Toward Inclusive Security and Privacy for Deaf and Hard-of-Hearing People: A Community-Based Interview Study

Mindy Tran*, Xinru Tang*†, Adryana Hutchinson‡, Adam J. Aviv‡, Yixin Zou*
*Max Planck Institute for Security and Privacy †University of California, Irvine ‡The George Washington University
Email: {mindy.tran, yixin.zou}@mpi-sp.org, xinrut1@uci.edu, {adryana.hutchinson, aaviv}@gwu.edu

***Abstract*—About 5% of the world's population experience disabling hearing loss. Nevertheless, deaf and hard-of-hearing (DHH) communities remain an understudied and underserved population in security and privacy (S&P) research. We conducted 24 semi-structured interviews with DHH participants (n=17) and their supporters (n=7) in Germany to explore (1) how DHH people perceive S&P risks in assistive technologies, (2) concerns about disclosing their identity and sharing sign language content online, and (3) sources of advice and common challenges. Our findings highlight participants' limited awareness of S&P risks in assistive hearing devices and limited interest in sign language video anonymization tools. DHH participants expressed concerns about identity disclosure—whether voluntary, involuntary, or mediated by third parties—and found existing S&P mechanisms and resources largely inaccessible. As a result, they often relied on trusted networks for support. While supporters were generally willing to help, their limited S&P knowledge, social dynamics within the DHH community, and translation challenges between spoken and sign languages hindered effective information sharing. Our research provides implications for researchers, industry practitioners, and policymakers to develop more effective and inclusive S&P tools and resources for DHH communities.**

1. Introduction

According to the World Health Organization, 430 million people, equivalent to over 5% of the world's population, experience disabling hearing loss [1].[1] The use of sign language is at the core of Deaf[2] identity, and there are over 200 sign languages according to the World Federation of the Deaf [4]. Nonetheless, deaf and hard-of-hearing (DHH) people[3] remain an understudied population in security and privacy (S&P) research and in the broader accessibility research [6]. While recent work has sought to include diverse marginalized populations in designing technologies and addressing harms [7], less is known about DHH people compared to people living with other disabilities [8].

The lack of representation of DHH people stands in contrast to the potential S&P risks they face. While assistive technologies, such as hearing aids and cochlear implants (CIs) play a crucial role in helping DHH people navigate daily life, they can also be exploited for eavesdropping, unauthorized access, and inference from malicious attackers [9], [10]. Voice-based authentication systems are used in various customer service settings (e.g., when customers verify their identity over the phone with their banks), but remain largely inaccessible to DHH people due to their reliance on spoken interactions [11], [12], [13]. Compared to textual and audio information, sign language is inherently visual, relying on hand movements and facial expressions—characteristics that introduce additional privacy risks for sign language users [14]. Moreover, disability and transformative justice activist Mia Mingus coined the term 'Forced Intimacy' to describe the onus on disabled people to disclose very personal information to able-bodied individuals for basic access [15]. Forced intimacy could also apply to DHH people, especially those who use sign language and rely on interpreters for information access, as they may have to share sensitive information with unfamiliar parties to communicate with the hearing society [16].

All the issues above highlight the need to rigorously understand how DHH people understand and manage S&P risks. While prior work has explored aspects of DHH users' S&P experiences in specific domains—such as when using voice-based authentication [12] and online dating platforms [17]—S&P concerns are typically secondary in their broader findings about accessibility. We conduct a more comprehensive investigation into how DHH people perceive, experience, and mitigate S&P risks across contexts, including the use of assistive technologies and the disclosure of

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[1] While we adhere to the terminology used by the WHO, we acknowledge that people have different understandings of how much hearing loss is considered a disability and if deafness is a loss or disability [2].

[2] Every statistic is calculated by a certain way of understanding d/Deafness. Lowercase *deaf* is oftentimes used to refer to an audiological condition. Uppercase *Deaf* is often used in the cultural sense, referring to a set of beliefs, practices, and traditions that are influenced by deafness and the use of sign languages as a primary form of communication [3]. We use d/Deaf to refer to people who identify as deaf, Deaf, or both and use sign languages.

[3] We use identity-first language throughout (including DHH, d/Deaf individuals), while acknowledging that people have varied preferences [5]. When addressing specific communities, we use the language used within the communities (e.g., 'd/Deaf' on their website). We use 'DHH' as an inclusive term to refer to participants who identify as d/Deaf or hard-of-hearing.

personal information both online and offline. We further assess how existing S&P tools and resources address, or fail to address, the specific needs of this population. Given that people's S&P practices are often social in nature [18], we also incorporate a collaborative lens in our research by involving those who support DHH people in everyday life—employees at support organizations, individuals who regularly organize and support events for local DHH communities, and friends or family members.

Our research addresses the following research questions:

RQ1: How do DHH people perceive and manage potential S&P risks when using (assistive) technologies?
RQ2: What S&P concerns arise for DHH people when disclosing their identity or personal information?
RQ3: What S&P advice do DHH people receive and give each other? What challenges exist with such advice?

We conducted 24 semi-structured interviews with DHH participants (n=17) and their supporters (n=7) in Germany. To ensure research justice and mitigate potential harms out of the researcher-participant power dynamics when working with marginalized populations [19], we developed our recruitment and interview protocol based on a year-long engagement with various local DHH-related communities and organizations. Our participants were recruited from a local d/Deaf community, DHH-related organizations and centers, and through snowball sampling. In the interviews, we asked DHH participants about their tech (non-)use and S&P-related concerns when using technology before probing into four scenarios (e.g., scams, advice and support, disability disclosure, and interactions with third parties). For interviews with supporters, we focus on how they provide assistance and what S&P challenges they observe in the DHH community.

We found that DHH participants were generally unaware of and unconcerned about potential S&P risks related to their hearing aids and CIs. In addition, participants expressed disengagement with sign language video anonymization tools as a type of privacy-enhancing technology intended for DHH people. Their risk perceptions mostly came from disclosing their identity, sharing sign language content online, and interacting with third parties such as sign language interpreters or community members. DHH participants resorted to their trusted network for support (e.g., for identifying and navigating scams in written language), as existing S&P mechanisms and resources were not accessible, particularly due to the lack of sign language support. While supporters played a crucial role in disseminating information and helping DHH people navigate S&P risks, they also struggled with their own limited S&P expertise, and translation challenges with abstract words like "computer security."

Our findings demonstrate how the inaccessibility of S&P tools and resources impacts DHH people's everyday experiences. We explore the implications of these issues and offer recommendations for researchers, industry practitioners, and policymakers. Researchers should engage more deeply with the community and prioritize participatory design approaches. Industry practitioners should actively improve accessibility of their services by providing multiple modalities and developing tools that can effectively support the community. Finally, policymakers can establish tailored awareness interventions and leverage community influence to disseminate S&P information within the community.

2. Background and Related Work

We first provide necessary background information about Deaf culture and sign languages, then review accessibility and S&P literature related to DHH communities.

2.1. Deafness and the Deaf Culture

2.1.1. Different Models of Deafness. There are medical [20], social [21], and cultural [3], [22] models of deafness. The medical model views deafness as a medical condition or disability that needs to be 'cured' for the benefit of the individual and society by using speech therapy, auditory training, or cochlear implants. The social model views deaf individuals as living with a disability, but highlights that the primary issues are not in the hearing but the barriers that are created by society, such as a lack of sign language support, interpreters, and discrimination. The cultural model sees deafness as its own culture with unique practices, beliefs, and languages. Sign languages play a major role in Deaf culture, and many DHH individuals learn spoken/written languages as a second language [23]. Even individuals proficient in written languages may still prefer using sign language as their native language [24]. Following the social and cultural models of deafness, our research focuses on individuals who are involved in DHH communities to some degree, not necessarily including older adults experiencing hearing loss in later life.

