Community-Driven Information Accessibility: Online Sign Language Content Creation within d/Deaf Communities

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Information access is one of the most significant challenges faced by d/Deaf signers due to a lack of sign language information. Given the challenges in machine-driven solutions, we seek to understand how d/Deaf communities can support the growth of sign language content. Based on interviews with 12 d/Deaf people in China, we found that d/Deaf videos, i.e., sign language videos created by and for d/Deaf people, can be crucial information sources and educational materials. Combining content analysis of 360 d/Deaf videos to better understand this type of video, we show how d/Deaf communities co-create information accessibility through collaboration in content creation online. We uncover two major challenges that creators need to address, e.g., difficulties in interpretation and inconsistent content qualities. We propose potential design opportunities and future research directions to support d/Deaf people's needs for sign language content through collaboration within d/Deaf communities.

CCS Concepts: • **Human-centered computing → Empirical studies in accessibility**.

Additional Key Words and Phrases: Deaf, d/Deaf, d/Deaf community, accessibility, information access, online content creation and sharing, sign language, sign language content creation, sign language interpretation, online collaboration

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1 INTRODUCTION

The priority of written and spoken languages in mainstream society has long posed challenges for the 70 million d/Deaf people [97] [1] people's information access across the world [66, 127, 147, 149]. The lack of information has

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[1]d/Deaf people in the U.S. often use the word "Deaf" with a capital "D" to emphasize their cultural identity of being part of the Deaf community, and "deaf" with a lowercase "d" to refer to their hearing status [100]. In this study, the term "d/Deaf" refers to people who identify as deaf, Deaf, or both and use sign languages [28]. We use "d/Deaf" to be inclusive and show the fluidity of identity [86], except when emphasizing cultural and audiological issues or at the insistence of the person referred to. The term "d/Deaf and Hard-of-Hearing" (DHH) is used to refer to people with hearing loss in general [28].

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caused barriers for d/Deaf people's full participation in all aspects of society, from education [63] to healthcare [112] to employment [108]. Although the advance of Information and Communication Technologies (ICTs) has improved many d/Deaf people's access to text-based information [132], information in written languages is still inaccessible to d/Deaf people who prefer to use sign languages [1, 77] due to sign languages' unique grammars and vocabularies [134]. Moreover, d/Deaf people often emphasize the significant role of sign languages in Deaf culture and their d/Deaf identity [150]. Therefore, access to sign language information is widely recognized as one of the most fundamental human rights of d/Deaf people [44, 93, 134].

In particular, the diverse variants of sign language often pose challenges in sign language information provision [44]. For instance, Chinese Sign Language (CSL) has vastly different variants [31]. While the Chinese government has been promoting Lexicon of Common Expressions in Chinese National Sign Language (LCECNSL) [4] to standardize CSL, LCECNSL is only an official dictionary of signs without standardization of grammar. Hearing people, including teachers at d/Deaf schools and interpreters, often use Signed Chinese ("手势汉语") rather than CSL [63]. CSL users often face challenges in understanding Signed Chinese because Signed Chinese is not a natural language but an artificial sign system created based on Mandarin by borrowing signs from CSL and it lacks the linguistic traits of natural forms of sign languages [47, 148] [2]. Therefore, d/Deaf people preferring to use CSL have limited access to information now due to a lack of qualified sign language interpreters [10, 13]. According to a survey with over 10,000 d/Deaf people in China, only about 8% of them can effectively understand sign language interpretations in official TV news [75]. Hearing stakeholders were also often found to use signed written/spoken languages rather than natural forms of sign languages in other countries, e.g., Japan [34, 47, 92], South Korea [64], Indonesia [27], and Spain [107] (see Section 2.2 for details).

To meet d/Deaf people's information needs, HCI researchers have long been interested in developing automatic sign language generation and interpretation/translation systems [25]. However, no existing machine-driven computation system is reliable enough for real-world adoption due to a lack of training datasets, limitations in computational models, etc. [23, 25] Given the challenges in machine-driven solutions, we seek to understand **the current situation of d/Deaf communities in creating sign language content and explore how to support them in growing online sign language content**. We look to d/Deaf communities because of the strong collective culture of d/Deaf communities, and they have traditionally played central roles in d/Deaf people's information access [35, 101, 149]. d/Deaf people naturally gather together at d/Deaf schools, clubs, or online social networks for information and support exchange [35, 101, 132]. Understanding d/Deaf communities' information practices may thus bring design opportunities to support d/Deaf people's information needs.

With the abovementioned research motivation, we conducted semi-structured interviews with 12 d/Deaf people in China to understand their access to online sign language content, especially how d/Deaf communities were engaged. We define d/Deaf communities as d/Deaf people who may not live in the same location but are connected by shared identities and set of norms [22, 35], because we aim to focus on d/Deaf communities on a large scale[3]. During the interviews, we found that 9 participants have watched online sign language videos created by and for d/Deaf people (we will term them d/Deaf videos hereafter). We found that these videos can be essential information sources and educational materials, which compensate for the lack of official CSL information. We then conducted content analysis

[2]We avoid stating that only CSL is the true sign language because d/Deaf people who use Signed Chinese may consider it as sign language. d/Deaf people may also use mixed styles of languages [146]. Nakamura described how d/Deaf people in Japan similarly debate over Japanese Sign Language and Signed Japanese [92].

[3]Prior research suggested that d/Deaf people in China have relatively low awareness of Deaf culture [62]. Therefore, we used "communities" to avoid the impression that there is a singular d/Deaf culture and a unified d/Deaf community in China, and to represent the diversity of d/Deaf communities and the dynamicity of d/Deaf community boundaries in China.

of the videos mentioned by our participants to strengthen our understanding of d/Deaf videos and better interpret the interview data. Based on data from both sources, we provide a thematic qualitative analysis of the d/Deaf videos, including the information delivered in the videos, collaborative efforts exemplified in the creation and sharing of d/Deaf videos, as well as the challenges in d/Deaf video creation and sharing from d/Deaf people's own perspectives. We found that while d/Deaf videos can provide CSL information, they are not always enjoyed by d/Deaf people because of interpretation difficulties and inconsistent content qualities. d/Deaf video creators may also have negative experiences because of online trolls and (micro)aggressions.

The main contributions of this work are two-fold:

(1) An empirical understanding of how the sign language content created by d/Deaf communities can support d/Deaf people's information needs. The findings highlighted how d/Deaf people address their information needs through community efforts and the challenges they encounter. We suggest HCI researchers and designers supporting d/Deaf communities in content creation because community-driven information will be crucial in contexts where variations of sign language are considerable [31, 37, 76, 88] or where sign language standardization is challenging (e.g., emerging fields such as science [29, 80]). Such a community-based approach is also important to empower information access of d/Deaf communities.

(2) Future directions and design opportunities that HCI researchers and designers can pursue to better support d/Deaf communities in sign language content creation: a) treating online sign language content creation as a *Community of Practice* [137]; b) maintaining a safe online space for d/Deaf communities; c) acknowledging content creators' (invisible) labor.

2 BACKGROUND

2.1 Ways of Being d/Deaf

There are many ways of being deaf, e.g., ranging from born deaf to late-deafened [150], holding different values about d/Deaf identity and culture [92], etc. Although deafness has been traditionally treated as a medical problem or disability, people found other ways to understand it (e.g., the cultural model of d/Deafness) [35, 101]. d/Deaf signers often emphasize their cultural identity of being Deaf [150]. Sign language, along with shared life experiences, provides a strong bond and collective identity for d/Deaf communities [150]. Many deaf people, especially those who do not use sign language, do not identify as Deaf or feel belong to the Deaf culture [129]. Deaf communities are thus recognized as communities created based on a shared sign language and Deaf culture rather than hearing status [35]. Although d/Deaf people in China were found to have low recognition for the Deaf culture [62], some are also proud of being d/Deaf [74]. In this study, we focus on signers who identify as d/Deaf. Given our research focus, we treat d/Deaf people as a linguistic minority. We situate our work within accessibility and disability research to dialogue with the HCI and accessibility research community.

