An Exploratory Study of Social Support Systems to Help Older Adults in Managing Mobile Safety

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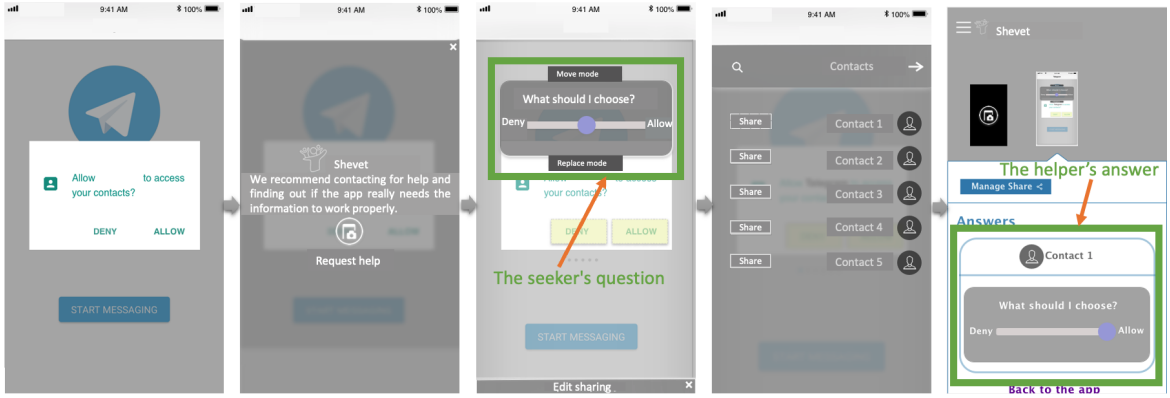

Figure 1: Prototype of a social support system for a mobile device. We display the main screens from left to right: an online safety situation, taking a screenshot, sharing the screenshot with potential helpers, selecting a helper from contacts, and receiving answers. The application recognizes the mobile safety problem. In this example, we display the permission management situation.

ABSTRACT

Older adults face increased safety challenges, such as targeted online fraud and phishing, contributing to the growing technological divide between them and younger adults. Social support from family and friends is often the primary way older adults receive help, but it may also lead to reliance on others. We have conducted an exploratory study to investigate older adults' attitudes and experiences related to mobile social support technologies for mobile safety. We interviewed 18 older adults about their existing support experiences and used the think-aloud method to gather data about a prototype for providing social support during mobile safety challenges. Our findings point to the potential of mobile technology to increase older adults' ability to mitigate mobile safety challenges through active learning from close social connections. We discuss how to support technology can address helpers' intolerance and overcome the challenges of physical distance.

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CCS CONCEPTS

• **Social and professional topics** → User characteristics; Age; Seniors; • **Security and privacy** → Human and societal aspects of security and privacy; Social aspects of security and privacy; • **Human-centered computing** → Human computer interaction (HCI).

KEYWORDS

Older adults, Social support, Help, Security, Privacy

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1 INTRODUCTION

Older adults are becoming more digitally connected, with social media and smartphone ownership increasing consistently in recent years [3, 43]. Older adults are a heterogeneous group that does

not conform to the myth of being technology-adverse [30]. For example, the smartphone ownership rate among people aged 50 or older from 2015 to 2018 rose from 53% to 67% in the United States [43]. Simultaneously, the online safety threats that older adults face are more challenging than those faced by younger adults. They are more likely to be targeted by online fraudsters: over half (53%) have reported being targeted by online fraud [1] and phone fraud [18]. Older adults valued privacy as an essential part of interacting with online services and others [26, 39]. They also exhibit more negative attitudes toward the risks involved in using new technologies [4, 30, 31]. As a result, older adults may considerably reduce their technology use [7, 8, 14, 16, 30], including using online technologies such as social networking [31] and mobile health [20]. In turn, lower adoption rates of mobile technology can lead to increased social isolation. Recently, the COVID-19 outbreak at the end of 2019 has created additional challenges. It has led to increased social isolation and directed older adults' social and work lives to online platforms [38]. This problem is not limited to today's cohort of older adults. With the acceleration of technologies and increases in life expectancy, technological challenges may become more severe.

Older adults regularly seek online advice about online safety from the people surrounding them, and they often prefer to rely on their friends, family, and media for support [33, 41]. People exhibit a relatively high willingness to assist their older relatives with online security and privacy, especially if they know their preferences [29]. Wan et al. found that older adults achieve more accurate and secure decisions when receiving online support through a mobile application from children or grandchildren; however, older adults did not acquire security-related knowledge or learn from delegate decisions [44]. Hunsaker et al. reported that older adults might have low satisfaction with general technical support from family because of the complicated process of receiving help and the lack of immediacy and availability [18]. These contradictory results point to the gap in understanding the possible consequences of social support in mobile safety. Social support may lead to learned helplessness [42], in which older adults feel an absence of control over their decisions and perceive an inability to use digital technology independently [14]. In contrast, a possible positive outcome could be active learning and developing empowerment and con dence in controlling online safety challenges, similar to how older adults learn computer programming [15] and carry out crowd work [5].

