses. We used Holm-Bonferroni corrections to account for the high number of hypotheses, with 10 in total. The corrected p-values showed that older adults are in stronger agreement that their private information can be accessed from anywhere in the world (H6, $p < 0.001$), and they are more apprehensive of giving private information to strangers provided there are safeguards in place (H3, $p < 0.001$). Finally, older adults are less concerned about giving permission to social media to access their private information (H7, $p < 0.001$), meanwhile working age adults are more concerned about this.

5 Discussion

5.1 Complex Attitudes

Researchers examining the needs of older adults have identified the complex privacy and security attitudes held by older adults [11]. Through the studies described in this paper we also saw evidence of such complexities and misconceptions. While older adults have been thought of as a group who are more trusting of online information compared to their younger counterparts [16], and express interest in health-based searching, e-shopping and online banking [3, 20], findings from our study highlighted their fears. These apprehensions are not so much associated with usage of each of these online systems, but more associated with how the data could be abused once submitted or stored. For example, participants wondered whether their data would be leaked through these channels, and whether recovery would be possible. There were multiple concerns aimed towards **unsolicited breaches of privacy by strangers**, but much fewer regarding family and trusted friends, confirming findings in other studies [27, 41]. Mitigation strategies adopted include visiting physical equivalents of online services (i.e., banks, shopping malls) as these were thought to be “safer.” Older adults’ acceptance or aversion of using technology often stemmed from their own personal experiences, or stories from close relatives or friends, which shares similarities with Barnard et al.’s [2] technology acceptance model. Similarities were found in our sample of working age adults as well, where participants would describe personal experiences to highlight their opinions and concerns about online privacy. This may imply that experiences may function as a trigger for one’s perception of online privacy, whether it be their own or that of someone else. Both age groups also depicted privacy via enclosed spaces by either drawing buildings with doors or circles/boxes around personal possessions. Oates et al. [30] also reported similar drawing patterns among their participants, more specifically with bedrooms and bathrooms shown as private spaces.

5.2 Empowerment Through Education

In contrast to perceptions and behaviors identified in a study by Turow et al. [39] where older adults did not know where to turn to for assistance, a theme of empowerment was identified from our studies, where older

adults were helping themselves to better understand issues relating to security and privacy. This was found to be motivated by concern to threats and concerns about their own lack of awareness. In accordance with previous work which suggests that older adults seek to learn and explore technology and are willing to learn as much as other age groups [27], some participants described being **enrolled and studying in classes** which would allow them to better protect their own data. Information gleaned could be shared with others in their respective communities. However, the presence of misconceptions and feelings of uncertainty highlights that education could go further to better support older adults. This is especially true if older adults faced incidents where they **felt specifically targeted and triggered** towards additional privacy concern. This could be facilitated through materials developed specifically with older adults’ needs in mind, and possibly using a strategy similar to that proposed by Frik et al. [11] of showing both the user’s and attacker’s perspective when attempting to protect oneself.

5.3 Being Too Social Can Impact Privacy

Research suggests that age is a strong predictor of Social Networking Service (SNS) usage, with young people relying heavily on SNSs in comparison to older adults [17]. While both older and working age adults in our studies touched upon the subject of social media, **the working age group highlighted concerns regarding how private and sensitive data can be leaked**. For example, information may be inadvertently shared with friends of friends, or via devices (e.g., smart speakers storing and sharing details when third parties are around). This makes it difficult to ascertain the boundaries of privacy, even if users modified their behavior or used privacy controls. Additionally, the time consuming and confusing nature of setting social media sharing controls was found to be a limiting factor. Similarities were also identified between both age groups, who expressed voicing caution to others around them and receiving advice from others as well, which impacted their perceptions of privacy. There were instances, however, where communication using mobile devices was appreciated by older adults who expressed being able to communicate with family and friends through these devices. Cotten et al. [4] also noted the impact of internet usage on social contact among older adults and feeling more connected to loved ones.