2.2 d/Deaf People in China: Chinese Sign Language and Signed Chinese

Compared with the U.S., where research with d/Deaf and Hard-of-Hearing (DHH) People was often conducted [79], d/Deaf people in China may face more challenges in information access due to fewer educational opportunities, a lack of trained teachers, emphasis on oral education [63], and less access to accessibility services such as captioning on TV [73, 146]. For instance, Li found that captioning was only provided in 29.03% of TV news programs of the 10 most-watched Chinese TV channels [73].

Language	Word Order
Chinese	你 you / 认识 know / 那个 that / 长 long / 头发 hair / 的 adjective suffix / 女人 woman / 吗? question particle for yes-no questions
Chinese Sign Language	[女人 woman / 头发 hair / 长 long / 指 (第三方) pointing (the third party) / 认识 know] 带着困惑的表情 with confused facial expressions
Signed Chinese	你 you / 认识 know / 那 that / 长 long / 头发 hair / 女人 woman / 问题 question mark
English	Do / you / know / that / woman / with / long / hair?

Table 1. An example sentence in Chinese and Chinese Sign Language in [33] after modification of the fourth author, a Deaf sign language teacher and interpreter. The sentence in Signed Chinese (word order) was also translated by her.

The diverse variants of Chinese Sign Language (CSL) also pose challenges to d/Deaf people's information access [76]. CSL has many variants; northern styles of CSL can be vastly different from the southern ones [11, 31, 76]. People using different variants of CSL often face challenges in communications in sign language [76]. The Chinese government has been trying to standardize CSL in recent years by promoting Lexicon of Common Expressions in Chinese National Sign Language (LCECNSL) [4]. However, LCECNSL is only an official dictionary of signs without clarification of grammar. Hearing people, including teachers at d/Deaf schools and interpreters, often use Signed Chinese rather than CSL [63] (see Table 1 for the difference between CSL and Signed Chinese and Table 2 in [63] for a visual example). d/Deaf people who do not use Signed Chinese often face challenges in understanding it because Signed Chinese is a manually coded language [115], i.e., an artificial sign system following structures of spoken language and lacking linguistic traits of natural forms of sign language (e.g., classifiers, facial expressions) [47, 148]. Currently, qualified sign language interpreters are hard to find in China, especially in professional scenarios, such as medical and legal inquiry [10, 13]. While sign language interpretation in TV news seems to provide a form of information access, it receives significantly low ratings among d/Deaf people in China [12, 75, 146].

Hearing people, including sign language interpreters and teachers at d/Deaf schools, were also often found to use manually coded languages rather than natural forms of sign language in other countries, e.g., Japan [34, 90], South Korea [64], Indonesia [27], and Spain [107]. For instance, most hearing sign language interpreters trained by the Japanese Federation of the Deaf only master Signed Japanese ("日本語対応手話") [90]. Although NHK[4] replaced Signed Japanese with Japanese Sign Language (JSL) in sign language news programs in the early 2000s, other TV news may still use Signed Japanese now [34]. Signed Japanese has also been used in public d/Deaf schools in Japan partly because using manually coded languages is often believed to be able to support oral education [15]. However, d/Deaf children using JSL as their native language may face challenges in understanding Signed Japanese [57]. On the other hand, some d/Deaf people may regard manually coded languages as part of sign language [92]. Besides, DHH people who do not take sign language as their native language often learn and use manually coded languages [14]. Therefore, while sign language has gained legal recognition in 74 countries [96], some do not distinguish between manually coded languages and natural forms of sign language to be inclusive of all signing community members (e.g., South Korea [60], Japan [90]). The responsibility to ensure the distinction then falls to practitioners in practice.

[4]Japan's only public broadcaster [94].

3 RELATED WORK

3.1 HCI Research with d/Deaf and Hard-of-Hearing People

Although research with DHH people is a relatively active sub-area in HCI (e.g., [82, 135]), this population has still received insufficient attention. Only 8.5% of accessibility research between 2010 and 2019 published at ASSETS and SIGCHI exclusively focused on DHH people, with almost half (41.1%) of the studies focused on blind and low-vision people [79]. Therefore, DHH people are significantly under-represented in HCI because auditory disabilities are more common than vision disabilities [5, 50]. According to the World Health Organization, over 5% of the world's population (i.e., 446 million people) are living with auditory disabilities [99]. The World Federation of the Deaf estimates that there are around 70 million deaf people around the globe [97]. Conservatively, at least 20 million people in China are DHH, making it the second most frequent type of disability after physical disability [5] [5].

From 2010 to 2019, 64.9% of accessibility research with DHH people in SIGCHI and ASSETS focused on communication issues [79]. A significant amount of work focused on DHH-hearing communications (e.g., professional communications [103, 135], education [82], and online conferencing [70, 113]). As for DHH people's information needs, researchers tended to focus on captioning [36, 65, 67, 121]. However, text-based information may still be inaccessible to d/Deaf signers [77], and an increasing number of studies have pointed out the importance of supporting language diversity to design for d/Deaf people [20, 77]. While researchers have also worked hard to develop sign language generation and interpretation systems through computer vision and natural language processing techniques [25], automatic systems are still hard to achieve because of a wide range of factors including datasets, technical limitations, as well as challenges in avatar design and UI/UX [25]. Our study can contribute an understanding of how d/Deaf people's needs for sign language information can be met by collaboration within d/Deaf communities.

3.2 d/Deaf People's Access to Information

Information access is among the most significant challenges faced by d/Deaf people [51, 104, 112, 149] because of the priority of spoken languages in mainstream society [127, 133]. As linguistic minorities, d/Deaf people often find it hard to access information in their preferred language (i.e., sign language) [149], especially incidental or emergency information [51, 104, 112]. For instance, governments often fail to provide information in sign language properly during crises such as COVID-19 [51]. d/Deaf people also have far fewer opportunities to access incidental information, as speech is crucial for picking up informal knowledge in a hearing-dominated society [112]. In addition, d/Deaf people may lack the right to decide what information they access, since much of the information should be mediated by interpreters [112]. Therefore, d/Deaf people have fewer opportunities and experience greater risk than hearing people in terms of a wide range of aspects, e.g., education and health [112].

The emergence of ICTs has largely increased d/Deaf people's abilities for information access. Valentine and Skelton have found that the Internet has enabled d/Deaf people to access information without mediation by hearing people such as interpreters, especially health and employment information [133]. Moreland et al. found that DHH people were more likely to get COVID-19 information from internet resources compared to healthcare providers, with nearly 60% reporting using internet resources [89]. However, accessibility services for DHH people are still often insufficient online (e.g., closed captioning in online videos) [77, 81]. Besides, d/Deaf people may still face significant challenges even with easy access to online information, because this population tends to have a lower literacy level than hearing peers in terms of written languages [1, 87, 109]. For instance, Almeida et al. found that d/Deaf adult students ignored

[5]We did not find recent national census data about DHH people in China. We also did not find the exact figure of the number of d/Deaf signers in China.

the meaning of more than 30% of the words, even though these participants treated text-based information as their first source of information [1]. d/Deaf people were also often reported to face challenges in understanding written health information [83, 112], especially those containing medical jargon [48, 130]. Indeed, many d/Deaf people still rely on traditional sources of information, e.g., friends, family members, and news with sign language interpretation [1]. Even those who are comfortable with written languages may still be more comfortable with sign language, as sign language is their first language [20, 149]. Therefore, many researchers have pointed out the necessity of supporting language diversity when designing ICTs for d/Deaf people [20, 77].