This paper examines social support through semi-structured interviews with 18 older adults who regularly use a smartphone. We interviewed the participants with online safety scenarios that included permission settings and password management and asked them to recall other social support experiences. Then, we used the think-aloud method to gather feedback on a mobile social support application prototype. The prototype allows them to capture a safety situation screen, share it with potential helpers, select a helper, and then receive and process answers (see Figure 1). We qualitatively analyze the interviews and focus on several key questions: How do older adults characterize social support for online safety? Who do they turn to for social support? What are the possible consequences of social support when family members and friends provide help? How should social support systems be designed to lead to more positive outcomes? The prototype evaluated how older adults captured supportable moments and reacted to di erent simulated explanations and suggestions from their social environment.

Our results point to the potential of social support technologies to aid older adults in mobile safety. While our study population was more educated and more tech-savvy than the average older adult, we show that social support can bridge technology language barriers and has the potential to help older adults become less dependent on others. It can also stimulate intergenerational conversations that allow older adults to generate discussion and sometimes to question existing technological norms that they deem problematic. Simultaneously, support technology can also lead to feelings of helplessness when encountering experiences that include intolerance by helpers and challenges in communicating problems and solutions due to physical distance. Our ndings illustrate several design opportunities for social support technology, including adherence to older adults' preferences, using explanations for learning, and helping older adults work at their own pace and according to their own cognitive abilities. In summary, the main contributions of this paper are as follows:

1. We examine older adults' attitudes towards mobile social support technologies for online safety and documenting their past actions following mobile support interactions.
2. We analyze how social support technologies can contribute to either empowerment or helplessness.
3. We evaluate a prototype for social support technologies that allow older adults to engage in support interaction with their social connections.

2 RELATED WORK

The study we present in this paper aims to ll a gap in three elds: 1) social support for mobile technologies that aim to help older adults, 2) online safety in communities, and 3) contextual help.

2.1 Social Support for Older Adults

Intergenerational support is essential for adopting, using, and learning to use technology [13, 32]. Older adults regularly seek informal support from family and friends because it is convenient, comfortable, free of charge, and trustworthy [37]. Some older adults reported low levels of satisfaction with social support when it was unavailable or if help was too complicated [18]. Additional challenges may stem from discrimination against older adults. Ageism can contribute to a reduction in technological self-e cacy among older adults through the internalization of society's negative perception of older adults' inability to use digital technology [25]. Older adults may also avoid technology because of the burden it puts on their families [36]. Interacting with technology is also not a binary state. While many older adult users expressed comfort in solving computer problems independently, they still sought support when they could not handle the challenge themselves [18].

Social support from friends and family can potentially help in ensuring a safer online experience. Studies have shown that older adults seek advice from various sources, including online sources, professionals, work colleagues, friends, and family friends [15, 33, 41]. A recent survey has shown that younger people are willing to assist their older relatives with mobile security and privacy more than they currently do [29]. Wan et al. presented a mobile

application that allowed older adults to delegate security decisions to younger family members, showing that they made safer decisions in this way. However, older adults neither acquire security-related knowledge nor learn from delegate decisions [44]. Therefore, it is still necessary to investigate how older adults learn through social support processes.

Social support may lead to learned helplessness [43], in which older adults feel an absence of control over their decisions and perceive an inability to use digital technology independently [14]. It is necessary to examine whether social support technologies can reduce some of the barriers and negative externalities. To our knowledge, no prior work has attempted to bridge the intersection of social support technologies and older adults. Therefore, we aim to investigate the characteristics of a social support system that matches older adults' expectations and encourages empowerment.

2.2 Community Approaches to Online Safety

Several recent human-computer interaction studies have explored community approaches to security and privacy, such as social in uence [12, 28] and social support [2, 9, 22, 27, 44, 46]. Das et al. found that close social members may in uence users to adopt similar security behaviors and have conversations about security features [12]. Mendel and Toch have shown that social ties in uence users' susceptibility to adopt security and privacy behaviors than formal sources [28]. Watson et al. examined how social groups (e.g., friends, family, or roommates) share digital resources, showing that social oversight practices lead to safer decisions [46]. Aljallad et al. evaluated a prototype that helps users collaborate with people they know to decide application permissions. Trust in the helper was particularly important, as participants wanted an unbiased opinion they could rely on [2]. Chouhan et al. explored a community oversight for users to interact with people they trust to help one another make digital privacy and security decisions. They discovered that participants were willing to provide lightweight passive assistance to their family and friends about online privacy and security decisions. Still, they did not see themselves doing this daily [9]. These studies evaluated tools for community oversight but did not assess designs in which older adults actively seek and receive technical support sessions. We investigate how to reduce some of the barriers towards support and to assess their negative externalities so that social support technologies will empower older adults to use digital technology independently.

The e ects of community support on older adults' self-e cacy are not straightforward. Kropczynski et al. demonstrated that older adults usually interact with people who have low technological self-e cacy. Therefore, enabling connections between older adults and people with above-average technical expertise may increase older adults' community collective e cacy for security and privacy [22]. As young adults exhibit a high willingness to assist their older relatives with online security and privacy [29], a promising path to social support can be through families and close-knit social groups. However, it is still unclear how e ective mobile applications can deliver social support and its consequences.