5.4 What Will Happen Will Happen

As described in the earlier sections, a theme of being **resigned to threats being faced was detected among working age adults**. The abundance of information about threats in the mass media (e.g., ransomware attacks) had begun to desensitize certain users. There was no evidence to suggest that users had become more complacent in protecting themselves from harm. On the contrary, participants described updating security credentials and engaging in more secure behavior. The feeling of resignation is not uncommon among users. Turow et al. [40] found that most consumers are resigned to giving up their data, which results in them apparently engaging in tradeoffs.

5.5 Risk Scenarios.

To better understand the practical implications of our findings, we offer “risk scenarios,” which are condensed **narrative exemplars of the core findings** regarding the primary privacy concerns of older adults, as compared to working age adults. While these narratives are not validated themselves, they can provide starting points for designers and future research, by allowing designers to develop empathy and understanding circumstances older adults face while using technology, which may be different from their own.

Example Scenario: Lucy’s experience: Lucy was recently affected by a large corporation cyber-attack in July 2019. While the incident did not cause much tangible damage, it instilled a negative image in her mind. She expressed anger and distrust in the company and was baffled as to how it was possible for such a large company to be breached so easily by just one person. Previously carefree, she is now wary and cautious of where her private information goes.

“I just don’t understand how this could happen. God knows what happened with my information.”

This representative example highlights how easily one’s perception of privacy can be affected. While Lucy may have been easygoing and less careful in the past, a single experience can completely change how she handles her private information.

Example Scenario: Alan’s experience: Alan’s “haunted” Alexa has been speaking at night while he tries to sleep. While most of these verbal messages from Alexa are not harmful, Alan is afraid that it may have

access to his personal details and may vocalize them against his will. He is now concerned about technology having access to his information, and is careful whenever he uses devices or applications on them.

“Who knows when the day will come. Is this what they call identity theft? Whatever it is, it’s quite unsettling really.”

This example shows Alan’s worries about sharing his personal information with applications on devices. He will now be less likely to give his applications access to his private information, such as his location or his contacts list.

Example Scenario: Mary’s experience: Mary visited the bank to deposit a check in her name. She was required to wait in line for approximately an hour for her turn, while others cut-in ahead of her. However, despite the long waiting time and overall poor experience, she still intends to deposit her check at the bank the next time, instead of using a mobile banking application.

“I know that using an app on my phone is probably faster. Or maybe even a machine. But I don’t know what is happening with my check when I use these devices. At the bank, I can see a person who is physically present. I can even talk to them and ask questions. I just feel safer and at ease this way.”

This scenario illustrates Mary’s concern with online banking and discomfort with not knowing what is happening behind the scenes. Fear of the unknown is a powerful detrimental factor, leading Mary to be more comfortable with tangible transactions rather than intangible/digital ones.

Through the experiences of the fictional characters Lucy, Alan and Mary, we can see how privacy attacks can affect one’s perception of privacy, concerns regarding sharing personal information with applications on personal devices and fears of online banking. Designers could potentially analyze these risk scenarios as motivators towards understanding older adults’ needs and pain points while designing tools for privacy.

6 Conclusion

We conducted two studies to elicit perceived privacy concerns and risks of older adults as compared to their younger, working age counterparts. Adapting a protocol from Oates et al. [30], we used drawmetrics to assess older (n=20) and working age (n=20) adults’ mental

models. Through the analysis of emerging themes, we found that older adults are more willing to abandon technology to protect their private information. Working age adults were understanding of older adults’ privacy concerns, but often felt it to be a naive way of thinking. They often felt resigned when faced by privacy attacks, and were mindful of the trade-offs necessary for convenience and connectivity. However, both groups shared the same desire to see a better way to protect themselves from privacy attacks, illustrated through visual metaphors and animated narrations of past experiences.