Furthermore, effective information access and engagement with information among d/Deaf people is not just a linguistic but also a cultural issue [149]. Young et al. have found that d/Deaf people may prefer content structured around visual elements; d/Deaf people may also perceive information shared by community members as more valid than other sources [149]. Their findings suggested the importance of d/Deaf communities in d/Deaf people's information access. However, HCI researchers primarily focused on assistive technologies for d/Deaf individual use (e.g., captioning [65, 67], text simplification [2], automatic sign language interpretation [25]), while little attention has been paid to d/Deaf communities. Only limited in-lab exploratory studies investigated the potential of signing communities in supporting crowdsourcing-related tasks (e.g., curating sign language datasets) [24, 29, 53, 124]. For instance, Cavender et al. built a forum to have American Sign Language (ASL) signers share and discuss signs in educational settings [29]. Bragg et al. used crowdsourcing to support sign language data collection for language model training [24]. We aim to contribute an analysis of how d/Deaf community-based collaboration can meet d/Deaf people's sign language information needs based on a real-world case.

3.3 Accessibility Achieved by Collaborative Efforts

Given our focus on d/Deaf communities' roles in sign language content creation, our work can be taken as a case of *human-powered access*, i.e., using human power to overcome accessibility problems [19]. While this line of work often portrayed disabled people[6] as recipients of assistance (e.g., [18, 54]), there is a growing body of literature in HCI highlighting disabled people's efforts in creating accessibility [17, 26, 40, 58, 135]. Bennett et al. introduced the framework of *interdependence*, emphasizing collaborative access and disabled people's contribution in these efforts [17]. Researchers have also been paying increasing attention to collaborative practices of ability-diverse teams in creating accessibility [41–43, 71, 78, 105, 126].

Research on multi-person collaborative systems for DHH people often focused on conferencing settings [70, 85, 113, 120], especially online ones [70, 113, 120]. Findings from these works highlighted DHH people's diverse communication preferences [70, 120] and informed design of features such as captioning [85] and visual display [113]. Informed by the framework of interdependence [17], Mcdonnell et al. also emphasized the collaborative efforts in DHH-hearing communications, noting that accessibility should be a shared duty of all group members [85].

In addition, disabled people were often found to build communities or support networks for accessibility purposes [39, 111, 114, 145]. For instance, Saha and Piper found audio professionals and hobbyists with vision impairments maintain many online communities as important places for exchanging support and resources [114]. Ringland et al. presented a case of autistic youth appropriating Minecraft as an assistive technology, i.e., online space supporting self-regulation and community engagement [111]. These findings present the potential of community-driven accessibility solutions.

[6]We use identity-first language in this work to reflect a Social Model of Disability, i.e., disability is caused by mismatch between a person's body and the environment where they live [98].

However, d/Deaf communities have received relatively little attention in HCI and accessibility research, with the majority of works focusing on assistive technologies for individual use (e.g., [20, 36, 65, 67, 121]). As "the first community of relatedness to emerge in the disability sphere [35]", d/Deaf communities have a long and strong tradition of collaborating to create accessibility for themselves. d/Deaf clubs are not simply for fun, but also important places for transmission of information and support, where d/Deaf people can feel a strong sense of belonging [101, 132, 133]. The emergence of ICTs has further broadened the scale of d/Deaf communities to a global network because d/Deaf people can distribute information beyond geographical restrictions, and communicate with each other remotely [35]. Our work will contribute empirical knowledge of how d/Deaf community-based collaboration can meet their accessibility needs.

4 METHOD

This study contains two phases, one interview study and a content analysis investigation. We began our study by interviewing d/Deaf people to understand their online information access, especially in sign languages. We chose to use interview-based qualitative methods as our primary methods since it is appropriate for understanding people's lived experience [38]. During the interviews, many of our participants mentioned the critical roles and impacts of d/Deaf videos on their lives and their communities. Therefore, we further analyzed the d/Deaf videos mentioned by them to strengthen our understanding of their experiences and create a better interpretation of our interview data.

4.1 Phase I: Interviews

4.1.1 Participant Recruitment. We set inclusion criteria for our participants as follows: 1) using any form of sign language as one of the preferred communication modes, and 2) identifying as d/Deaf. The participants were primarily recruited through purposive sampling [84] because we faced huge challenges in recruiting d/Deaf people who were comfortable participating in research conducted by hearing people (who they are unfamiliar with). Therefore, we had to reach out to d/Deaf people from diverse sources and as many as possible. More specifically, the participants were recruited from six sources: 1) alumni network of a high school for d/Deaf students in city A (Tier 1 city; see Table 2 for a detailed explanation of the city classification); 2) a Deaf person's social network in city A (Tier 1 city); 3) a coffee shop run by DHH people in city B (new Tier 1 city); 4) a d/Deaf shop assistant in a shopping mall we met occasionally in city B (New Tier 1 city); 5) the social network of a hearing teacher at a school for d/Deaf students in city C (a New Tier 1 city); 6) online social media (e.g., DouBan[7], WeChat groups).

Finally, twelve d/Deaf people participated in our study (four female, eight male; age: median = 30.5, mean = 36.42, SD = 16.16, see demographic information in Table 2). The participants were from diverse places in Mainland China, including five cities considered to be Tier 1, New Tier 1, and Tier 4 areas [140]. Tier 1 cities represent the most developed cities in China; New Tier 1 cities represent relatively developed cities in China; Tier 4 cities represent less developed areas. Although we offered 100RMB as study compensation, four participants joined as volunteers. This study has been approved by Duke Kunshan University's Institutional Review Board (IRB).

4.1.2 Semi-Structured Interviews. We conducted semi-structured interviews with our participants from July to August 2022 either in text or sign language depending on our participants' preferences (see details of interview settings in Appendix D). All interviews were conducted one-on-one online via real-time text chat (written Chinese) or video chat (sign language). The interviews conducted in sign language were mediated by professional sign language interpreters, d/Deaf people bilingual in sign language and spoken Chinese, or acquaintances the participants recommended, except

[7]https://www.douban.com/

ID	Age	Gender	Location	Formal Education	Occupation	Hearing Status	d/Deaf Videos
P1	65	M	Tier 1	High School	retiree	profoundly deaf	watching irregularly
P2	24	F	Tier 1	Bachelor's Degree	office clerk	profoundly deaf (w/ cochlear implant)	not watching
P3	24	F	Tier 1	Bachelor's Degree	public relations assistant	profoundly deaf (w/ cochlear implant)	not watching
P4	24	M	New Tier 1	High School	shop assistant	profoundly deaf	watching irregularly
P5	23	M	New Tier 1	Bachelor's Degree	food deliveryman	profoundly deaf	watching a lot
P6	25	M	New Tier 1	Junior College	ride-sharing driver	profoundly deaf	used to watch a little
P7	37	M	Tier 4	Master's Degree	teacher at a high school for d/Deaf students	profoundly deaf	watching a lot
P8	51	F	New Tier 1	Junior College	retiree	profoundly deaf	watching a lot
P9	47	F	New Tier 1	Junior College	unemployed	profoundly deaf	not watching
P10	62	M	New Tier 1	Primary School	retiree	profoundly deaf	watching a lot
P11	19	M	Tier 4	High School	student at a high school for d/Deaf students	profoundly deaf	watching a lot
P12	36	M	New Tier 1	Junior College	preferring not to disclose	profoundly deaf	creating and watching a lot

Table 2. Demographics of our interview participants. All the information was self-reported. The classification of the locations is based on an unofficial yet well-adopted hierarchical classification of cities in China [140]. Tier 1 cities represent the most developed cities in China; New Tier 1 cities represent relatively developed cities in China; Tier 4 cities represent less developed areas. "profoundly deaf" refers to hearing loss over 90db for the ear with less hearing loss [32]. All the participants are fluent signers. Complementary information about the participants is presented in Appendix D.

the interview with P12. The fourth author conducted the interview with P12 in sign language and translated the conversations. We screen-recorded all the interviews conducted in sign language to validate the sign language interpretation. All the recordings were under our participants' informed consent.