2.3 Contextual Support

Contextual help supports users by showing instructions and highlighting the tangible interface they interact with rather than in a separate viewer. The existing literature assessed tutorials created by experts rather than by community members. For example, stencil tutorials use sticky notes on the graphical user interface, providing necessary tutorial material in the application [21]. Graphstract implemented a graphical help system presenting multiple small graphic elements with screenshots [17]. Yeh et al. developed a tool that allowed designers to generate contextual help tutorials by writing a simple script and taking screenshots [47]. EverTutor generated interactive tutorials on a smartphone and showed that contextual help tutorials are particularly well suited for older users when older participants had equal or faster completion times using interactive tutorials than younger participants [45]. However, previous studies did not investigate these tools on how technology can work with social support.

Learning mobile safety from close social circles can be more signi cant than learning from developers and designers. First, most research on contextual help focuses on tutorials generated by designers or developers [17, 21, 45, 47], but people are more trusted than organizations in the context of privacy and security [28]. Older adults may be more trusting of close social ties with mobile security and privacy. For example, when an application requests permission that is not legitimate, the user should not trust the developer and designer of the application. Second, social help may encourage actual conversations with a family member about security features, which are key enablers of a socially-driven behavioral change and essential for online safety learning [12]. Third, older adults prioritize social resources based on availability rather than cybersecurity expertise (e.g., developers and designers), and they may avoid using the internet for cybersecurity information [33]. Therefore, contextual help from social connections shows a high potential to teach and help older adults with mobile safety issues.

2.4 Research Questions

Our main objective is to understand how mobile applications can help reduce the barriers to helping older adults through social support by families and close-knit communities. Older adults can be empowered and meaningfully engaged when learning new skills, such as computer programming [15], crowd work [5], and blog writing [6]. Leung et al. demonstrated that older adults strongly preferred to learn from manuals rather than from trial-and-error. Yet, older adults have problems using the instruction manual because of poorly written, unfamiliar terminology, and di erences between the manual's image and what is shown on the device screen [24]. Therefore, our goal was to examine older adults' attitudes towards social support mobile applications that rely on friends and family. We evaluated a prototype for older adults that allows them to interact with their social networks. Our three main questions are the following:

1. What are older adults' attitudes towards mobile social support systems for mobile safety situations?
2. What are the reactions of older adults to past mobile support interactions?
3. What are the design con gurations of social support systems that older adults prefer to receive mobile safety help?

We wanted to understand how to create mobile social support systems based on older adults' needs, attitudes, and concerns.

Table 1: Prototype support interactions

Prototype Interaction Name	Description	Explanation	Suggestion	Examples
Long Explanation	Contain a long explanation for making privacy and security decisions.	Yes	No	Pros and cons to allowing or deny permission. Ensure a strong password using a checklist.
Advice	Present the nal solution without explanation.	No	Yes	Present a suggestion to allow or deny permission. Present a suggestion that the link is safe or not safe (phishing).
Validation	Present whether the seeker's decision is correct or incorrect.	No	Yes	Present whether the password is strong or weak.
Short Explanation	Present the nal solution with a short explanation.	Yes	Yes	Present a suggestion that the link is safe or not safe with a short explanation (phishing).

3 PROTOTYPE IMPLEMENTATION

The purpose of our prototype is to assess various support interactions with a mobile application. Speci cally, we wanted to understand the role of di erent types of explanations and suggestions. The prototype allows users to capture a screenshot (in interaction such as permission management, password input, a suspicious phishing message), sharing with potential helpers and writing a question, selecting a helper from contacts, then receiving an answer (see Figure 1). We used Sketch software to link di erent screens to create our prototype, and then we ran our prototype in a mobile browser.

We implemented four di erent support interactions in the prototype, combining explanations and whether the suggestion was presented to the user (the total permutations of the support interactions are explained in Table 1). The explanation allows older adults to request the helper explanation of how to address the mobile safety situations. The suggestion grants older adults to ask the helper to present the nal mobile safety decision. The support interaction designs of advice and validation contain the suggestion without explanation, and the support interaction designs of the long explanation and short explanation contain explanations. As we described earlier, older adults neither acquire security-related knowledge nor learn from the process of social delegate security decisions [44]. To investigate how older adults react to explanations through social support processes, we design the prototype support interactions by combining two aspects: 1) contain an explanation or not, and 2) whether it contains a suggestion. We evaluate the prototype support interactions based on an explanation and suggestion to understand how older adults prefer to receive their social support answers. Based on that combination, we implemented the four di erent prototype support interactions.

4 STUDY DESIGN

We conducted a study with older adults to understand how social support systems should be designed to aid older adults during mobile safety situations and what opportunities are available in social support processes. Our study received ethics approval from the Institutional Review Board (IRB).

4.1 Participants

We recruited 18 participants through yers, bulletin boards, and word of mouth around the university campus. We stated in recruitment materials that we were looking for people aged 60 and above who owned a smartphone to participate in an approximately 90-minute interview. Many pensioners regularly visit the university as exam supervisors or as students. Most of our older adult sample is semiretired, which may provide them with a wide range of social connections, such as friends, coworkers, and family. Participants had to regularly use smartphones, as they needed basic technical knowledge to interact with our prototype. This sample is correlated with the general population in Israel because 80% of Israelis aged 50 or older in 2018 own a smartphone [43]. Also, most of our older adults in our sample are semiretired, which may provide them with a wide range of social connections, such as friends, coworkers, and family. Participants were rewarded with $14 at the end of the interview.