2.1.2. Sign, Spoken, and Written Languages. Sign languages have distinct syntax, grammar, and semantic structures that differ significantly from spoken/written languages [25], [26]. In contrast to spoken/written languages following linear structures, sign languages are visual-spatial (non-linear) and rely on both manual elements (e.g., hand shapes, movements, and locations) and non-manual signals (e.g., facial expressions and mouthing) as critical expressive elements [2]. As such, written languages can pose significant barriers for many DHH individuals, and they tend to have lower literacy in written language compared to their hearing peers [27]. Moreover, translating between sign languages and spoken/written languages is complex and involves many challenges [25], [28]. For instance, German sign language (DGS) currently lacks a standardized form and consists of several regional dialects that have not been extensively researched [29], [30], [31]. In addition, younger people who use sign language tend to use different signs than older generations [29], [32]. This language gap often contributes to limited access to sign language information and education (e.g., health content [33]) and a loss of incidental learning opportunities, such as learning from peers' conversations [33]. These linguistic and cultural differences shape the communication barriers that DHH communities face in their daily lives and often lead to systematic exclusion in various contexts. This barrier can further extend to their interactions with S&P information and systems, where complex language in S&P advice [34] and technical jargon in privacy policies [35] already present challenges for hearing people.

2.2. Security, Privacy, and Technology Use in DHH Communities

Recent human-centered security and privacy research has paid increasing attention to the S&P needs and practices among disabled people, especially visual disabilities [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46] and cognitive disabilities such as dyslexia [40], [47], [48] and down syndrome [49]. This line of work also informs the development of more accessible S&P technologies and design practices for disabled people [50], [51], e.g., tools for blind people to obfuscate private images [42], [52] and website/email security indicators for people with visual disabilities [53], [54].

Nevertheless, few studies at S&P venues have focused on the S&P needs and practices among DHH people. Even in the broader HCI and accessibility research, only 8.5% of articles published at ASSETS and SIGCHI between 2010 and 2019 exclusively focused on DHH people, and most of the studies focused on DHH people's communication needs [6]. There is also a dearth of research on accessible authentication techniques for DHH people [11].

DHH people use a wide set of technologies [55], [56], [57], including smartphones [58], personal computers [59], smart assistants [60], and social media [61], as well as assistive technologies that cater to their needs (such as hearing aids, CIs, flashing doorbells, and sound awareness systems) [62], [63]. Many of these technologies may bring unique S&P risks to this population. Malicious remote reprogramming attacks can target CIs and hearing aids, making the device a relay point for all sounds in the user's surrounding environment [9], [10]. Sound-awareness systems collect an extensive amount of information that can trigger users' privacy concerns, especially when always-on sound monitoring occurs in the home setting [64]. Privacy risks can also originate from sharing sign language videos online as the videos reveal one's face [14]. Unlike written communication, which allows for fully anonymous interactions online, sign language communication remains largely tied to visual representation, which limits privacy and anonymity of the sign language user [14].

Nevertheless, little is known about the extent to which DHH people know about the aforementioned risks and how they address the perceived risks. A few studies touch on the S&P aspects in the broader contexts of DHH people's technology use. Focusing on authentication in customer support settings, Andrew et al. found that DHH participants often had to trust third-party support to use voice-based authentication [12]. For self-presentation in online dating, Zhu et al. found that while DHH participants hesitated to reveal their hearing status, they actively revealed relationship challenges with respect to hearing-DHH relationships [17]. Other studies have included DHH participants as a subgroup of disabled people when investigating accessibility issues of authentication [39] and online dating [65]. Our research addresses a critical gap in S&P literature and complements prior work by offering a more comprehensive understanding of DHH people's S&P risk perceptions and practices across diverse online and offline contexts, and the extent to which existing S&P tools and advice serve their needs.

2.3. Interactions with Supporters

A growing body of S&P literature highlights the critical role of supporters in helping at-risk groups such as older adults [66], migrants [67], refugees [68], LGBTQ+ [69], people with low socioeconomic status [70], or sex workers [71]. In parallel, accessibility research has examined the dynamics between disabled people and their support networks (e.g., employers, family, friends, peers, and communities) for using authentication methods [39], [72] and navigating everyday S&P [73], [74], [75]. For instance, Hayes et al. showed that people with visual disabilities rely on allies for S&P support, but privacy concerns still shape their decisions about whom to trust, even for family members [73]. Similarly, Erinola et al. found that human assistance is crucial for disabled users during authentication tasks, e.g., by helping out with recovering credentials or setting up card readers [39].

While relational support is valuable, research shows that disabled people might have concerns about bothering others and appearing dependent [76], [77]. Kröger revealed the power imbalance within support relationships, characterized by asymmetries in needs, interests, and autonomy [78]. In addition, existing S&P mechanisms often fail to support the negotiation of access to shared resources [18]. For instance, older adults with mild cognitive disabilities often have to share their security-sensitive information, such as passwords, with their caregivers due to limited support for shared account management [74], [75], [79].

As "the first community of relatedness to emerge in the disability sphere" [80], d/Deaf communities have a long and strong tradition of collaborating in creating access. Due to a lack of information provided in sign languages, friends, family members, and communities play a significant role in d/Deaf people's information access [24], [81], [82]. Information access among d/Deaf people is both a linguistic and a cultural issue [24]. d/Deaf people often prefer visually-oriented content aligned with Deaf norms and culture, which typically requires a deep understanding forged in close relationships [83]. As a result, d/Deaf people often perceive information shared by community members as more valid than other sources [24].

Previous research on DHH people typically focused on their individual experiences or interactions within DHH communities [14], [62], [84]. Inspired by prior work that examined the dynamics between other disabled people and their support networks [72], [73], [74], [75], we include the broader network embedded in DHH communities and examine how they collaboratively navigate S&P challenges and practices with DHH people.

3. Methods

We ground the inquiry of DHH people's S&P risk perception and management in three aspects: (1) DHH-relevant assistive technologies, (2) identity and information disclosure, and (3) sources and challenges regarding existing tools and advice.We conducted 24 semi-structured interviews with DHH individuals (n=17) and people in their support networks (n=7). Below, we describe our community engagement efforts, recruitment and interview protocol, data analysis procedure, limitations, and ethical considerations.

3.1. Study Design and Community Engagement

Prior work highlights the importance of community engagement when conducting research with Deaf communities [85], [86]. As such, we actively engaged with several DHH communities and organizations throughout the research process. Our community engagement informed our study design, guided the development of our interview protocol, and gave us a deeper understanding of the community's cultural context and lived experiences.

For the research method, the community members we established contact with strongly recommended interviews over other qualitative methods (e.g., observations) that may be too invasive and not well-received by the community. They also viewed surveys – even with sign language translations – as too burdensome for participants and lacking opportunities to clarify misunderstandings. Afterward, we developed our initial interview protocol based on our literature review (§2).

Subsequently, we refined the interview protocol to ensure it is relevant to the community and grounded in empirical observations. To align our research goals with DHH communities' interests and concerns, the lead author started the community engagement effort through multiple visits to a sheltered workshop[4] that accommodates people who are DHH and deafblind.[5] During these visits, we sought feedback from employees there on our study design regarding feasibility, ethical considerations, compensation, and recruitment channels. We further conducted informal interviews with three hard-of-hearing members and piloted our initial interview protocol with two deafblind members to gather preliminary feedback. We iteratively refined the phrasing of our interview questions based on the feedback.

After the workshop visits, and for almost a year before we officially started recruitment, the lead author engaged in various activities to learn more about Deaf culture and build trust with members of a local d/Deaf community in Germany. These activities included attending weekly sign language classes, participating in sign language meetups and game nights, joining church events, and volunteering in a donation hosted by this community. We pilot-tested the interview protocol with one d/Deaf community member. Furthermore, we consulted several community members and three experts in sign language and/or d/Deaf studies to elicit their feedback and adjust our interview protocol accordingly. Our final protocols are available in Appendix A.

3.2. Recruitment and Demographics

We spent seven months recruiting participants from Germany using various channels: (1) direct contact with a local d/Deaf community, (2) snowball sampling, and (3) recruitment through DHH-related organizations, centers, and schools. We ended data collection after reaching data saturation, with no new themes emerging from the data analysis [90].