We clarified our backgrounds and intentions during recruitment and before each interview. All the interviews were conducted under our participants' informed consent. During each interview, we asked our participants about their daily information-related behaviors, including how they seek information (online) for their needs, what information they need most, what challenges they meet in getting access to information, and so on. Given our research question, we paid particular attention to their access to online sign language content, as well as how d/Deaf communities were involved. We focused on specific situations mentioned by our participants and asked follow-up questions to build a detailed understanding of their experiences.

4.1.3 Data Analysis. The final data for analysis consisted of text chat, transcribed sign language interpretations, and excerpts translated from the recorded videos. We adopted grounded theory in the qualitative analysis [125], reviewing and labeling the emerging codes in an iterative process. The lead author conducted inductive coding of the data [125],

and discussed the resulting themes with other co-authors to identify principal themes from the data. The primary codes included: lack of information in CSL, lack of information in sign language during COVID-19, d/Deaf video as information sources, d/Deaf video as educational material, need for negotiation of sign language interpretation, etc. The whole research team reached a consensus on the final themes. All the quotes used in the paper were translated into English by the lead author and checked by co-authors. Translation of the quotes from sign language into written Chinese was double-checked by the fourth author, a Deaf professional who works as a sign language teacher and interpreter.

4.2 Phase II: Content Analysis of d/Deaf Videos

During interviews, we found that many of our participants mentioned popularity of d/Deaf videos among d/Deaf people in China. We then decided to conduct content analysis of the d/Deaf videos they mentioned to improve our understanding of these videos and also for better interpreting the interview data.

ID	Platform	Number of Followers	Number of Videos	Starting From	Number of Videos in a Recent Week	Number of Videos in a Recent Month
V1	WeChat	N/A (140k in KuaiShou)	724	2017	18	45
V2 (P12's channel)	KuaiShou	29k	225	2020	6	23
V3	KuaiShou	8.6k	117	2019	6	17
V4	KuaiShou	6.0k	68	2022	9	39
V5	KuaiShou	7.1k	408	2019	5	22
V6	KuaiShou	17k	114	2021	6	18
V7	KuaiShou	48k	402	2019	4	21
V8	KuaiShou	41k	98	2019	5	22
V9	WeChat	N/A (67k in KuaiShou)	1085	2018	6	31
V10	WeChat	N/A (40k in KuaiShou)	not disclosed	2019	4	20
V11	WeChat	N/A (8.3k in KuaiShou)	441	2020	3	8
V12	WeChat	N/A (91k in KuaiShou)	619	2019	2	8

Table 3. General information of the video channels we included for analysis. WeChat does not present the number of followers, therefore we instead present the number of followers the same video creator has in KuaiShou.

4.2.1 Data Collection. In late August 2022, we asked our participants to recommend d/Deaf videos they enjoyed watching. Combined with recommendations from the Deaf professional in our team, 12 video channels (see Table 3) were finally included for data analysis. The channels were from WeChat[8] and KuaiShou [9], which are among the most popular social media platforms for information or video sharing in China [68, 141]. We excluded the channels which have primarily shared personal life, considering our research focus on d/Deaf people's and their communities'

[8] A multi-purpose mobile application in China primarily used for instant messaging; see Appendix A.
[9] A short video sharing mobile application in China; see Appendix A.

information needs. We selected the first 30 videos in each channel (videos pinned by the creators and the most recently published videos) for analysis. We chose to analyze the first batch of videos because they represent the recent status of the channels. The dataset consisted of 360 videos in total.

4.2.2 Data Analysis. We conducted a thematic analysis of the 360 videos' titles and captions in the videos [61]. Two of the team members first did inductive open-coding [125] of the first three videos of each channel (i.e., 10% of the data) independently. During the initial coding, they recorded the video title for confirmation. After the initial coding, the two coders discussed the results with the team to determine the codebook. Specifically, we chose to code the content category, whether including captioning, number of "Likes" received, number of comments, and number of views for each video if applicable. We iterated the inductive coding process twice to generate themes. In the first round, we tried to have a general idea of the content. For instance, we learned that most of the videos were about news in public media. In the second round, We then identified the nuances in the videos considering the video's content topics and creators' intentions. For instance, we found that some news-related videos are specific to d/Deaf communities (e.g., scams targeting d/Deaf people, events for d/Deaf communities), and then we generated more nuanced codes accordingly (e.g., warning messages, community information). Finally, we identified 11 major content categories, i.e., news, personal life, general knowledge, etc. (see Table 4 in the Results section for details).

To ensure the codes were not systematically different from the remaining videos in each channel, the two coders conducted an independent deductive coding of 60 videos randomly sampled from the rest of the videos in each channel (5 videos in each channel). We calculated the inter-coder reliability for the coding of these 60 videos (Krippendorff's Alpha=93.33 based on content category) [69]. The two coders then evenly split the remaining 330 videos in the dataset for deductive coding. After the coding, the coders and the lead author went over and discussed all the codes together. We determined the codes based on the opinions of the majority if we cannot reach a consensus. While we did not code the comments under the videos, we summarized the viewers' reactions to each video. We anonymized all the channels to protect their privacy and made sure their channels were not traceable or searchable online.

4.3 Positionality Statement

Our research team consists of 5 hearing researchers and a Deaf professional. We consider d/Deaf people as linguistic minorities in this study. All of us are originally from Mainland China. The hearing members are not signers and are raised in hearing culture. The fourth author identifies as Deaf Chinese born deaf to a d/Deaf family (i.e., both of her parents are d/Deaf) in a Tier 1 city in China. She now works as a sign language teacher and interpreter in China. She has long worked with d/Deaf communities in the city she was born. She provided input and feedback for the research design, interview guide, and the final findings, to avoid that our research design and data interpretation were solely based on hearing norms [122].

5 RESULTS

We found that many d/Deaf people are creating sign language videos online targeting at d/Deaf audiences across the country (Figure 1). These videos have an indispensable role in five of our participants' lives, serving as important information sources or educational materials. Next, we detail how and why d/Deaf videos thrive online, as well as the challenges in the creation and sharing of this type of video.

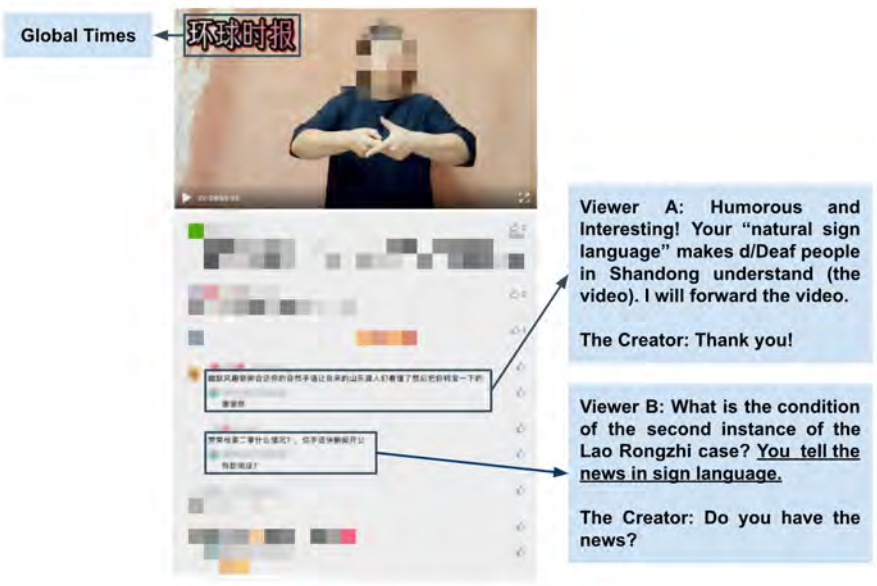

Fig. 1. A typical example of a d/Deaf video about news in WeChat. The video creator captioned the original Chinese word for a proper noun "Global Times", which is an official daily newspaper in China. The term "natural sign language" in one comment is usually referred to CSL to mark the difference from Signed Chinese. "Lao Rongzhi case" is a recent case about a pair of Chinese serial killers [138]. The underlined sentence is not clear in meaning.