Participants' ages ranged from 63 to 83 years, with an average of 71 years. A total of eight participants identi ed as female and ten as male. All participants owned and used a smartphone, which they reported having between one and ten years, with an average of 6.4 years, consistent with older adult smartphone use [48]. The number of years of education ranged from 11 to 18 years (average of 13.8 years), which correlated with the OECD report that 46% of Israel's population ages 25-65 had attained tertiary education [35]. All our participants were living independently and reported having adult children. The participants mentioned at least three applications they used with their smartphone (except for one participant who said only one application), such as Facebook, Instagram, Waze, Chrome, WhatsApp, Gmail, bus, train, and shopping. Fourteen participants worked as exam supervisors, three worked at the university in administrative positions, and one retired. Most participants reported that coworkers and family members regularly

helped them. Two participants obtained an IT-related degree (P8 & P12).

4.2 Study Structure

We conducted semi-structured interviews with 18 older adults to understand their needs, attitudes, and concerns regarding the use of social support for mobile safety situations. Interviews were conducted in person in our lab at the university, and we audio-recorded and took notes to summarize the interviews. The study had two main phases: semi-structured interviews about social support scenarios and a prototype evaluation.

4.2.1 Social Support Scenarios Interviews. We started by collecting background information and asked about demographic and technical aptitude. Then, we tested the reaction to scenarios and focused on understanding participants' responses to two scenarios of everyday security and privacy situations. We used printed papers of mobile user interfaces to visualize the scenarios as conversation starters and as a way to highlight important parts of the interaction. We showed the participants two scenarios: the permission management scenario and the password management scenario (the paper scenarios are presented in Appendix A).

In the scenarios section, we wanted to understand the participants' perceptions and thoughts about social support in mobile safety, including what they would do if they needed help and how they would seek help (interview questions are presented in Appendix A). We started the reaction to scenario interviews with the permission management scenario, and then we repeated the process with the password management scenario with the same questions. In the permission management scenario, participants were asked to grant the application access to the contact list. In the password input scenario, participants were asked to select a password.

4.2.2 Prototype Evaluation. The second part of the user study is the prototype evaluation. Our goal was to understand how participants react to different support interactions. Our eighteen participants performed six tasks using the prototype (see Figure 2 for a visualization of all the tasks). We have asked participants to request help with a safety scenario and to receive a support request. Each task was characterized by the support designs (explanation and suggestion) and scenario (permission management, password input, and phishing message). We used different prototype support interactions containing explanations, suggestions, or both. We selected the prototype support interactions based on three primary considerations: 1) contains an explanation or not, 2) includes a suggestion or not, and 3) provides operational support to the scenario.

We presented the scenarios in the following order: permission management, password input, and then phishing message scenario. Each scenario includes support interactions with explanation and without explanation (all support interactions are defined in Table 1). In the permission management scenario, we first displayed support interactions with a lengthy explanation and then advice. In the password input scenario, we showed support interactions of a long explanation and then validation. Finally, in the phishing scenario, we displayed support interactions of advice and then a short explanation.

We used the "think aloud" method to understand the participants' mental models of the system, asking them to verbalize their thoughts as they stepped through the user interfaces. We also asked participants to report the preferred designs for each scenario, and they could prefer multiple designs in different scenarios, so the results are not mutually exclusive.

4.3 Qualitative Analysis

We collected four types of data from the sessions: 1) audio recordings, 2) transcriptions of the interviews, 3) physical design artifacts, and 4) prototype usability performance. We analyzed our data using thematic analysis, which included five stages: familiarization, initial codes, searching for themes, reviewing themes, defining, and naming themes, and interpretation [34]. The transcripts were read iteratively by the first author to initially code the data to find similarities and differences across participants. Through frequent meetings with a second researcher, we explored the data for categories and central themes. We assigned each participant a unique identifier used to present our results to maintain the participants' confidentiality. For quotes, we refer to each participant by P# (P followed by a number). The interviews were conducted in Hebrew and then translated into English. The translation process was executed with two research team members working on the data that ensured agreement on the translation.

5 RESULTS

5.1 Attitudes towards Social Support Experiences

Generally, our participants showed a positive attitude toward social support. Thirteen participants reported regularly receiving some form of social support. Five participants pointed to specific examples when they learned and became proficient in using social support. Four participants said that support should always be available for them in any application. Overall, these statements point to an interest in social support. In the following two subsections, we show older adults' expectations and helper selections in social support.

5.1.1 Expectations of Social Support. We requested the participants in each scenario to come up with a question about the scenario. The question should have represented their expectations of social support interactions. We coded the expectations of our participants from social support questions. We categorized the expectations into four main categories:

Advice: Expectations for a recommendation on how to make a particular online safety decision. We coded six out of 36 questions with advice requests. For example, in the permission management scenario, one participant asked, "Is this application dangerous? Can it have viruses?" (P8). This expectation is tied to a relatively narrow conversation, which revolves around providing security advice in a specific context. Therefore, the advice category is more focused and thinner than other categories, and exchange is limited.

Guide: Expectations for instructions on how to solve a specific online safety situation. We categorized 12 out of 36 questions as guidance requests. For example, P16 had asked for instruction about permission management: "How to find the contacts list?" (P5). This

Figure 2: The prototype interaction designs of the seeker questions and helper answers. Each task characterizes by a scenario (permission management, password input, and phishing), and each scenario includes support interactions with explanation and without explanation.

expectation leads to relatively narrow conversations that focus on guiding older adults toward a particular outcome. Practically, the main di erence between advice and guidance is the number of screens that the helper needs to support; one screen is used for advice, and guide support involves more than one screen.