We recruited several participants from a local d/Deaf community in Germany and expanded our recruitment through snowball sampling, whereby participants recommend others who qualify for this study [91]. Although this method was very effective for us to get the first few participants, we realized that due to the shared connections, these participants had similar experiences and backgrounds. Thus, we diversified our recruitment channels and reached out to more DHH organizations, communities, and schools in Germany. Most of them were suggested by members of the local d/Deaf community and our sign language interpreters. Altogether, 10 participants were recruited from the local d/Deaf community and snowball sampling, and the remaining 14 participants came from the broader outreach in Germany.

For DHH individuals, we looked for individuals who (1) self-identify as DHH, (2) are at least 18 years old, and (3) can communicate in German, DGS, or English.[6] For supporters, we similarly looked for individuals who (1) regularly interact with DHH communities, (2) are at least 18 years old, and (3) can communicate in German, DGS, or English. We had a total of 24 participants, including 17 DHH participants and seven supporters. About half of the DHH participants (n=9) self-described their hearing status as deaf, attended a deaf school, and prefer to use sign language to communicate. Most of the supporters (n=6) self-described their hearing status as hearing, were educated, and able to communicate in DGS. Table 1 and Table 2 summarize the detailed demographics for DHH participants and

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[4] A sheltered workshop describes a model of vocational rehabilitation for people with severe disabilities, who are not, not yet, or not yet again able to work on the open labor market [87].

[5] Deafblind refers to individuals with combined hearing and vision disabilities. Deafblind individuals communicate in a number of ways, including spoken languages, sign languages, tactile sign languages [88], or Lorm alphabet [89].

[6] We did not include sign languages of English-speaking countries, such as ASL, since DGS is the predominant sign language in Germany, and it would be challenging to find a suitable interpreter for other less commonly used sign languages in our region.

supporters, respectively. We also provide a more detailed description of the supporters' role and relationship in the Appendix B

3.3. Interview Procedure

For DHH participants, we began by asking about their demographics and background (e.g., hearing status, community belonging, and preferred means of communication). We then inquired about their technology (non-) use, including use cases, frequency, and reasons behind use or non-use for each mentioned technology.

Next, we delved into DHH participants' S&P risk perceptions, potential concerns, and practices in four scenarios: (1) scams and fraud, (2) S&P-related advice and support, (3) disability disclosure, and (4) interaction with third parties. This scenario-based approach and the specific scenario selection were informed by our literature review (§2) and community engagement. Our initial interview protocol consisted of broad, open-ended questions about S&P only. However, from pilot interviews, we learned that generic discussions did not lead to useful data. Rather, scenarios are necessary to help participants relate S&P to their day-to-day experiences and provoke detailed responses [92], [93], particularly since some studies suggest that DHH people may engage more effectively with concrete examples than with abstract thinking [94], [95]. We went through an iterative process to ensure the final scenarios aligned with DHH participants' actual concerns. To minimize priming effects, we asked participants about their general S&P concerns first, open-endedly before getting into the scenarios. Throughout the interview and when relevant, we probed participants about potential S&P concerns regarding DHH-relevant assistive technologies or services (e.g., relay services, hearing aids, cochlear implants, and face anonymization tools).

For supporters, we similarly started off with general questions about their demographics, hearing status, relationship to the DHH individual and/or community they support, and sign language proficiency. Afterward, we asked about their role in the community and their views on S&P in DHH people's lives. Thereafter, we probed about observed challenges in the community and support they provided in two relevant scenarios: (1) scams and fraud, and (2) giving advice. These scenarios were similarly chosen based on insights from community engagement and the pilot interview. Lastly, we presented popular S&P advice based on research conducted with hearing people [96], [97], [98], and their perspective on how such advice may differ for DHH people.

All interviews were conducted between July 2024 and January 2025 by the lead author. Among them, 22 were conducted in person at locations chosen by the participant (e.g., sign language meetups, deaf schools, or public libraries), and two were conducted online over Zoom. Discussing unfamiliar S&P topics and engaging with sign language interpreters for extended periods can be mentally draining for DHH participants. Therefore, we carefully managed the interview length to ensure we gathered relevant insights without harming participants' well-being. The interviews with DHH participants lasted 54 minutes on average (min: 32 mins; max: 91 mins). The interviews with supporters lasted 29 minutes on average (min: 16 mins; max: 47 mins).

All interviews were conducted in the languages preferred by the participant: 12 interviews were conducted in spoken German, 10 in DGS, one in sign-supported speech (LGB), and one in spoken English. We hired professional sign language interpreters for all interviews conducted in DGS, and two DHH participants additionally brought in their partner or family member for support. Sign language interpreters paraphrased S&P terms without equivalent signs in a dialogic manner. Discussing abstract S&P concepts coined in hearing languages and cultures is difficult, so the lead author was also present in all interviews to clarify misunderstandings and provide missing details when needed. The majority of interviews were audio-recorded and later transcribed using a GDPR-compliant transcription service. For interviews conducted in DGS, we recorded the interpretation of the sign language interpreter to protect participants' privacy. Two DHH participants felt uncomfortable being audio-recorded, so the interviewer took detailed notes during the interview instead. We acknowledge that this protocol may have introduced experimenter bias; however, it was important that we prioritize participant comfort, respect their preferences, and preserve their unique perspective.

3.4. Data Analysis

We used open coding to qualitatively analyze our data [99]. Following established practices of qualitative analysis [100], one researcher worked as the primary coder and was responsible for coding all transcripts. They also took the lead in creating, updating, and revising the codebook. The primary coder coded the first two interview transcripts to create an initial codebook. Our research questions informed our initial codebook structure. However, our coding process remained open to new themes emerging from the data, so that we balance between a structured analysis and the flexibility to capture unexpected insights. As part of the coding process, the primary coder highlighted quotes or sections that seemed particularly meaningful to answer the research questions, jotted down thoughts or potential patterns, and tracked clear codes using MAXQDA [101] and Miro [102]. For instance, the quote "I also often simply don't understand written language that well" was coded as "written language barriers." All codes were organized into categories and revisited every few transcripts to avoid redundant codes.

To achieve a mutual understanding of the codebook, two secondary coders used it to code the same two interview transcripts. We calculated inter-rater reliability (IRR) to guide our discussions and reflect on our coding. The primary coder reached a high IRR (κ=0.81) with the first secondary coder and a substantial IRR (κ=0.67) with the second secondary coder [103]. Afterward, all three coders met to collaboratively resolve any remaining disagreements and iterate on the initial codebook. All remaining transcripts were double-coded by the primary coder and one of the secondary

TABLE 1. DHH PARTICIPANTS' DEMOGRAPHICS

ID	General information				DHH related information		
	Age	**Gender**	**Formal education**	**Occupation**	**Hearing status[1]**	**Language(s) practiced**	**DGS proficiency[2]**
D01	43	Male	Deaf school, Vocational training	Mover	deaf	DGS	Good
D02	39	Male	General school, Technical University	Electronic Engineer	deaf, HoH	Russian, German, DGS	Intermediate
D03	46	Male	Deaf school, Vocational training	Painter, Varnisher	deaf	German, DGS	Proficient
D04	48	Male	Deaf school, Secondary general school	Warehouse Worker	deaf	DGS	Proficient
D05	59	Female	Deaf School, Vocational training	Service Sector	HoH	German, DGS	Proficient
D06	19	Male	Deaf school, Intermediate school	Student	HoH	German, English	Basic
D07	23	Female	Deaf school, High school	University student	deaf	DGS, German	Good
D08	25	Male	General school, undergraduate degree	University student	HoH	Persian, Turkish, English	None
D09	19	Female	Deaf school, Intermediate school	Student	HoH	German	Basic
D10	19	Male	Deaf school, Intermediate school	Student	deaf	German	Basic
D11	19	Female	General/Deaf school, Intermediate school	Student	deaf, HoH	DGS	Intermediate
D12	22	Male	Deaf school, Intermediate school	Student	deaf	DGS	Proficient
D13	27	Female	Deaf school, N/A	Educator, sign language teacher	deaf	DGS, German	Proficient
D14	22	Female	Deaf school, Intermediate school	Hotel service staff	deaf	DGS	Proficient
D15	20	Male	Deaf school, Intermediate school	Student, sign language teacher	deaf	DGS, TİD. ASL	Proficient
D16	18	Male	Deaf school, Intermediate school	Student	HoH	German, DGS, LGB	Intermediate
D17	31	Male	General school, university degree	Sign language teacher	HoH	German, DGS	Proficient

[1] The hearing status was self-described by the participants.