5.1 Significance of d/Deaf Videos to d/Deaf People

We found that d/Deaf videos have served as valuable information sources and/or educational materials to nine of our participants, which compensate for the lack of official CSL information in China.

5.1.1 d/Deaf Videos as Important Information Sources and/or Educational Materials. Nine of our participants (except for P2, P3, and P9) thought d/Deaf videos were important information sources and/or educational materials. For instance, P4 and P5 first knew about the outbreak of COVID-19 through d/Deaf videos behind the news. P5 is one of the most active followers of d/Deaf videos among our participants, also a typical example of active followers of d/Deaf videos,

> *"The official news is lengthy and sometimes made me feel confused...Sometimes I first learned about something from TV news, but I found that V1's videos helped me grasp things better."*

P12 is a d/Deaf video creator. From his perspective, we can also see the importance of d/Deaf video to d/Deaf people,

> *"Many d/Deaf people lack access to information in mainstream society, and may have low Chinese literacy. I hope d/Deaf people can understand the news and know about how to live better (through my videos)."*

Although P7 does not treat d/Deaf videos as important information sources for himself because he is quite fluent in Chinese, he as a teacher at a high school for the d/Deaf often shares d/Deaf videos with his students to broaden their horizons. He compared d/Deaf students now and then to us,

> *"I started working at the school in 2009. Computers were the only devices available at the time for accessing the Internet, and the d/Deaf students had limited access to these devices. There were also no online video platforms like KuaiShou. Therefore, d/Deaf students then did not have the wide perspective as of today."*

While P11 did not treat d/Deaf videos as his information source, he still watched d/Deaf videos frequently for educational purposes. He told us he watched d/Deaf videos to learn CSL in different places because he wants to be a lawyer for d/Deaf people across China. He also actively follows another d/Deaf lawyer's channel to learn sign languages of legal terms. From these participants' experiences, we can see the important roles that d/Deaf videos played in d/Deaf people's information access and education, e.g., for career development.

5.1.2 Lack of Official CSL Information. The popularity of d/Deaf videos resulted from the lack of official information in CSL. Our participants told us it is common that d/Deaf people cannot understand the interpretations in TV news, because the interpreters sign in Signed Chinese rather than CSL (e.g., P1, P6, P12), consistent with what was reported in online reports [12] and prior research [146]. As P1 (former secretary general of the d/Deaf association of a district in the city he lives) said,

> *"d/Deaf people in (a Tier 1 city) all said they cannot understand sign language interpretations in TV news. The interpreters were invited by hearing people who do not understand CSL. It is very common that they don't verify the abilities of interpreters and invite people without careful consideration."*

Our participants also told us they cannot fully understand the interpreted news because of other reasons, such as *"the area showing interpretations is too small"* (P1, P8, P12), and *"the signing is too fast"* (P8, P10). Sign language interpretations were also hard to be provided instantly in crisis or incidental situations [51]. For example, according to P3, sign language interpretations were not provided in official TV news during the outbreak of COVID-19. Therefore, watching TV news may not be effective enough for d/Deaf people to receive information, especially those who are not fluent in written Chinese. P1 told us, many older d/Deaf people would attend monthly gatherings that are organized by d/Deaf people in each sub-district ("街道"),

> *"We have d/Deaf people fluent in Chinese share news in sign languages at the events...The older d/Deaf people who are illiterate in Chinese find value in these events."*

From this quote from P1, we can partly see why d/Deaf videos are popular among d/Deaf people. In a sense, these videos have played similar roles to the offline gatherings P1 described, i.e., supporting the creation and promotion of content in CSL that many d/Deaf people need. This point can be supported by comments under d/Deaf videos, in which people express appreciation towards the use of "natural sign language" (Figure 1). The term is used to refer to CSL to mark the difference from Signed Chinese.

5.2 What are d/Deaf Videos and Who are Making Them?

From our interviews and video content analysis, we identified two types of d/Deaf video creators, 1) individual d/Deaf content creators and, 2) d/Deaf-led organizations. Nine of our participants have watched d/Deaf videos from individual content creators; two have volunteered in an organization led by d/Deaf people aiming to create and promote information that d/Deaf people need (P3 and P7). Next, we dive deeper into these two types of d/Deaf videos based on both video analysis results and our participants' descriptions.

5.2.1 Active Sharing from Individual d/Deaf Content Creators. All the video channels that our participants recommended to us were from individual content creators, which have actively shared a wide range of information (Table 4). These channels share videos almost every day on a regular basis (Table 3). These results suggest that d/Deaf video sharing is almost a daily routine for the creators. The details of each account can be checked in Appendix C. We further noticed that three video creators even left messages to the followers for leave of absence if they cannot share videos on the day

Content Category	Definition	Example
news (55.67%)	recent important events on public media	Sichuan earthquake, Luding 6.8 magnitude earthquake Russia-Ukraine war, Poland asks Germany for 9 trillion as compensation
personal life (13%)	personal life events or stories	My wife is pregnant and hungry fast. I am busy! Grandpa is giving (the video creator's daughter) noodles
general knowledge (10.67%)	general knowledge such as science, history, culture, and trending social issues; the creator may also share his/her opinions	The legend of Henry Chang-Yu Lee, the top Chinese American detective What's the difference between having children go to learning centers and not
life tips (7%)	suggestions about how to live a better life; sharing reflections on life	No badmouthing behind people's backs. It's annoying! What happened to some d/Deaf people? Please spend wisely
d/Deaf peer support (6.33%)	sharing knowledge with explicit intentions to help d/Deaf people	What to do when a d/Deaf person is laid off? Why is social security important and what are the benefits of paying social security?
community information (5.67%)	sharing information about d/Deaf communities	Interview with Chairman (anonymized name) of China Association for the Deaf, who served for d/Deaf people for 38 years Shandong d/Deaf e-sports competition
warning message (5%)	warning d/Deaf people against potential risk, especially crime	The face recognition payment fraud I hope d/Deaf people do not have international travel (in recent times), not safe
interaction with followers (5%)	interaction message with followers, such as greetings, thanks note and interactive questions	Thanks in advance for advice from my followers! Which one is better? Fuel cars or electric cars? Thank you all for your support
advertisement (4.67%)	promotion of a product or service, from which the video creator may gain profit	For the d/Deaf people who stay up late! What tea is good for you? Driving school for the d/Deaf – (annonymized driving school)
announcement (3.67%)	a notice or announcement about the video channel	Do you miss me? See you in live-streaming on July 8 at 7:30 pm! My eyes hurt, and I need to rest for a few days!
entertainment (1.67%)	interaction message with followers, such as greetings, thanks note and interactive questions	Fight with a mosquito, a funny video The best ever funny video
sign language teaching (1.67%)	teaching how to interpret simple Chinese words into sign language	Follow me to learn signs: How to sign "bottom line"? Sign Language Vocabulary: Karma

Table 4. Content category of the d/Deaf videos we analyzed.