Explanation: Expectations for explanations about how to solve the online safety situation. We coded 10 out of 36 questions as asking for explanations. Explanation requests may create an opportunity to learn about online safety. For instance, P8 had requested information about password management: "Why is my password

disquali ed?" and the helper could start a deeper conversation about password selection. This expectation involves a broader discussion, which includes explanations and reasoning of online safety.

Motivation: Expectations for explanations about the bene ts involved in some behavior, such as providing private information for engaging an application. For example, the participant had tried to understand whether they truly needed the application: "At the end of the process, what does it give me? What is the purpose? "(P7). We coded eight out of 36 questions with motivation requests. This expectation mostly leads to opportunities to start a broader conversation about online safety.

Participants described questions about security and privacy situations. Das et al.[12] noted that conversations about security features were a key enabler of a socially-driven behavioral change. Both broad and narrow conversations are essential for online safety learning.

5.1.2 Helpers Selection. We asked participants to point out the people they would choose to ask for help and explain their selection. Nine participants preferred to ask for support from their children. They reported trust and felt comfortable asking their children for support in online safety situations. For example, one participant described how she trusts her son with technical issues: "I trust my son with technology and know he can answer my questions, feel comfortable asking him, if busy he will call back" (P9).

Three participants mentioned support from their friends. They noted that their friends should understand smartphones: "People who know and understand smartphones. People that are experts in it (P6)". Four participants reported that they asked professionals for support. When participants did not choose a close family as helpers, they looked for people who had relevant expertise or were physically nearby. For example, P10 mentioned that she asked random people who were physically near her; in this case, she received free support but exposed her private information to strangers.

> Anyone who [physically] is close to me. Someone who can help that is close to me physically... No problem to ask strangers that can explain. Why not approach them? (P10)

Overall, our participants considered four factors when selecting helpers: trust, comfort, expertise, and physical closeness. With close social connections, e.g., family members, participants felt con dent and comfortable, even if they were not necessarily experts. Most participants trusted and felt comfortable asking for help from their children.

5.2 Characteristics of Social Support

We found di erent social support characteristics that are associated with empowerment and helplessness. We analyzed social support characteristics when we asked participants about the reaction to the scenarios. We describe these results next.

5.2.1 Empowerment by Social Support. We observed that social support interactions led older adults to feel empowered and report on meaningful engagement.

Intergenerational conversations: Social support provided opportunities for intergenerational discussions among older adults and younger adults. These conversations allowed the older generations to question and sometimes address technological norms deemed problematic. Speci cally, six participants were interested in understanding the tradeo s between the clear bene ts of the application and the costs of adopting new technology. In many cases, embracing new technology is directly related to retaining social ties, which can be easily communicated through social support. For example, a grandmother did not understand why she had to use WhatsApp, and her daughter helped her share with her granddaughter:

> My daughter arranged for me to install WhatsApp. I did not understand why it was convenient. No way I would have asked for it [because] I can call. My daughter insisted, and I agreed with her in the end. Then, I could talk with my granddaughter abroad (P14).

When participants described social support experiences, the experience often included an opportunity to talk more broadly about mobile safety. For example, one participant reported that he asked his social circle about mobile permissions:

> I began to ask friends, kids, grandchildren, and other family members, should I allow this permission [accessing contact list]? Did you hear about this? Did you know about this? (P17).

Social support provides the opportunity to share broader information about online safety. Conversations about security are a vital enabler of positive security behavior, for example, when people discuss security concerns with family and friends to determine the reasons for safer behavior[12]. Participants noted that they asked their friends and family, so even if they did not know how to solve the problem, they could start a conversation about how safety practices could address various threats.

Learning in social support: Several participants showed interest in being less dependent on others by learning to use the technology through social support. One participant generalized about the con dence other people provide when encountering new technology:

> The technology is new to me, something we have not encountered before, so it is good to hear details about it. For every application, I think that I need help... A person who does not always know well; someone needs to guide and teach. (P13)

The participant ties the ability to be independent in a continually changing world by having a social support network that can facilitate learning. Participants expressed a willingness to understand and learn from the helper. For example, P9 said that she asked her son to explain how to operate the smartphone, and now she can use the smartphone by herself. Another participant had written instructions based on her guidance to know what to do when her daughter was not around (P10).

Reaching technological independence: Some of our participants also seek social support to gain technological independence rather than rely on others. For example, one participant demonstrated her approach toward social support as the rst step of an escalating hierarchy of support venues:

> I asked for help with WhatsApp from a friend who knows about this technology more than I do. I talked to him on the phone, and he told me what to do, and I tried several times until I succeeded. If the problem continues, then I would contact the seller at the store and ask questions. I am not afraid to get help from people, and I am not scared to try. (P6)

The discussions between helpers and older adults touch on the types of barriers to technology adoption. The belief of older adults in learning and being independent is central to social support processes. For example, one participant noted that her daughter tried to teach her how to use the bank application, but because of the barrier of using technology and fear of being helpless; she preferred to go to the bank:

> I like to go to the bank twice a month. It suits me. My daughter says that you can download the application and not have to go to the bank. I do not want to. There is some barrier from not knowing whether I will not know how to operate or whether it is complicated. You need to make a switch in your head "you know it can help you, it is friendly." (P10)

Support in understandable language: Another barrier is related to intelligible languages. For example, one participant requested help without "tech language": "There are concepts that I do not always understand in a computer language that I do not speak every day. I ask for help when I do not know" (P18). As many digital services were only available in English, relying on friends and family to translate text was common. While most of our participants were able to understand English, they were not always comfortable with it. For example, one participant described that the problem was the language, and he waited for his daughter to translate: "The problem is in English, which I understand less. Afraid to click and to use the system :, I wait for my daughter to translate" (P4). Overall, participants are motivated to be independent and learn from their social supporters, who know their preferences and technical capabilities.