In the second study (n=111), an online survey was generated based on findings from the prior study. We found that older adults perceive a greater threat from using online banking, e-commerce, and global threats to privacy, while working age adults showed more privacy concern regarding social media. Despite key differences regarding privacy concerns and risks between older and working age adults, there is also significant overlap. Future studies should consider performing more direct comparisons rather than focusing on older adults in isolation, as it should provide more direct and focused paths to impact this important user group.

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Appendix

A Study 1 Information

Older Adults Interview:

Good morning/afternoon!

Thank you so much for coming in. How are you doing? We have some consent forms. Would you like to read through them?

Hand them the consent form

Could you tell me your age, gender which you identify with, your occupation, IT background, disabilities which you identify with, your experience with web and mobile devices on a scale of 1 to 5, 1 being the lowest and 5 being the highest?

On a similar scale, how confident are you in maintaining privacy online or on mobile devices?

On a similar scale, how confident are you in maintaining privacy offline?

Fill in demographic form

What does privacy mean to you? Please use this sheet of paper to illustrate your thoughts.

Hand them a blank sheet of paper

If you are uncomfortable with drawing, you can verbalize your thoughts and I can draw for you.

Thank you. Could you describe why you chose to draw this?

What does privacy mean to you in the digital age? Please use this sheet of paper to illustrate your thoughts.

Hand them a blank sheet of paper

Thank you. Could you describe why you chose to draw this?

Do you feel that individuals over the age at 60 are at risk of not maintaining their privacy? If so, why?

Why do you think that some individuals don't maintain their privacy?

What steps can individuals take to maintain their privacy?

Is it ever justifiable to for a third party to invade your privacy? If so, why?

Have your feelings about the term "privacy" changed over time? If so, what factors have motivated this change?

Which resources do you use to learn about privacy?

How frequently are these resources accessed?

How much impact do these resources have on you?

How much trust do you have in these resources?

Are you more concerned about privacy from people you know or people you don't know?

Are you worried about identity theft?

What examples of privacy violation have either you or someone you know experienced?

Alright, this was great! Thank you so much for your time!

Working Age Adults Interview: Good morning/afternoon!

Thank you so much for coming in. How are you doing?

We have some consent forms. Would you like to read through them?

Hand them the consent form

Could you tell me your age, gender which you identify with, your occupation, IT background, disabilities which you identify with, experience with web and mobile devices on a scale of 1 to 5, 1 being the lowest and 5 being the highest?

On a similar scale, how confident are you in maintaining privacy online or on mobile devices?

On a similar scale, how confident are you in maintaining privacy offline?

Fill in demographic form

We have a set of 10 hand-drawn images. Could you look through these images one-by-one and tell me which images relate to you the most? While selecting the images, try to think aloud and describe why these images relate to you.

Hand/show them the images

Alright, so these are the images you chose.

Separate the chosen images from the rest of the pile

*Take the first image, then second image and so on. For each image, ask: *

What elements of this image did you relate to?

What elements of this image did you not relate to?

Collect the images together

Are there aspects of your fears that are not represented in any of the images?

What elements of the images that you didn't select do you not relate to?

Thank you for your answers.

This data was actually collected from a variety of people. Who do you think these people are?

Would you say there is a reason why your perception of privacy is different from that of older adults/these people? Why do you feel that way?

How would you illustrate what privacy means to you?

Hand them a blank sheet of paper

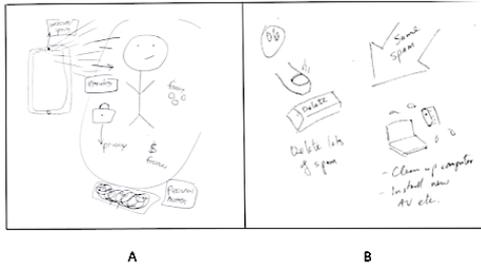
Could you explain the drawing/this part in more detail?

Alright, this was great! Thank you so much for your time!