(see "announcement" in Table 4), which imply that some creators treated their sharing very serious. For instance, P12 even told us he treats video creation and sharing as his *"job"*.

From the 360 videos, we categorized 11 types of d/Deaf videos based on content (Table 4). The most common type of video in our dataset is news (55.67%, N=167), covering a wide range of domains such as politics, sports, education, military, economy, health, etc. P12, who manages the channel V2, told us how he selected news to meet d/Deaf people's diverse needs this way,

> *"I chose the news based on whether d/Deaf people will benefit from or like it. I would also make an effort to accommodate my followers' requests for news on politics, military, or international events."*

Besides news videos, we found that d/Deaf videos also cover a wide range of other topics that d/Deaf people may need, or be interested in (e.g., general knowledge such as science; see Table 4 for details). In particular, we found that four types of videos were specific to d/Deaf communities (i.e., d/Deaf peer support, community information, warning messages, sign language lessons). Among these videos, there are two types of videos intended to provide support to d/Deaf people (i.e., warning message, and d/Deaf peer support). P12 told us he would *"emphasize news or information about scam to make d/Deaf people cautious."* As such, d/Deaf video has covered a wide range aspects of d/Deaf people's life, not limited to sharing news on public media.

We noticed that four channels promoted commercial advertisements. P12 told us video creators may promote commercial advertisements to make money. He said,

> *"I would sometimes end my videos with advertising to be paid for my time...I don't care how much money I can make from the videos, though. I make a steady paycheck from a full-time job. V1 does not have a full-time job, so some of his videos require payment."*

We further noticed that nearly 10,000 people paid for V1's videos (that required payment) and these videos are much longer (about 1 hour) than the free ones (usually within minutes). Even though V12's videos are free to watch, around 10 followers would usually donate to support her, which demonstrated the followers' support for the video creators [10]. As one comment under a video of V1 put, *"You've put in a lot of effort signing for 51 minutes. It's long, and not easy! Seriously, I can't live without you. I need your sharing. I'll study hard. Thank you! I'll be there for you!"*.

5.2.2 Collaborative Content Creation by d/Deaf-initiated Organizations. Besides individual content creators, interview results suggested that some d/Deaf people joined d/Deaf-initiated organizations to promote information in sign language. According to the two participants who have volunteered in an organization run by d/Deaf people, organization-led content may have the advantage of combining different expertise from people. For instance, P3 told us that she collaborated with others in the organization to provide pandemic-related information in sign language in WeChat and KuaiShou for d/Deaf people during COVID-19. She introduced their collaborative works to us,

> *"People across China and the world – both hearing signers and d/Deaf people – worked together. We had several groups to be responsible for different tasks."*

P3 told us the organization also hosted online workshops for d/Deaf high school students when they noticed that many of their audiences are teenagers,

> *"Following the interpretations for COVID-19, the organization's founder invited eight college students, including myself, to share our university life with d/Deaf students across China. I did a lot of work, preparing events, inviting speakers, conducting online interviews, creating hosting scripts, interpreting sign language, and moderating WeChat groups, among other things."*

According to her, each WeChat group they organized for the sharing events has about 200 high school students, and she answered many questions from the students, such as how to choose universities and majors, the condition of her university, etc.

We were surprised to find that P7 also had connections to the leader of the same organization that P3 joined, although they were recruited from different sources. P7 told us the organization also collaborated with professionals to promote sex education in sign language. According to P7, many Chinese words, especially jargon, have no common ways of expressions in CSL. Therefore, people have to work together to promote sex education with proper interpretations,

[10] WeChat includes a feature to enable people to reward the creator (see Appendix B - Figure 1).

> *"We regularly talk about sign language interpretation in our WeChat group...We would also consult specialists who are knowledgeable about sign language and sex education. It is much like business English. You must be an expert in both business and English."*

As reflected in this quote, the interpretation of unforeseeable words in sign languages can be challenging, requiring d/Deaf people with expertise in different domains to work collaboratively.

5.3 Challenges in Community-Driven Sign Language Content Creation

While d/Deaf videos benefit d/Deaf people with broader information access, we identified two major challenges in d/Deaf video creation and sharing, i.e., difficulties in sign language interpretation and inconsistent content qualities. Therefore, two of our participants did not enjoy watching d/Deaf videos very much, though they did see the potential of d/Deaf videos for d/Deaf people (P1, P6). Besides the two major challenges, online trolls and (micro)aggressions may also cause negative experiences for d/Deaf video creators.

5.3.1 Challenges in Sign Language Interpretation. One significant challenge in d/Deaf video creation is manifested through the difficulties in sign language interpretation due to sign language diversity in China, and interpretation of unforeseeable words in CSL.

Language Diversity. One of the most significant challenges in interpretation comes from language diversity among d/Deaf people in China, i.e., the CSL that d/Deaf people use is different across China. Some participants told us they encountered difficulties in communication with people who use different variants of CSL (e.g., P2, P4, P11). Even in the same region, the sign language that d/Deaf people use can be very complicated. P6 told us the sign language he uses is a mixture of local sign language, Signed Chinese, as well as a variety of sign language created by older d/Deaf adults in the city he lives in.

The diversity of CSL presents significant challenges in interpretations. As P1 said, *"The diversity of CSL is an issue that needs to be addressed (in d/Deaf videos). d/Deaf people in Shanghai may not understand sign language in Beijing."* Regarding the complexities of CSL, P6 and P7 suggested that d/Deaf videos should contain Chinese captioning so that d/Deaf people can check the original words if they can read Chinese. According to P5 and P12, d/Deaf video creators would adapt their signings according to viewers' feedback. P5 told us,

> *"V1 has been always improving his videos based on feedback from viewers...V1 would collect ways of signing from people in different places. He once shared a video talking about the issue."*

P12 also said many followers told him they cannot understand sign language in his first video. He then changed his way of signing,

> *"I switched to CSL after realizing that I shouldn't sign in Signed Chinese. I found that d/Deaf people with limited Chinese literacy may not understand Signed Chinese. According to my observations, only very a few d/Deaf people are fluent in Chinese."*

As reflected in these two quotes, interpretation in CSL is a complicated process that requires negotiation within the community.

Interpretation of Unforeseeable Words in CSL. The difference between vocabulary in Chinese and CSL also makes sign language interpretation challenging. Sign languages have distinct vocabularies and grammar from spoken language [16]. Therefore, video creators often have to deal with unforeseeable words in CSL during interpretation. P3 told us how they dealt with interpretations during COVID-19,

> *"The COVID-19 outbreak brings many unforeseeable words. The interpreters in our group would consult older d/Deaf adults to interpret more properly and make people understand the information more clearly."*

Some participants told us interpretation from Chinese to CSL is often based on interpreters' personal understanding (e.g., P1, P6, P7, P11), and may *"lose original meanings of the Chinese word if it was not clarified" (P6).* P6 further explained, *"some d/Deaf people may not know how to describe accurately nuanced ways of being good. They just simply described it as 'good'."* For P1, it would thus be better to interpret in Signed Chinese than CSL during news sharing, as Signed Chinese can better deliver the original meaning of Chinese. P1 explained why he did not like watching d/Deaf videos,

> *"I don't particularly enjoy watching d/Deaf videos because many of the interpretations are wrong or confusing to me. The interpretations from Chinese to CSL are often based on the creators' own understanding. Many creators are not fluent in Signed Chinese."*

Given the issue, we noticed that some d/Deaf videos added the original Chinese words of some keywords (e.g. proper nouns, jargon) in the video for clarification (Figure 1). However, half of the video channels we analyzed have not been captioned at all (Appendix C). As P7 said, *"captioning for the whole video would be extremely time-consuming".*