5.2.2 Helplessness Associated with Social Support. While most of our participants reported positive experiences related to social support, several reported feeling helpless due to a negative social support experience. We found that intolerance and physical distance are two leading social support challenges that cause older adults to feel helpless in mobile safety.

Intolerance : Two participants reported incidents in which helpers had little patience in assisting them. One participant described the gap between older adults and younger generations:

> Some people do not have the patience to explain: "You do not understand, we have already shown you once how to do it on Facebook." Today, the younger generation has no patience "Leave it, mother, you will not understand. We have already shown you." (P13)

As a result of these interactions, this participant felt less comfortable requesting support from her children. Participants connected the helper's impatience with their limitations. Four participants reported frustrating cognitive limitations such as impaired memory and forgetfulness, and slow speed of comprehension. P9 explained that they learn technologies slowly, and it took them time to understand. P14 had to see how to solve the problem several times before she understood. Another participant said that she forgot what was explained to her after two days (P18). These sorts of negative experiences have led participants to act more independently. One participant (P10) explained that the helper's negative attitude gave her the motivation for technology independence by requesting support with explanations to learn and address the issue next time by herself:

> When I had a problem, [my daughter said] "Mom, you do not understand." [I said to her] "So please explain it to me." While she is showing and explaining, I am writing. So, when my daughter is not next to me, I will know what to do. (P10)

When the helpers had only a little patience in assisting the seekers, the seekers want to become less dependent on their helpers as much as possible in the future.

Physical distance: Four participants had di culties explaining their problems and understanding the helpers when participants were not physically close to the helper. For example, one participant described barriers to understanding her son because they were not close to each other:

> My son wants to help and has no patience, he thinks fast, and he does not understand that I am not next to him. He tried to help with my smartphone so I would call my granddaughter, and he started asking me questions about passwords, and we could not contact the granddaughter abroad at the end. (P14)

5.3 Social Support Systems Design

We examined how older adults think that a mobile application can aid social support processes. We asked participants to design the question and the answer screens regarding the two scenarios presented with the permission management and password management scenarios.

We asked participants to describe how they preferred to ask for support. Most participants chose to send over support requests using screenshots of the screens they had trouble with (9 out of 18). Eight participants preferred to add text to the screenshot to explain the problem, and one had suggested assistance with video. Overall, participants preferred to request and receive mobile support with a combination of screenshots and text.

We asked participants to draw the location of the question and the answer on the printed paper scenarios (i.e., the permission management scenario and password management scenario). They wrote the question on the printed paper scenarios either near the decision they needed to make on the screen or at the bottom of the screen (see Appendix B for examples). P3 and P6 drew reactions of a smiley face or a sad face to express their feelings. P7 and P12 wrote their password on the screen to ask what was wrong. Three participants drew an arrow pointing to the element in the screen they wanted to highlight (P11, P12, P15). One participant drew a lock with a question mark to represent a security problem (P1). Participants expected the answer to be next to the question, usually beneath the question. For example, one participant drew stages for the helpers to complete.

When we asked participants about how they asked for help without the mobile application, we found that eight participants asked for help by calling the helper. Some participants preferred to use different methods than calling the helper. For example, one participant said that she wants to send a screenshot. Nevertheless, she needs someone to show her how to take a screenshot on her smartphone: "I will ask the question on the phone. I do not know how to take a screenshot, and I do not know how to send it. Someone needs to explain to me how to do it. A screenshot is better than typing" (P6). Our participants' main challenge when they are not nearby one another is to coordinate between visual and voice modalities. They face di culties aligning their experience on their phone (primarily visual) and the modalities of communicating with their social circle (which is mainly through voice). Therefore, getting help through text, images, or videos is inconvenient, and they prefer to talk on the phone, which makes it challenging to explain the problem. A social support system may use advanced methods to help older adults describe their mobile situations.

Overall, participants preferred to send support requests using screenshots annotated with text to explain the problem. They preferred the question placed either near the decision they had to make or at the bottom of the screen. Some used doodling to draw various reactions (smiley face or a sad face), arrows, and icon of a lock.

5.4 Interacting with the Prototype

To understand how social support systems can lead to potential positive outcomes, we investigate older adults' reactions to social support system designs. Our eighteen older adult participants executed six requesting and receiving social support (see Figure 2 for all tasks).