[2] The sign language proficiency is an estimation based on the self-description of the participants.

TABLE 2. SUPPORTERS' DEMOGRAPHICS

ID	General information				DHH related information			
	Age	**Gender**	**Formal education**	**Occupation**	**Hearing status[1]**	**Relationship**	**Assistance**	**DGS proficiency[2]**
S1	42	Female	Bachelor's Degree	Pastor	Hearing	Community pastor (D01-D05)	Church, Meetups, Teacher	Proficient
S2	23	Female	High School	Tax clerk	Hearing	Community volunteer (D01-D05)	Doctor, Grocery, Meetups	Basic
S3	31	Male	Master's Degree	Software test engineer	Hearing	Community member (D01-D05)	Meetups	Basic
S4	38	Male	Master's Degree	Job coach, Pedagogue	Hearing	Community member (D01-D05), Partner	Article writer, Meetups	Basic
S5	60	Male	Diploma	Pensioner, Lecturer	Hearing	CODA, Lecturer, Volunteer	Interpreting, Lecturer	Proficient
S6	53	Female	College Degree	Inclusion consultant	Hearing	University Inclusion Center (D07, D08)	Consulting	None
S7	26	Male	Bachelor's Degree	Sign language interpreter	Hearing	Sign language interpreter	Interpreting	Proficient

[1] The hearing status was self-described by the participants.

[2] The sign language proficiency is an estimation based on the self-description of the participants.

coders to ensure that we do not miss any important details. The primary coder regularly coordinated with the secondary coders to reach consensus and refine the codebook. In the end, all three coders met to jointly reflect on the data and identify important themes from all interviews [104]. Our final codebooks are included in the Appendix A.

3.5. Limitations

Our study has several limitations. First, similar to any other interview study, our collected data is subject to participants' acquiescence and social desirability bias. To ensure that participants felt accepted no matter what response they gave, we assured participants that we were seeking their honest thoughts and views, none of the questions were trying to test their knowledge, and we would not judge their opinion. We also framed the interview questions as open-endedly as possible to prevent participants from simply agreeing or disagreeing.

Second, our sample size is limited to Germany and may not capture cultural, linguistic, and contextual differences across other regions and communities. However, we made every effort to recruit participants with diverse backgrounds and ended data collection after reaching saturation. We do not claim that our findings fully represent the experiences of all DHH people, as generalizability is never the goal for qualitative research [105]. When presenting findings, we also refrain from reporting exact counts to avoid implying generalizability. Instead, we focus on reporting common issues and relevant themes. Future research could explore similar questions in other cultural contexts to assess cross-cultural differences or patterns. In addition, future research could complement our interview approach with ethnographic or observational methods to collect data in more naturalistic settings.

Lastly, our interviews were conducted in multiple languages, including German, DGS, and English. Some idioms, expressions, slang, and structures can be language-specific and unique to specific cultures, introducing gaps when translating content from one language or one culture to another. As our best efforts to mitigate nuances lost in translation, all interviews were mediated and double-checked by two professional sign language interpreters (in two cases, a trusted individual chosen by the participant) who supported the translation and clarified any misunderstandings during the interview. All German transcripts were translated into English by a bilingual researcher. To ensure accuracy and reduce potential bias, all translated quotes were independently reviewed by a bilingual colleague who is not part of the research team. The reviewer did not observe any significant mistranslations but provided minor suggestions to improve accuracy and better capture nuances. These suggestions were reviewed and incorporated into the final translations.

3.6. Accessibility Considerations and Ethics

This study was approved by the Ethics Review Board at the authors' institution. Additionally, we followed ethical practices for conducting research with marginalized/at-risk populations [19], [106], [107] and DHH communities [85], [86], detailed as below.

To promote research justice and minimize potential harm (§3.1), we engaged closely with DHH communities throughout the research process. While we initially sought to include DHH individuals on our research team, those we contacted were unable to commit formally but provided valuable feedback. Several local d/Deaf community members reviewed and approved our research design, consent form, and interview protocol.

Before each interview, we obtained informed consent regarding the study's purpose, procedures, and potential risks. For DGS users, the consent process was conducted in DGS through a dialogic format to encourage Q&A and allow participants to make informed decisions. We also asked for consent before audio-recording and offered to take notes if participants were uncomfortable being audio-recorded. During the interview, participants could skip questions, take breaks, pause recordings, or withdraw at any time without consequence. We offered each participant 25€ for the interview compensation, aligned with Germany's average hourly wage and calibrated with the local d/Deaf community's feedback. Participants could also decline the compensation and decide to participate voluntarily.

Positionality. Our personal experiences, identity, and beliefs influence and shape our research process and choices [108]. All five researchers in our team have academic training in security and privacy. One researcher has done professional accessibility work. One researcher has academic training in accessibility research and has previously conducted research with d/Deaf communities in China. As a team, we bring together expertise in security, privacy, and accessibility and exchange knowledge across disciplines while applying our perspectives to interpret findings and form the narrative. As a limitation, our research team consists of only hearing researchers raised in hearing culture. Nevertheless, two researchers are learning sign language and have family members/friends who are d/Deaf. These efforts and connections help us develop a better understanding of DHH communities and Deaf culture to interact with them in more respectful and responsible ways.

4. Results

4.1. Technology Perception and Usage (RQ1)

Here, we summarize DHH participants' technology use to contextualize their understanding and perception of S&P risks when using (assistive) technologies, such as hearing aids and CIs. Most participants prioritized the functionality and accessibility of assistive hearing devices, showing little awareness or concern about their potential S&P risks. Similarly, participants' interest in sign language video anonymization tools was minimal, with many expressing confusion or skepticism about their usefulness.

4.1.1. A wide range of technologies used to facilitate communication. Similar to prior work (§2), most DHH participants used various technologies to support communication, education, and leisure activities. The technologies mentioned include devices such as computers, laptops, mobile phones, tablets, and smartwatches; and assistive technologies such as hearing aids, CIs, microphones, speech-to-text tools, and sound awareness systems (e.g., vibrating or flashing doorbells, alarm clocks). Most DHH participants further use social media platforms, email, and videoconferencing tools to communicate with family and friends, authorities, health insurance, or at school or work.

4.1.2. Unawareness of S&P risks related to assistive hearing devices. The majority of DHH participants used hearing aids and CIs to support everyday communication, yet few were truly aware of or concerned about potential S&P risks associated with these devices [9], [10]. Most participants said that *they were just using them* (D01) and *haven't thought about that yet* (D03). D08 was indifferent to the potential consequences of being hacked: *"I don't have a problem with someone playing music for me."*

Other participants were skeptical regarding the technical feasibility of certain cybersecurity attacks, such as eavesdropping or remote control. For instance, D02 believed that their hearing aids do not record sounds—which may or may not apply to his particular device—thereby posing no risk of sounds being captured or shared: *"Hearing aids are fine because they don't record information. No, there is no reason to be concerned."* D16 mentioned that Bluetooth-enabled hearing aids are low risk since they can only receive audio files, which cannot carry programs or viruses capable of initiating recordings. Some of these mental models may be inaccurate, as prior research has identified possible attacks targeting Bluetooth-based hearing aids [9].

Even if feasible, some participants considered such attacks unlikely as they *"can't really imagine that someone would hack into that and try to adjust something."* (D06). D11 said she could not understand the attacker's motive: *"I can't imagine that a person would get the idea to do a cyberattack on you. So there are more useful things to do. What benefit does that person get when they can access your hearing aids with Bluetooth?"*

4.1.3. Disengagement with sign language video anonymization tools. Sign language video anonymization tools have received a lot of attention in accessibility research [14], [109] and claim to help signers to anonymize their faces when sharing sign language video content, while retaining the key linguistic information it conveys [14]. However, we learned that most participants were largely unaware of and showed little interest in them.