P7 agreed that *"interpretation of words that are not common in the d/Deaf world should be discussed. (I) use Signed Chinese in these settings if possible. Interpretations during the pandemic could be an example."* However, given the language diversity among d/Deaf people as noted above, interpreting in Signed Chinese is often just an ideal. P7 told us there are four typical types of d/Deaf people in his mind, who may need information in different languages,

> *"1. fluent in Chinese; only signing in Signed Chinese. This is common among younger d/Deaf people, especially university students; you should deliver information in Signed Chinese to them.*
> *2. fluent in CSL but having limited literacy in Chinese. This is common among older d/Deaf people; you should deliver information in CSL to them.*
> *3. fluent in both CSL and Chinese; knowing a little hearing culture. Their interpretations between Chinese and CSL may be incorrect or sometimes biased; you should deliver information in Signed Chinese to them.*
> *4. fluent in both CSL and Chinese; being familiar with both d/Deaf and hearing culture. Only these people are truly bilingual, who should be regarded as experts (in interpretations)."*

This quote well illustrated the complexities in interpreting sign languages in China. P7 told us sometimes the interpretation of d/Deaf videos was even wrong. He gave an example of a mistake in the interpretation that he recently found, in which the creator interpreted "亚健康" ("sub-health") into "亚洲" ("Asian") plus "健康" ("health"). Mistakes in interpretations can also be common in an emergency situation when there is insufficient time for careful discussion and consideration. P7 said he found many mistakes in interpretations in videos they created about COVID-19 when he watched back, which, however, he felt he could do nothing about.

5.3.2 Challenges in Ensuring Content Quality. Perceived low content quality of d/Deaf videos is another major challenge in d/Deaf video creation and sharing, including content depth, the quality of signed interpretations, and information trustworthiness, etc. P6 told us that he used to watch d/Deaf videos, but he did not enjoy them very much because of the perceived low content depth. He explained this way,

> *"I did not like d/Deaf videos in KuaiShou because of the mediocre content quality. The education level of d/Deaf people is a far cry from each other. I refuse to watch some videos. I can't speak for all d/Deaf people; this is simply my personal opinion."*

Some d/Deaf people may not be satisfied with the accuracy of the signed interpretations. P12 thought the information quality of many d/Deaf videos is far from perfect because of the relatively low literacy of the creators, either in Chinese or CSL. As he commented,

> *"V1's videos were not so good as now because he might not fully understand the news. He later built a team, nevertheless, with hearing people in charge of understanding the news. His videos have greatly improved because of teamwork...The information in (anonymized channel) is accurate, but his sign language is not natural enough."*

P12 further told us he started to realize the high demands in news sharing after he has shared videos for a year. He now also feels that he needs a team to reduce his burden in content creation.

Deaf people may also hold concerns about trusting the information from the d/Deaf videos. P12 told us he has received messages from his followers, asking whether the news in his videos was trustworthy, although he *"only picked news from reliable sources such as CCTV*[11] *and Tencent news rather than personal media"*. He told us,

> *"Some followers questioned the information sources of my videos...I heard other d/Deaf video creators received similar questions. These comments taught me that I shouldn't distribute news without reliable sources. Another time, after publishing the video, I made some adjustments. Then, some supporters claimed I was fabricating information (in the video). I had to present them with the original news source. I learned that I should hold off on breaking the news for a few days."*

While P10 does not have a strong negative attitude towards d/Deaf videos, he also felt that TV news is more trustworthy because of the backup of the government.

P7 told us he noticed that some videos from d/Deaf people are even harmful to teenagers in terms of education,

> *"There's no content moderation for signed videos now. Some d/Deaf people would publish inappropriate content using sign language. One of my students once sent me a sexually explicit video, which is inappropriate for sex education. Also, I watched a video in which a d/Deaf person encouraged viewers to drink disinfectant to kill the COVID-19 virus."*

As implied by P7, content moderation is necessary to ensure the content quality of d/Deaf videos, which unfortunately is a void now. P7 advocated for content moderation of d/Deaf videos, and he emphasized that *"the moderators should understand CSL that d/Deaf people use."*

5.3.3 Potential Harmful Experience Caused by Online Trolls and (Micro)aggressions. Besides the two major challenges, we found that sign language content sharing may also be disrupted by online trolls. P12, a d/Deaf video creator, told us his channel was once banned because a hearing viewer reported violations to the platform. He told us the story,

> *"The hearing person reported to the platform that one of my videos, despite being entirely about China-U.S. relations, has adult content. I had to ask my hearing friend to call the platform and got my account back."*

This quote from P12 revealed that viewers of d/Deaf videos may include hearing people who did not understand sign language at all, and some of them could be online trolls. Echoing P12's experience, we noticed that some comments under d/Deaf videos may not be perceived as friendly enough. Take the following comments as examples,

[11] China Central Television, a Chinese government-owned broadcaster [139].

"How can deaf-mute people[12] *drive? How can you drive since you can't even hear the sound?"*
"What is the purpose of having hearing aids since you are deaf? Hearing aids are only useful to people who cannot hear well ("耳背"), right?"
"You're so pretty, but unfortunately, you can't speak."

These comments imply potential (micro)aggression that d/Deaf video creators may experience during content sharing, which may lead to their unpleasant experiences [56], and require them to deal with additional emotional labor [46].

6 DISCUSSION

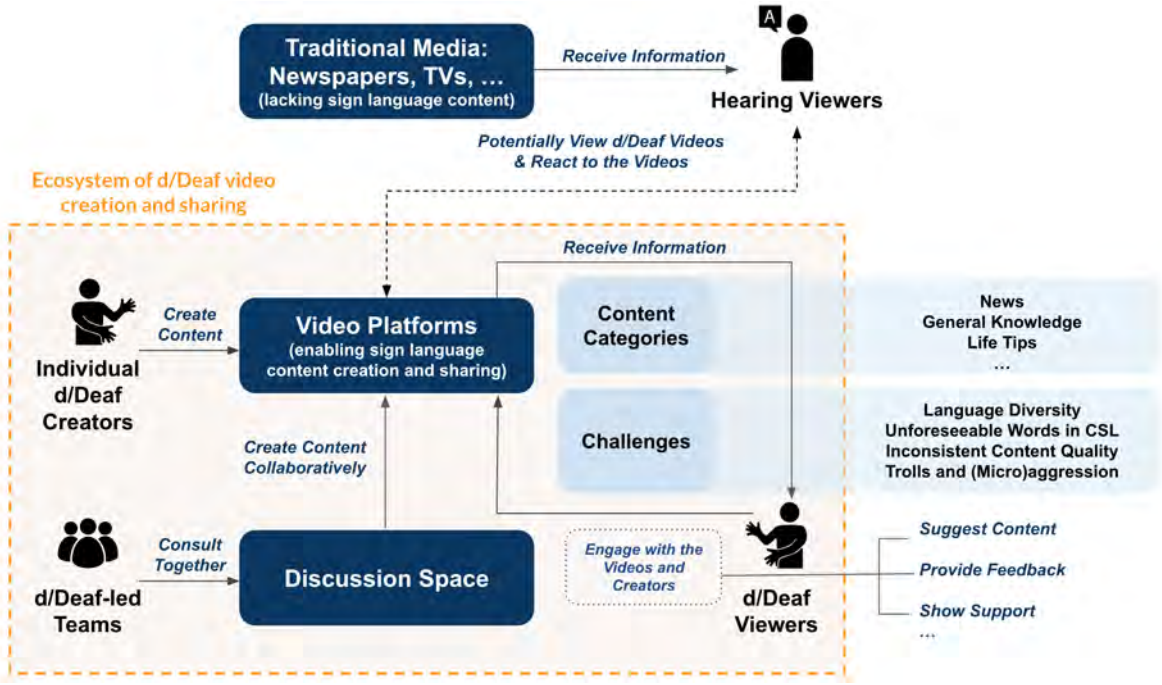

Fig. 2. The ecosystem of d/Deaf video creation and sharing.