We compared support interactions with explanation and without explanation for each scenario. In the permission management scenario, 7 out of 18 preferred social support without explanation (advice design) compares to ten participants who have preferred explanation (long explanation design). In the password input scenario, 10 out of 18 participants preferred social support without explanation (validation design) compared to eight who preferred explanation (long explanation design). Finally, in the phishing message scenario, only one participant has preferred the social support suggestion without explanation (advice design), and 14 participants have preferred social support suggestion with the explanation (short explanation design). In most cases, we found that participants preferred support interactions with explanation rather than without an explanation (32 out of 54 instances). To further analyze the results, we used the participants' feedback gathered by the think-aloud method. We present the feedback comparing between explanations and without explanations designs. As described the following:

Without explanation: Participants found the advice design clear and straightforward. For example, one participant explained that advice about privacy permission included the absolute solution: "[Advice] is more suitable for those who are hesitant" (P11). P1 described that it is essential to remove uncertainty, which may remain "without the nal answer" (comparing to long explanation design). Explanations to describe the reasons for the suggestion are important. For example, in the phishing advice, participants have asked, "Why is the link unsafe?" (P9) and "Why?" (P17).

Participants described the validation design as easy to understand, yet they pointed that explanation was missing. For example, P8 explained that the password validation is short, but it can explain what went wrong accurately. He recommended adding an explanation when selecting a password, such as "a lowercase letter is missing." Explanations are required to describe the reasons for the decision. For example, participants' reactions to the password validations were "Why say no?" (P4) or "Why did he reject it? Need to say why rejected?" (P2). Therefore, we observed that explanations are essential to describe the suggestion.

With explanation: We displayed two types of social support design that use explanations: long explanation and short explanation. The long explanation design helps participants to learn how to solve the mobile safety situation. For example, one participant expressed the desire to be independent in the future and to know how to select a password: "Next time I will know what to do" (P10), and another participant mentioned that the long explanation "explains very well what needs to be done:" (P7). In contrast, one participant found that the explanations about the privacy permission were redundant. For instance, P5 said, "fewer stories and confusion" because the suggestion did not include in this design. Several participants requested the short explanation design, which presented the suggestions with an explanation. For example, one participant was interested in learning how to react to the scenario and becoming independent: "We need an explanation I will understand it better. Once there is an explanation, I try to think; otherwise, I am working as an automaton" (P6). Another participant described that "the combination of explanations below the nal solution wins. The description below clari es the situation" (P7). Fourteen out of 18 participants preferred to have a short explanation design. We observed that most of our participants were interested in learning from the mobile safety situation, and therefore explanations with suggestions were preferred.

Overall, most participants thought that the application was straightforward and reported that they would be happy to use the application (12 out of 18); the average score for "I will use this support system" was 5.26 (the standard error was 1.79; the range was 1 to 7). Participants mentioned that they recommended the application to friends (11 out of 18); the average score was 4.94 (the standard error was 2.19; the range was 1 to 7). One participant reported that "I think the system is good, friendly, and speaks to the user. The system simpli es and clari es things. It speaks to the general public and not to programmers." (P7)

6 DISCUSSION

This paper provides qualitative evidence for how social support may allow older adults to become more pro cient with mobile security and privacy. We document "support pathways" that demonstrate how older adults can become more con dent in using technology through social support and when they know that social support can be available to them. Previous studies have pointed to the limitations of social support for older adults [13] and di culty to learn from social [44]. Our analysis points to the importance of the design of social support systems and embedding them in existing relationships. We found that most participants reported trust and comfort in receiving some form of social support, mainly from their

children. They preferred a combination of a suggestion with a short explanation to understand and learn how to solve similar mobile safety problems independently. If they do not receive an explanation, they ask for it. Social support technologies can empower older adults to tackle mobile security and privacy challenges through intergenerational conversations and active learning. They also can address intolerance of helpers and communicate problems due to physical distance.

We rst discuss what we discovered about social support used by older adults for mobile safety challenges. Then, we re ect on the challenges of social support related to intergenerational impatience. Finally, we discuss the limitations of our study and future work.

6.1 Social Support and Empowerment

Our social support interactions analysis highlights how helpers, especially from younger generations, may bene t from assisting with mobile safety situations. Support interactions provide opportunities for communication with older relatives. Social support is a convenient avenue for spurring more general conversations and can be seen as an opportunity to strengthen ties. Even more importantly, social support provides opportunities for intergenerational conversations that allow older adults to address technological norms that they deemed problematic. These intergenerational conversations may provide younger generations with a di erent perspective on new technologies' ethical and normative nature. Future work could extend the notion of intergenerational support to examine factors that motivate helpers and older adults to use the social support system.

One of the most critical aspects of social support is broader conversations about online safety. Prior studies show that conversations about security and privacy are primarily educational and are crucial for learning how to use new technology [12]. Our analysis shows that social support interactions had two essential elements for e cient support. First, unlike manuals, the instructions in social support are in language and jargon that older adults can understand. Support from close connections familiar with older adults' preferences allows older adults to learn in their language about online safety. Second, the conversations provided broader motivations, explanations, and advice customized to the seeker's preferences and abilities. Overall, social support interactions provide help customized for older adults.

Social support systems have the potential to empower older adults and drive meaningful engagement in mobile safety challenges. We found that participants shared and alerted friends and family for mobile security and privacy, which re ected motivations to use social support and increase awareness. Moreover, most participants were interested in receiving advice and explanations to learn online security. Explanation in understandable language about online safety can help them to learn and become independent smartphone users. While previous studies were not successful in proving older adults learning through social support [18, 44], our ndings point to the potential of a positive support pathway: experiences that start with social backing but increase the individual's learning.