Some participants, while aware, chose not to use the tool due to concerns about reliability and privacy guarantees. For instance, D04 said: *"I know face anonymization but rarely use it because I'm scared that it doesn't work. Then people will see my face."* D17 noted that these tools may not be effective because other people may still be able to recognize them based on their hands or bodies.

Beyond technical skepticism, some participants further felt that such tools could obscure their personal expression and pride in their identity. D15 felt these tools were undesirable: *"I stick to my face. That's me. I don't need to be ashamed of that or something...Nope, so I don't need it."* D13 similarly added: *"I just ask myself why? I don't understand the point behind it, because the faces are all quite beautiful."*

These findings show that participants do not seem to value the potential privacy promises offered by sign language video anonymization tools, highlighting a potential mismatch between prescribed tools and DHH people's actual wants and needs.

4.2. Security and Privacy Issues in Identity and Information Disclosure (RQ2)

For DHH participants, disclosure of their identity or personal information can happen voluntarily or involuntarily, often also through intermediaries. In this section, we present participants' S&P concerns and risk perceptions when using sign language, disclosing their identity, sharing sign language videos online, or communicating through third parties.

4.2.1. Privacy risks due to the visual nature of sign language. DHH participants often experience involuntary disclosure of their identity through the visible use of sign language, switching to written communication, or simply wearing hearing aids or CIs. Several participants explained that the visual nature of sign languages, combined with the general awareness that sign languages are used by DHH individuals, inevitably reveals their identities. S02 explained it this way:

> *"I think people immediately notice, when sign language is used, that there is simply a different hearing status. And that's why, simply using sign language in public with deaf people would immediately reveal the hearing or deaf status."*

As a coping strategy, D04 refrains from using sign language at night to protect themselves from potential physical threats such as theft, assault, and robbery: *"I'm always very brave and use sign language in public, but maybe I prefer not to use it at night."*

Additionally, D01 noted that simply switching to written communication can inadvertently disclose their DHH identity. Other participants described how communication breakdowns and the visibility of assistive hearing devices often lead to unintended identity disclosure. D17 pointed out how DHH people's writing style (e.g., grammar, phrasing) and social networks can mark them as members of the community:

> *"It is very often visible from the way the person writes, so you might assume that they are also a deaf person. And also from the way they are networked. So friends of deaf people are very likely also going to be deaf themselves."*

4.2.2. Disclosing hearing status could be empowering or 'forced intimacy'. Participants expressed various concerns centered around disclosing their identity. While disclosing their hearing status is often necessary to access certain services and can also serve as a way to express their identity and build the community, participants also expressed concerns about how such disclosure can expose them to stigma, discrimination, or misuse of their personal information.

Many DHH participants shared that they disclose their identity on social media or at DHH events to express a sense of belonging to the community. D15 described this type of disclosure as empowering and a way to advocate for the DHH community:

> *"I'm proud. I'm just very proud of it. So many people have the image that deaf people are weird. But I'm of the opinion that deafness is great. And deaf people identify with other deaf people, they proudly show their culture, that they are different."*

While most participants really value the social benefit of sharing their hearing status, some DHH participants were concerned about social consequences, such as being bullied, spoken to condescendingly, or perceived as incapable. D08 explained why he sometimes decides to hide his disability:

> *"When I'm going to meet someone, I want to hide it because it may affect you. For example, when I'm approaching a normal guy and told him that I have a disability, they speak to me like a disabled man, you know, they shout at me while I can hear them directly."*

While most participants were not aware of how their hearing status could be misused online, such as for targeted profiling, harassment, or scams [110], [111]), D01 expressed discomfort in revealing his hearing status online because he feared how companies or platforms could potentially misuse this information: *"[I] would keep this information to myself most of the time. I also wouldn't want, for example, that other companies share this information, depending on what they want to do with it."* D04 commented on the possibility of context collapse [112] where information may be seen and shared with unintended or hostile audiences.

German states and health insurances provide DHH people with sign language interpreters for medical appointments, assistive hearing devices, and additional financial support, depending on the degree of deafness or hearing loss [113]. When disclosing to health insurance providers, D07 described engaging in strategic disclosure where they share only specific details to access social benefits while withholding others to avoid being disqualified from other support programs. For many participants, revealing their hearing status has become routine, particularly in situations where accommodations were required, reinforcing the term ‘forced intimacy’ [15]. These findings reveal that disclosing their hearing status—voluntary or not—can strengthen the community, but can also expose them to personal, social, or institutional harm and vulnerabilities.

4.2.3. Sign language increases exposure online. As sign language is a visual language that relies on hand movements and face gestures, using it to communicate with others can be more revealing than using traditional modes, such as text chat or audio calls. S01 explained that because of sign language’s nature, DHH participants who used sign language naturally had more information recorded digitally for communications, even though such information is not always public:

> *“The fact that a lot of things operate for them via video means that there is simply a lot more online. A voice message is different from a sign language video. So there’s a much greater risk that much more of you will be revealed than you actually want.”*

Several DHH participants highlighted potential concerns around sharing sign language videos online. D12 was concerned about their videos being potentially used for impersonation attacks: *“I also don’t want that others might steal my face. But on the Internet, it’s possible on a much larger scale... Videos could be downloaded. You could certainly call someone, then show that video, and pretend to be the false person.”* In a similar vein, D11 shared a story where another DHH person’s video was used without their permission for an advertisement scam:

> *“People from other websites take your videos for advertisements ... That was a public figure. They created videos by themselves and they have been used for a fake website ... That’s how this concern was formed. This could also happen to me.”*

To protect themselves from such risks, some DHH participants refrain from or become more conscious about sharing sign language videos online. Other DHH participants change their privacy settings or only do video chats with people they already know and are familiar with, such as family and friends.

4.2.4. Involuntary and mediated disclosure through third parties. In DHH communities, the disclosure of private information is often mediated through third parties – such as sign language interpreters or other community members – which introduces concerns around information spreading in the community without consent.

Many DHH participants use sign language interpreters to communicate with authorities, lawyers, or during medical appointments. In this process, they are often required to share very personal information with sometimes unfamiliar third parties, which makes them concerned about secondary disclosure and unauthorized use of their information. While most DHH participants deeply trust their interpreter and are unconcerned about the possibility of secondary disclosure under a confidentiality agreement, D03 shared an experience where a sign language interpreter shared their private information without consent:

> *“Nine years ago ... another person told me something that they shouldn’t or weren’t allowed to know. But the interpreter passed it on, and since then, I no longer hire this interpreter... I made that mistake back then, and of course I regretted it, I was scared and worried.”*

Several DHH participants and supporters stated that many DHH individuals are concerned about their private information spreading within the community, as DHH communities tend to be relatively small and tight-knit. D15 explained:

> *“With deaf people it’s that everyone suddenly knows it. It can also be a dirty secret or it can be nudes. It can be abuse or something like that. ... When that person is moving inside the community, everyone will look at that, and that’s really not nice for that person, because they know that everyone knows. With hearing people it’s not like that.”*

D01 confirmed the tendency of information spreading in their community. As a result, they are very careful in sharing things about themselves: *“Simply that I keep that to myself, that I’m silent about them, about these private things. I only talk about these things with my partner ... I just don’t want it to get around.”*

4.3. Security and Privacy Advice and Challenges (RQ3)

We present where DHH participants get S&P advice from, topics featured in the advice, and common issues and challenges concerning the advice. Since supporters play an integral role in DHH people’s lives, we also analyze how supporters interact with DHH participants in the advice giving and receiving process.

4.3.1. Advice came from trusted family, friends, and community. The majority of DHH participants seek reliable information and advice from people in their circle of trust. The sources include family members, partners, close friends, schools, and information centers, and can involve both hearing and DHH individuals.