B Study 2 Information

1. If you are willing to disclose your private information, please enter:
 - Age
 - Identified Gender
 - Educational Background/Discipline
 - Occupation
 - Disabilities

- Rate your confidence in maintaining privacy on-line (Scale of 1-5)(1 being the lowest and 5 being the highest)
 - Rate your confidence in maintaining privacy in your daily life (Scale of 1-5)(1 being the lowest and 5 being the highest)
2. How often do you feel either targeted or victimized by privacy attacks, such as spam emails, scam phone calls, identity theft attempts, or reselling your private information?"
 - Never ○ Sometimes ○ About half the time ○ Most of the time ○ Always
 3. If you have been targeted by other privacy attacks not specified above, list them in the text box below.
 4. If you had to use a safeguard/measure to protect your private information, what would it be? Please describe it in a few words.
 5. How worried are you regarding the effects of privacy threats on society?
 - I am only worried about my personal privacy and not that of society ○ I am mostly worried about my personal privacy but I can understand that society also has privacy concerns ○ I am equally worried about my personal privacy and that of society ○ I am mostly worried about society's privacy but I can understand that individuals also have privacy concerns ○ I am only worried about society's privacy and not my personal privacy
 6. Select option D for this question.
 - A ○ B ○ C ○ D ○ E
 7. How often do you consider abandoning the use of mobile devices to safeguard your private information?
 - Never ○ Sometimes ○ About half the time ○ Most of the time ○ Always
 8. Provided there are safeguards/measures in place you have taken (E.g., a subscription to an identity theft protection service), how do you feel about giving your private information to strangers?
 - Strongly agree ○ Somewhat agree ○ Neither agree nor disagree ○ Somewhat disagree ○ Strongly disagree
 9. "I have come to terms with the fact that privacy threats exist, and not deeply concerned when dealing with them." How well does this sentence describe you?
 - Describes me extremely well ○ Describes me very well ○ Describes me moderately well ○ Describes me slightly well ○ Does not describe me
 10. "I give permissions to most of my apps on my phone to access my private information." How well does this sentence describe you?
 - Describes me extremely well ○ Describes me very well ○ Describes me moderately well ○ Describes me slightly well ○ Does not describe me
 11. How strongly do you believe in the following? (*Likert response: Strongly Agree, Moderately Agree, Neutral, Moderately Disagree, Strongly Disagree*)
 - My private data can be used by society in good or bad ways. ○ I can take measures to maintain power and control of what happens with my private data. ○ Restricting the amount of personal info shared helps in protecting my private data. ○ Private data is vulnerable and there is not much I can do about it. ○ Private information gets leaked despite having measures and safeguards in place. ○ Measures can be used to deny access to my private data.
 12. How well does this sentence describe you? (*Likert response: Describes me extremely well, very well, moderately well, slightly well, does not describe me*)
 - I am too afraid to use technology for fear of my privacy being attacked. ○ I am not too keen on learning how to use new technology and I am content with the way my private data is. ○ I feel targeted by privacy attacks and I get angry and/or fight back. ○ I feel targeted by privacy attacks and I feel overwhelmed by it.
 13. How strongly do you believe in the following? (*Likert response: Strongly Agree, Moderately Agree, Neutral, Moderately Disagree, Strongly Disagree*)
 - Your privacy can be attacked in multiple ways. ○ An "ideal" world of privacy cannot include a large number of people. ○ Your private information can be accessed from anywhere in the world. ○ Identity theft and credit card fraud should be given more importance and awareness than spam email and advertisements.
 14. Given below are two images. On the left, we see a person worried about being spied on through the webcam on their own mobile phone. On the right, we see a person frustrated by the same spam appearing in their computer and after deleting everything one by one, they finally clean up their computer.



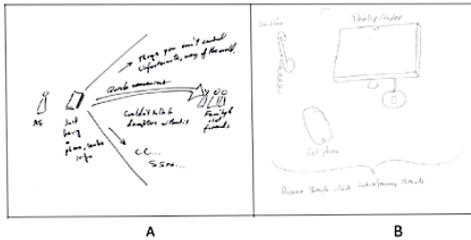
Which of the two images above do you relate to the most?

- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

15. Given below are two images. On the left, we see a person describing how private information is leaked through her mobile phone. On the right, we see how private information can be leaked through various devices.



Which of the two images above do you relate to the most?

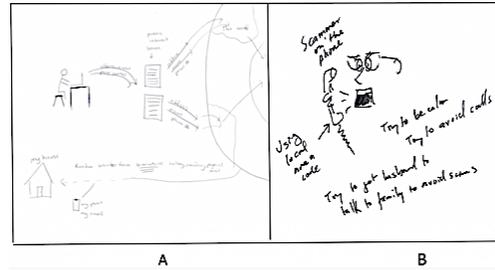
- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

16. Given below are two images. On the left, we see a person sitting at home being attacked from somewhere else in the world. On the right, we see a

scammer calling the victim using a local area code.



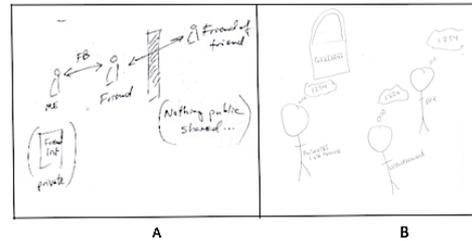
Which of the two images above do you relate to the most?

- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

17. Given below are two images. On the left, we see privacy concerns about information being shared on social media. On the right, we see privacy concerns about information being shared on online businesses and internet banking.



Which of the two images above do you relate to the most?

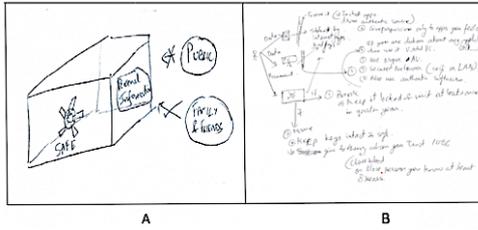
- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

18. Given below are two images. On the left, we see a safe, which is a metaphor for keeping private information safe. On the right, we see various detailed technical guidelines to keep private information safe,

such as installing apps from an authentic source.



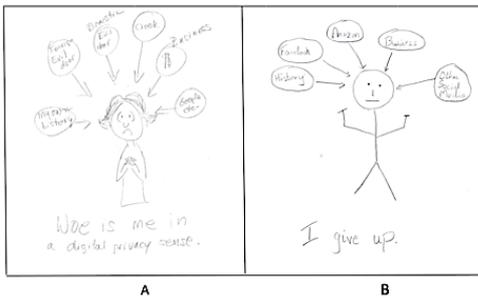
Which of the two images above do you relate to the most?

- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

19. Given below are two images. On the left, we see a person who feels targeted and victimized by privacy attacks. On the right, we see a person who has come to terms with it.



Which of the two images above do you relate to the most?

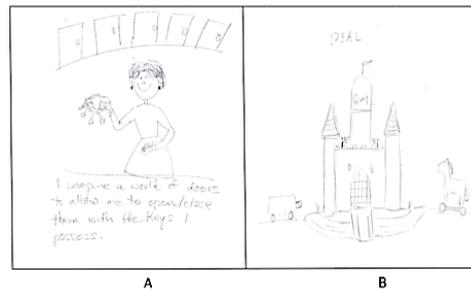
- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.

20. Given below are two images. On the left, we see a person whose ideal world of privacy involves having control/possession over objects. such as keys. On the right, we see a person whose ideal world of privacy involves having control over the location

and the environment, such as a castle with guards.



Which of the two images above do you relate to the most?

- A
- B
- Neither

Use two words to describe why you relate to the image you chose (A or B). If you chose neither, describe why.

Choose the aspects of these images you can relate to (or don't relate to). Click once if you relate, twice if you don't.