6.2 Intergenerational Impatience

While we document mainly positive aspects of social support, our ndings can understand how we can avoid several negative aspects. Participants felt frustrated by the cognitive limitations caused by age, such as impaired memory and forgetfulness, the slow pace of comprehension, and limited mental clarity. Our ndings support existing results that documented this kind of age-related frustration [40]. We extend the existing literature by providing the negative aspects when older adults use social support for mobile safety issues. Our participants felt that age-related limitations could cause intolerance in social support. The participants felt that helpers had little patience in assisting them because they asked the helper to explain slowly and did not remember the helper's explanation after a few days. Ageist stereotypes can hinder older adults' technology adoption. Cuddy et al. argue that ageism is pan-cultural and common even in more traditional societies, where respect for older people is considered a signi cant social value [10]. At the same time, we observed that our participants ask for deeper explanations to handle the problem independently in the future.

We found that many social support challenges are related to seekers and helpers' lack of physical closeness. Participants had di culties explaining the technical problem and understanding the helpers when participants were not physically close to the helper. The COVID-19 outbreak led to increased social isolation and directed older adults' social life online [38]. Therefore, helpers could not be physically close to older adults to help with mobile safety problems. It emphasizes the importance of helpers understanding and awareness of older adults' security and privacy preferences. When helpers know older adults' preferences, they have a better understanding of how to help. Additionally, helpers can leverage older adults' existing knowledge of other technologies they are familiar with and then bridge analogies to similar concepts in newer platforms.

Social support technology could help solve these challenges by using a mechanism and user interfaces to describe the situation to helpers and explain in understandable language based on older adults' preferences. Our study shows that older adults can use social support systems to address mobile safety problems. Participants described that they would prefer a short explanation, a combination of advice and explanation, to learn what to do the next time independently.

6.3 Limitations

This study aimed to capture the understanding of older adults using social support in mobile safety situations. We conducted a convenience sample with independent older adults with an active social life. We advertised and conducted interviews in person within our lab at the university, so most of our older adults in our sample are semiretired, which may provide them with a wide range of social connections, such as friends, coworkers, and family. We miss the population of older adults who need more support and have higher probabilities of living in assisted living facilities. Nevertheless, since we assume that our sample has a wide range of social connections, we can better understand o ine social support interactions and move them to online interactions. Further studies would have to

be carried out with an older adults' heterogeneous population to generalize the results to the entire older adults' population.

Our sample of educated older adults is likely to become more common and representative in the coming years in other countries. Understanding how this sample learned and received support to use technology can help develop technology that eases the social support process of future models in other countries.

Importantly, culture is crucial in how older adults manage social relationships and their access to social support [19]. Most older people in Israel maintain a close connection with their children and proximity live close to at least one of their children, and most of them retain daily contact in person or by phone with their children [23]. Further studies should examine the assistance process for a variety of cultures. Moreover, in this paper, we have analyzed the seekers' point of view. Future work could extend this research by collecting data from helpers and older adults to understand their interactions further.

7 CONCLUSIONS

This study conducted an exploratory study to investigate attitudes towards social support technologies helping older adults with security and privacy challenges. We interviewed and used the think-aloud method to gather data about a prototype for providing social support during mobile safety challenges with 18 older adults. Seeking social support is a common strategy in overcoming mobile threats, and older adults often ask for support from their children. Support requests include opportunities for teachable moments that may have a positive support pathway: experiences that start with social backing but increase the individual's self-e cacy. Intergenerational conversations allow older people to generate help and sometimes address technological norms deemed problematic. Older adults requested explanations and advice in an understandable language without the tech jargon to learn from close connections. Social support technology may help older adults use their immediate social network most e ectively by addressing intolerance of helpers and communication problems due to physical distance.

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A APPENDICES

A.1 Interview Questions

For the first scenario, we displayed participants the scenario of permission management, and then in the second scenario, we presented participants the screenshot of password management (Figure 3).

We had permission management and password management scenarios; both of them were displayed to participants. The permission management was related to a privacy situation when participants were asked to allow contact lists permission. We told participants that "The Telegram app (which allows sending text messages to friends) is installed by most people close to you and to contact them, you have installed the app. Let us say you already have the app installed on your device. In this task, the app is launched on your device. Then you see this screen." The password input scenario is a signup screen that was related to a security situation. We told participants: "you decided to open an email account on Google (Gmail), you are asked to choose a password."

For each scenario, we asked participants while observing the screenshot, and then we asked:

1) Please describe what is displayed on the smartphone screen?
2) Please recall a similar case that happened to you in the past. Where and when did it happen to you before? How did you deal with it?
3) Do you have any questions or concerns if the screen would appear on your smartphone?
4) What questions do you want to ask if the screen would appear on your smartphone?
5) What set of design screens do you suggest that allowed you to request and receive support?
6) What forms of support do you prefer? The options were calling, texting, video, and screenshots.
7) Can you please draw on paper user interfaces that could explain your questions with the given safety scenarios?
8) What forms of communication do you prefer to receive assistance? The options were calling, texting, video, and screenshots.
9) Whom would you ask for help? Why? What is the type of relationship and the age of the helper?

A.2 Social Support Design

We asked participants to design the question and the answer screens on the permission management and password management scenarios. See examples in Figure 4