D01 and D03 shared that instead of relying on written resources, such as books or newspapers, they prefer to seek information from trusted family members and friends. D01 commented that the source’s trustworthiness matters more than the quantity of sources: *“I don’t ask exceptionally many people. I have my private contacts that I would ask. I would always, always, rather exchange with a trusted person who would always help me.”* S05 shared that DHH people often seek information and support from established local support networks, consisting of children of deaf adults (CODA) and other DHH people: *“There is a somewhat larger support network, especially from CODAs, a lot of whom have already retired because we can’t [support] anymore.”*

4.3.2. Advice about phone settings, password management, and scams.

Most DHH participants sought advice and support regarding password management, privacy settings, and identifying scams using written communication.

When asking DHH participants about common S&P topics they discuss with their social networks, D01 mentioned asking for advice on phone settings. D03 shared password-related advice from his brother: *"I know that you should use strong passwords. And I always try to use automatically generated passwords. My brother told me once. After that, I knew about it and [have been] using it ever since."*

Some participants frequently seek or receive advice on online scams and fraud, as written communication—often inaccessible to DHH individuals [27], [33], [81], [114]—can make it harder to recognize and navigate deceptive content. One supporter was present during the interview with D01 and described an incident where D01 signed a mobile phone contract without being fully informed about the requirements and conditions in place. D03 described the guidance he received on how to respond to online scams and fraud from his daughter:

> *"So I actually do sometimes receive such emails or SMS, and my daughter tells me to block them and not click on [them] . . . It was most of the time an email. For example, I would have won something . . . And then my daughter would always say, no, no, we didn't order that, no subscription or something like that, and then we block that."*

D17 explained how he sometimes helps his DHH mother identify scam emails, as her limited access to technology awareness resources and lower literacy levels make it difficult for her to recognize such threats:

> *"For example, my mother. She finds it difficult to classify an email as to whether it was a real email or whether it's a spam email that somehow wants to steal data. The classification is missing. A lot of people find it difficult. Primarily because of the lack of access to technology awareness and partly also due to limited written language proficiency."*

Some participants expressed interest in more advice regarding account security, secure email servers, and identifying malware.

4.3.3. Advice and resources not provided in sign language.

Many participants and supporters noted that awareness and understanding of S&P are hindered when resources are not available in sign language, which is a more accessible modality for those who use sign language as their first language. D03 explained having limited opportunities to learn about S&P:

> *"My brother knows that I can't hear. Of course, through television consumption he simply gets more opportunities to hear about things and therefore knows more."*

S05 brought up a concrete example regarding authentication. Building on prior work on DHH people's challenges with audio-only authentication [12], [39], S05's quote highlights that even when the modality is not constrained to audio only, the authentication's setup and processes often involve complex instructions that can be hard to follow for DHH users who primarily use sign languages:

> *"[Two-factor authentication] is undoubtedly useful, but has the big disadvantage that you sometimes have to login in a very complicated way. And that cannot be done in simple language. This means that at some point we will reach a language barrier and many deaf people will simply get left behind."*

Several DHH participants encountered challenges when accessing online written resources. D03 shared his experience: *"I also often simply don't understand written language that well. I just need simple language to understand that, but it's often written in a very complicated way."* As such, several DHH participants shared that they had to rely on supporters, as in D04's case: *"[I] often wait until someone or an advisor has time to explain it to me."* D07 unpacked that the challenge is often due to unfamiliar words and sign language having distinct vocabulary and grammar in comparison to spoken language [115]:

> *"There are many words that I'm not familiar with, that I don't know, but are used in such texts. Sometimes the grammar is different from sign language. And that's why the sentence is more difficult to understand."*

The lack of sign language support also extends to safety mechanisms on online platforms, where DHH users are found to experience ableist hate and harassment [17], [116], [117]. While reporting the toxic content is a potential coping strategy [98], accessibility issues arise when platforms require users to detail why specific online content was defamatory or offensive in written language, which could pose a barrier for DHH people with a lower literacy level than hearing peers [33], [81], [114]. S05 made this point:

> *"I think the biggest hurdle is actually reporting it. If only it were that easy. No matter which platform I use . . . I have to write why I find it defamatory or offensive or whatever. But the problem is that I have to write it, and that is already a barrier, because an acceptable German is simply not present, or not present for many."*

Crucially, we do not observe difficulties in understanding written resources from participants who prefer to use spoken language. This difference highlights that sign language availability is the fundamental issue to be tackled for ensuring equitable access for DHH people who use sign languages.

4.3.4. Limited S&P knowledge in the community.

While many community members expressed willingness to provide support and guidance, their own limited understanding of security, privacy, and technology sometimes prevented them from doing so. This lack of expertise can exacerbate S&P unawareness and limit advice across the community; in some cases, it can even result in unintentional privacy violations (§4.2.4). S01 cautioned: *"I stop immediately whenever I don't know for sure. And I'm also not a specialist in that, not at all. But the little things I do know, I'm happy to pass on . . . but not more than that."*

While some DHH participants shared S&P advice about online scams and authentication methods, other DHH participants did not feel confident and experienced enough to share S&P advice with others. D03 explained, *"I'm interacting more with my family, but I, myself, didn't pass on anything. Just because I don't feel very experienced in this topic."* D01 worried about the social repercussions if they unintentionally gave misinformation: *"I don't help and support with that. I don't want to say something wrong and that someone would come complain to me."*

4.3.5. Social dynamics limit advice sharing. Social dynamics within DHH communities can prevent open discussions and sharing experiences about S&P. Concerns about privacy risks from unfamiliar third parties and information spreading within the community often make members hesitant to share sensitive experiences due to fear of judgment, blame, or stigma. Some of these experiences involve S&P incidents, as described by S05:

> *"For one story it was definitely identity theft. That also led to a sudden decrease in their credit score, which no one was able to explain. The damage was not that big but the shame limit was so high that they didn't want to admit it. Because, as a deaf person, you don't want to be seen as dumb."*

Furthermore, S01 explained that recounting traumatic experiences through third parties, such as sign language interpreters, can intensify feelings of shame, as it requires emotional vulnerability in front of others.

Social trust dynamics in DHH communities can also have complicated S&P implications. For instance, D15 gave an example of where DHH people fall for a scam due to peer influence, facilitated by the DHH community's close-knit nature:

> *"I have heard of cases in the Deaf community where someone advertises that you should donate to something, or spend money on something, and then that was a scam. When someone says, 'Ey, come, come, join too, I invested there.' Then it is very typical that deaf people would say, 'Ey, if you do that, I will do it too.' We are very social in that aspect and support each other very, very quickly."*

4.3.6. Challenges translating advice to sign language. Building on prior work on sign language content creation [82], we identify challenges that come from translating S&P terms from spoken or written languages to sign language due to sign language diversity as well as cross-linguistic and cultural gaps and syntactic issues.

D09 shared that discussing technical topics can be difficult within the DHH community, as they often use different vocabulary and linguistic structures. Even terms that might seem familiar to people using spoken languages may be unfamiliar to DHH individuals if they are not part of everyday language use:

> *"Just because in sign language there are many technical terms that most people don't know. Even if those are technical terms that I, as a hard-of-hearing person know and think, okay everyone knows this word. But deaf people just don't know this word, because those are not in their everyday language use. There are just some difficulties talking about this."*

S05 added that explaining abstract words such as "computer security" through contextualization can easily lead to confusion and misunderstandings:

> *"When I talk about computer security, the term security is generally used in everyday language. I feel safe because I have the police nearby. But computer security has nothing to do with the police. So I have to explain what computer security is first. But now comes the problem . . . I have to make that very clear at the beginning. The police have nothing to do with my security on my PC or my cell phone. Nothing at all. But if something goes wrong, the police have something to do with it . . . and that's two opposing aspects that I somehow have to bring together, but it's not easy at all to bring together."*

Additionally, S05 explained the sign language diversity within Germany and how this can further add challenges:

> *"And then there are also the regional peculiarities of Northern Germany, Southern Germany, the Ruhr region, Central Germany and so on. There are dialects everywhere, so we have to include that too. Just to make sure that we have a uniform term for phishing emails, for spam, that we have a uniform term for that and that there are no dialects."*

5. Discussion

Our work provides insights into DHH individuals' perceived S&P risks and examines their interaction with their support networks to navigate S&P risks. In this section, we situate our findings in prior literature and propose implications and recommendations for designing S&P awareness interventions, accessible S&P tools and resources, and leveraging strong community influence.

5.1. Key Insights

5.1.1. Sign language availability as the underlying issue. We observe different patterns between DHH participants who use or do not use sign language as their primary means of communication. DHH participants who do not use sign language as their primary means of communication do not encounter major issues accessing and understanding written information resources; they also exhibit generally higher awareness of security threats and risks. Thus, the availability of sign language translation and support is often the fundamental challenge for those who use sign languages in using S&P tools and absorbing advice. Building on prior work highlighting DHH people's issues with voice-only authentication [12], [39], our findings highlight that even if the authentication comes in multiple modalities, challenges can still arise because of inaccessible languages.

Moreover, these findings reflect the broader diversity of DHH communities, which can include people who identify as hard of hearing, late-deafened, deafblind, deaf-disabled, and more; some experiences are shared by all members of these diverse communities, while others are more unique [118]. If viewed by hearing status and self-identification, our study captured perspectives from a diverse group of DHH participants. However, one's hearing status does not represent their cultural belonging to the Deaf culture and communities. Most of our DHH participants practiced sign language, which is a core part of d/Deaf communities and identities [3], [80]. In this way, most of our findings are rooted in perspectives from d/Deaf communities, which not all DHH people would identify with.

Unfortunately, sign language has received little attention in existing S&P research. For HCI and accessibility research, current efforts primarily center around captioning tools, automatic sign language interpretation, or translation systems [119]. However, captioning tools provide text that is not fully accessible to sign language users, and a perfect sign language translation tool designed and deployed in another context, being providing travel information [120] or designing surveys [121], may still fail when adapted to S&P contexts considering the nuances in contextualizing seemingly basic terms like 'computer security' (§4.3.1). Our findings highlight that there is still a long way to go in addressing the linguistic barriers to translating S&P advice from spoken/written languages to sign language.

5.1.2. Potential mismatches between prescribed tools and DHH people's actual needs. Prior work has showcased potential mismatches in existing tools and disabled people's actual needs, such as how obfuscation systems [122] and smart assistive technologies [123] fail to capture the needs of blind and low-vision people. While existing research has made significant progress in addressing DHH people's communication needs [6], [124], [125], [126], a similar gap might exist between DHH people's presumed and actual S&P needs. In particular, participants remained largely unaware of, and expressed little interest in sign language video anonymization tools (§ 4.1.3) [14].

As our study is qualitative in nature, the findings are not intended to be generalized to the broader, diverse DHH communities. Instead, we encourage future research to engage more deeply with the community and prioritize participatory design approaches. Researchers can delve into potential reasons behind the mismatch and explore possible solutions, such as working toward more inclusive sign language AI research [109], [127], to encourage DHH communities' acceptance and adoption of the tool. More broadly, we encourage tech designers to involve DHH people in the design process to challenge audism norms and build technologies and structures that align with the real-world wants and needs of the DHH community.

5.1.3. Community members as both supporters and potential risk factors. Prior work has examined the social interactions between people from at-risk groups and their allies, highlighting issues related to agency, interdependence, and trust (§2.3) [73]. This pattern also manifests in our findings about the role community members play in DHH people's lives. Community members can act as supporters, providing crucial advice on password management and navigating scams. Meanwhile, the perception of community members as potential risk factors due to general gossip of private information in the community shapes DHH participants' tendencies towards self-censorship [128]. When self-censorship applies to sensitive experiences such as falling for a scam and exposure to sexual violence, it further inhibits DHH participants from seeking help [129], and disseminating valuable lessons and warnings within the broader community (§4.2.4, §4.3.5). As such, it is important to foster inclusive communication environments in the community so that DHH people feel empowered to share their S&P concerns, experiences, and knowledge safely and openly.

5.1.4. Forced intimacy amplifies S&P risks in DHH people's everyday experiences. Our findings show that forced intimacy for DHH individuals extends beyond clinical settings [16] into daily life—when accessing services, signing in public, switching to written communication, or relying on interpreters to conform to hearing norms. This need to self-disclose to navigate a hearing-dominated world highlights the pervasive nature of forced intimacy in DHH people's lives and how accessibility often comes at the cost of privacy and autonomy, leading to emotional toll, exclusion from services, and inequitable access.

Moreover, these accessibility failures alter DHH people's threat models and amplify their S&P risks. For instance, when a DHH user must rely on third parties to reset their password or use two-factor authentication, it raises risks around data confidentiality and misuse. DHH users may turn to insecure workarounds or avoid adopting these additional security measures altogether [130], [131].

Many DHH people experience S&P challenges due to social and structural pressures to conform to a hearing-centric world. A DHH person might have to use hearing aids because of living in a hearing-dominated society. The concern about using sign language and revealing their identity boils down to the concern of revealing the minority status, which further leads to marginalization and harassment [7]. The reliance on third parties also reflects a DHH person's need to talk and adjust to the hearing world.

5.2. DHH-Tailored S&P Awareness Building and Outreach

While trustworthiness of the source is a key metric for S&P advice's acceptance [132], it holds even greater significance for DHH people [24] due to the historical discrimination and communication issues between hearing and deaf people [133]. Moreover, most of our DHH participants showed limited interest or engagement with S&P topics. While this is likely due in part to advice and resources being inaccessible, it also highlights the need to raise awareness and improve S&P outreach within DHH communities. Below, we discuss several considerations for DHH-tailored S&P awareness building and outreach.

5.2.1. Featuring S&P risks for DHH assistive technologies and disclosures. Prior work has found that risk awareness is often a key precursor for the adoption of secure behaviors [134], [135]. Limited awareness of specific threats can be dangerous for DHH people as it can lead to over-disclosure of sensitive information (such as one's hearing status or face online) or misplaced trust in insecure technologies like hearing aids or CIs where cybersecurity attacks can have severe consequences for their personal safety, privacy, and emotional well-being [9], [10], [136], [137]. Although assistive hearing devices help the majority of our DHH participants navigate everyday situations, none of the participants reported being aware of or seriously concerned about potential cybersecurity attacks.

Our findings provide a few pointers for the content of S&P awareness campaigns tailored to DHH people: (1) risks tied to hearing assistive devices; (2) implications of sharing sensitive information like hearing status and sign language content online, and (3) the critical role of sharing S&P knowledge and advice to build skills and expertise across the community. The risk communication should not be done in ways that cause undue fear, especially when these devices are vital to participants. We hope to figure out the communication in our ongoing, longer-term engagement with the community. Ultimately, the goal of raising awareness is not to discourage DHH people from using the technology, but to empower them to make informed decisions about the technologies they rely on daily. For instance, users can choose more secure models or settings when available, demand better protections by reporting issues to manufacturers or regulators, and join conversations to shape safer technology designs for DHH communities.

However, DHH communities are quite diverse and not monolithic; depending on a DHH individual's specific tech use and cultural belonging to the community, they may need only some but not all bits of the information. Moreover, it is crucial that the awareness building employs effective communication strategies (e.g., being accessible in sign language) and centers DHH community-specific preferences.

5.2.2. Leveraging community influence. Our findings, supported by prior work [3], [80], highlight the central role of local DHH networks as vital sources of information and support. While supporters may have limited S&P knowledge, they play a critical role in sharing information and guiding others within the community. As such, we see great potential in tapping into the community's influence to promote S&P information and awareness with DHH people.

One idea for leveraging the community influence is connecting to and training key members of the communities, such as sign language interpreters and people who took leadership positions (e.g., employees at information centers, meetup organizers, technicians, family members, and friends) who can then promote accessible S&P information and resources across the community. However, supporting these efforts requires both financial and educational investment. Policy interventions can help institutionalize S&P education, e.g., by integrating best practices into the curricula of DHH schools.

5.2.3. Approaching S&P protection as collaborative and infrastructural effort. Prior work has found that security advice is often rejected due to poor cost-benefit tradeoffs to users [138], [139] and the pressure from everyday lives can force S&P "best practices" into the background [68]. For DHH people, the self-protection burden [140] could be further complicated by accessibility needs, as disabled people often have no alternatives for assistive tools [141]. The inevitable use could cause privacy as a secondary consideration. As such, even though tailored awareness interventions have many promises, they are not silver-bullet solutions. S&P protections for DHH people require coordinated efforts from many stakeholders (e.g., technologists, hearing aid manufacturers, relay service providers, sign language interpreters, and more) and systematic changes across the entire technological and social ecosystem.

5.3. Toward More Accessible Advice and Tools

A coherent theme across our findings is that existing S&P advice and tools—ranging from authentication to reporting toxic online content (§4.3)—largely remain inaccessible to DHH people. When someone cannot easily access accurate S&P information or tools, they are more susceptible to misinformation, have lower awareness of best practices, and adopt fewer protective measures. For instance, DHH users may be more vulnerable to targeted phishing in written texts or risks from sharing their hearing status and sign language videos online, as they lack the tailored resources needed to recognize these attacks and form their threat models. Most of these accessibility issues stem from a lack of understanding among tech designers, service providers, and the hearing society at large about the needs of DHH individuals, as well as the assumption that the majority of DHH individuals can comprehend and use written language as effectively as sign language. Technologists should actively work towards improving accessibility of their S&P infrastructure for DHH communities by going beyond traditional text-based communication and providing a broader range of modalities that better align with the diverse communication preferences and needs of DHH users.

Beyond sign language support, S&P resources, interfaces, and tools could be provided in a variety of modalities that involve visual aids (e.g., icons, videos, comics, interactive tutorials) [142] or simplified explanations that better match the reading skills and habits of DHH users. For instance, prior work has evaluated automatic text simplification tools for DHH individuals [143], which could enhance the comprehension and usability of existing tools. However, the design must also consider the multiple and intersecting marginalized identities (e.g., people with different hearing levels and multiple disabilities) [73]. In addition, S&P tools requiring written input should offer diverse input options. To this end, some social media platforms are already implementing automatic cyberbullying detection [144], which could reduce DHH people's harmful content exposure and the self-protection burden imposed on them.

Another space to explore is collaborative tools between DHH people and their supporters that empower S&P related help-seeking and help-giving while mitigating concerns about potential information spread within the community. Recent work by Angelini et al. [145] has highlighted how speculative design can expose different socio-technical perspectives and encourage equitable technological development between able-bodied peers and DHH individuals. Additional inspiration can be drawn from recent work on safety setting collaboration among older adults with memory concerns [146], which similarly navigate the paradox between surveillance and independence.

6. Conclusion

Despite potential S&P risks of assistive hearing devices and limited resources and support in sign language, DHH communities have received little attention in S&P and accessibility research. We address this gap with a qualitative interview study, including 17 DHH participants and seven supporters, to understand how DHH people perceive S&P risks in assistive technologies, their concerns around identity and information disclosure, as well as sources of advice and common challenges. Our findings highlight low S&P risk awareness among DHH participants, S&P concerns and risks around disclosing their hearing status and sharing sign language videos online, and the broader impact of inaccessible S&P advice on their day-to-day experience. We further highlight the important but also nuanced role of community influence. Based on our findings, we suggest two directions for future research and real-world practices to support DHH people: creating DHH-tailored S&P interventions and providing more accessible S&P tools and resources.

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Appendix A.
Supplementary Materials

We provide our interview protocols, qualitative codebooks, and detailed descriptions of supporters' role and relationship as supplementary materials on OSF: https://osf.io/vn9jm/?view_only=e93f6a2460e247828b72fd050c8f683b

Appendix B.
Supporters' Role and Relationship

Here we provide a more detailed description of the supporters' role and relationship to other DHH participants. We used the supporters' language, even though that might be different from recommendations from academic literature [5]. We use asterix (*) to mark these instances.

- **S1** is female and 42 years old. She has been active as a pastor in a local d/Deaf community for 10 years. D01-D05 are part of this d/Deaf community. She frequently works with deaf people as part of her professional role. Together with D04, she holds worship sessions in sign language and organizes deaf-related events (e.g., deaf seniors' meeting, sign language meetups and classes, educational leave for deaf adults) to help deaf people socialize and learn about local deaf events and opportunities.
- **S2** is female and 23 years old. She attended sign language classes from the local d/Deaf community and has several deaf friends from there with whom she spends a lot of time, particularly during deaf meetups (D01-D05). She sometimes helps deaf community members with doctor visits and grocery shopping when something is not comprehensible to them.
- **S3** is male and 31 years old. He attended the sign language classes for beginners and advanced learners 1.5 years ago and has been regularly visiting the deaf meetups. He often has interactions with different deaf people, including deaf people with different degrees of deafness and different national backgrounds. He interacts with D01-D05, but is particularly close to D02, who is hard-of-hearing on bordering deafness.
- **S4** is male and 38 years old. He started learning sign language two years ago and has a partner who is hard-of-hearing. He often interacts with d/Deaf community members (D01-D05) and meets up with other acquaintances of his partner. He watches many sign language videos and is enthusiastic about improving his sign language. Together with a friend, he has drafted an article for a local newsletter of this community to advocate for deaf people and sign language users.
- **S5** is male and 60 years old. He is a child of a deaf adult (CODA). Due to his family background, he views sign language as his mother tongue, has interacted with deaf people for his whole life, and feels equally at home in the d/Deaf community. When his deaf parents were still alive, he supported them with all sorts of issues, be it interactions with authorities, banks, work, or during sickness. Nowadays, he does sign language interpreting (e.g., during doctor visits), offers international gardening training for deaf people, and holds lectures about sign language and deaf culture at a university. In addition, he is also very interested in the political situation of deaf people.
- **S6** is female and 53 years old. She works as an inclusion consultant at the university's center for inclusion. She is part of the group for people with severe disabilities* and often interacts with students with severe disabilities* at her profession. Her husband is severely hearing impaired*, and she often interacts with students who are hearing impaired* or deaf, and come to their consultations for support. D07 and D08 are DHH students whom she supports.
- **S7** is male and 26 years old. He is a professional sign language interpreter and often interacts with DHH people through his profession. He has been working with the d/Deaf community for 2.5 years. Before that, he had engaged with d/Deaf communities for 3-4 years at meetups during his sign language studies.

Appendix C. Meta-Review

The following meta-review was prepared by the program committee for the 2026 IEEE Symposium on Security and Privacy (S&P) as part of the review process as detailed in the call for papers.

C.1. Summary

This paper examines how the deaf and hard-of-hearing (DHH) community in Germany perceives S&P risks in assistive technologies, their concerns regarding online identity disclosure, and the types of sources they utilize for advice and support. The results from semi-structured interviews with 17 DHH participants and 7 of their supporters show that the majority of the participants are unaware of the potential S&P risks or are indifferent towards them. Additionally, it reports on how the DHH community perceives existing S&P interventions, such as advice or tools. The paper concludes with a discussion and recommendations for different stakeholders to better accommodate the S&P needs of DHH individuals.

C.2. Scientific Contributions

- Provides a Valuable Step Forward in an Established Field
- Establishes a New Research Direction

C.3. Reasons for Acceptance

The paper contributes new understanding of how DHH community perceive S&P risks when using assistive technologies, disclosing private/identity information, and receiving advice. Existing work with the DHH community has focused on interface, tool, and accessibility aspects. Other related S&P works have focused on vulnerable populations, but not a lot on the DHH community. This paper fills this gap.

Through the qualitative analysis of these interviews the paper is able to bring forth how S&P issues interfere with their day-to-day activities, ranging from inadvertent forced-intimacy, wherein they have to publicly disclose their disability to the lack of proper guidelines and advices available to the DHH community.

As such, this paper opens the conversation about the S&P needs of the DHH community. This qualitative study brings out new insights that S&P researchers did not know before about the S&P needs of DHH community. Hopefully, it will start the discussion on future security and privacy interventions for the DHH community.

C.4. Noteworthy Concerns

Despite these important contributions, the review process revealed a noteworthy concern regarding the study's methodology and the framing of its results.

1) *Recruitment and Generalizability*: The study is limited to Germany and is potentially concentrated around a single institution. The findings from the specific population studied cannot be used to making broad claims about the global DHH community.