This study contributes a real-world case showing how community-driven content creation can meet d/Deaf people's information needs at scale. The findings outline an ecosystem of d/Deaf video creation and sharing (Figure 2). While researchers usually focused on design for d/Deaf individuals to support their information needs (e.g., captioning [20, 36, 65, 67, 121] and automatic sign language interpretation or translation [25]), our study identifies the potential of supporting collaboration within d/Deaf communities to meet their information needs. Our findings support that accessibility should be treated as a result of human collaboration and negotiation [17, 41, 78, 135], not limited to assistive services or features for individual use (e.g., [20, 36, 65, 67, 121]). As suggested in the findings, accessibility requires negotiation within the communities (e.g., dealing with language diversity) and collective efforts of all community

[12] deaf-mute is a term that is often perceived as offensive by d/Deaf people because d/Deaf people are not mute. They can express themselves through sign language. Besides, d/Deaf people usually have functioning vocal cords. However, it is possible that d/Deaf people in China would use the term "deaf-mute" to refer to themselves.

members (e.g., discussing interpretation). Next, we further our discussion to argue for the importance of community-driven information for d/Deaf people. We end by discussing opportunities for design and future research.

6.1 Empowering d/Deaf People in Information Access Through Community-Based Collaboration

Our findings show that d/Deaf community-generated video content can improve d/Deaf people's sign language information access for a wide range of purposes, e.g., news, education, peer support, etc. Although sign language has gained legal recognition in 74 countries [96], there is still a global shortage of qualified sign language interpreters [10, 116, 117], especially in certain contexts (e.g., crisis times [51, 127]). d/Deaf people may also often lack access to education and information in their preferred forms of sign languages in many countries [44]. Considering the difficulties of machine-driven solutions [25], fostering community-based collaboration would be a promising direction to support the growth of sign language information. We will detail opportunities for future design and HCI research in Section 6.2.

As shown in this study, community-driven information can well support the diversity in sign languages. Currently, the standardization of sign language is difficult in many countries (e.g. China [10, 13], Cambodia [55], Indonesia [102]). Even in countries where there is a standardized official form of sign language, there is still considerable variation in sign languages within the countries because of socio-cultural influences [23] such as racial segregation [101], and differences in d/Deaf education people received [92]. Oftentimes, the information needs of d/Deaf people from sub-communities are not well met now [44]. For instance, currently, of all the signed languages used in the U.S. (e.g., Black ASL), only ASL gains legal recognition [91]. Sign languages may also lack standardized signs in professional or emerging fields such as science [29, 80]. Our findings then have the potential to be generalized worldwide.

More importantly, supporting d/Deaf communities in content creation can increase d/Deaf communities' control over the information they can access. Currently, in most cases, accessibility service for d/Deaf people is represented in the form of providing interpreters [44, 112]. However, sign language interpretation provided by hearing people is often found to be ineffective because hearing interpreters are often unfamiliar with the culture and communication norms of d/Deaf communities [59]. As revealed in prior research, meaningful information access for d/Deaf people is more than just having interpreters; it also requires knowledge of Deaf culture, communication norms, and life experiences [49, 123, 149]. d/Deaf people around the globe are often found to be dissatisfied with interpretations by hearing interpreters [136]. Even highly-skilled hearing interpreters may struggle in sign language interpretations/translations in certain fields (e.g., science) [80]. Our findings suggest that community-generated accessibility solutions may be effective since the contents are generated from the perspective of community members and can meet their diverse needs [114]. Moreover, supporting the growth of community-driven information can not only improve d/Deaf people's access to information from public media but also empower their information needs in education, peer support, community connectedness, and so on. However, community-driven information may still encounter difficulties in terms of quality control, sustainability, etc., as examined next.

6.2 Envisioning Online Sign Language Content Creation as a Community-Driven Ecosystem

We envision sign language content creation as an ecosystem that can be powered by d/Deaf community efforts with the support of an ecology of tools, e.g., captioning, discussion space, and features to show support. We propose the following directions that researchers and designers can work on to support d/Deaf communities in co-creating information accessibility in the future. We suggest fostering collaborations within d/Deaf communities and considering the broader social contexts in online space as well.

6.2.1 Treating Online Sign Language Content Creation as a Community of Practice. *Community of Practice*, i.e., "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly [137]", is a compelling framework that can be used to consider online sign language content creation. Below we detail how designers can support d/Deaf people as different roles based on their varied abilities and availability to achieve community-driven information accessibility.

1. Creators: Fostering Collaborative Content Creation. This study supports the importance of accessibility design in sign language content creation, e.g., facilitating captioning for signed content [77]. Additionally, we reveal two major challenges in creating interpreted signed content, e.g., language diversity and unforeseeable words in sign language. Therefore, both sign language experts and professionals from related domains (e.g., health, law) should be involved in promoting sign language content. Designers can consider strategies to encourage collaborative efforts within d/Deaf communities, e.g., creating an accessible space such as group chats or forums for discussion and archiving results. Comments from experts in relevant fields can be highlighted to indicate their expertise and increase their visibility within the community (e.g., through features such as user flair on Reddit, i.e., a colored text to indicate user identity [52, 110]).

2. Moderators: Supporting Sign Language Content Moderation. Our findings reveal the necessity to support content moderation in ensuring sign language content quality. Currently, d/Deaf viewers may face challenges in selecting high-quality content to serve their needs because of the void of content moderation. While content moderation is a significant issue that has been long discussed in HCI (e.g., [118, 119]), few works explored the moderation of content in minority languages, such as sign languages. The reality of sign language as a minority language makes content moderation challenging. The model of centralized moderation taken on platforms such as Twitter and YouTube [118], is hard to achieve, considering the lack of qualified moderator candidates (i.e., bilingual in sign language and written language). Community self-governance and self-moderation may thus be important to the moderation of contents in sign language [118]. Designers may take Reddit as an example, supporting d/Deaf people to assign qualified content moderators [52] and establish community norms for self-governance [119].

3. Viewers: Supporting Viewers in Information Reception. This study uncovers many challenges d/Deaf people face in information reception when watching user-generated sign language content (e.g., misunderstanding, misinformation). As suggested in our findings, d/Deaf people may not fully understand interpreted information. Therefore, captioning the signed content is not only helpful to hearing people [77], but also to d/Deaf people, if the content contains non-standardized words in sign language [29]. Besides, it is also challenging for d/Deaf people to have trustworthy information through user-generated content. Designers can consider strategies to support cross-checking information from multiple sources (e.g., including a section for curating related information from reliable sources for d/Deaf people who are literate in written language). Text simplification tools may be considered to support reading [2].

4. Viewers as Co-creators: Encouraging Peripheral yet Important Contribution. The viewers can also make significant contributions to support a division of labor in content creation and moderation. For instance, designers can enable viewers to add captions for signed content. Besides, d/Deaf people can provide feedback for the videos, which was shown to be significant to the improvement of content quality. Designers can add features to enable d/Deaf people to achieve community-driven content quality control (e.g., enabling viewers to point out mistakes for a selected time range of videos). The opinions from community members may also help to achieve distributed content moderation [52]. For instance, community members can control the visibility of content by voting up or down the videos based on reflection of the quality [52]. Designers can implement similar voting systems to the karma system of Reddit [106], and give more weight to experts in related fields or those who make more qualified contributions to the community.

6.2.2 Maintaining a Safe Online Space for d/Deaf Communities. Our findings reveal d/Deaf-hearing relationships in online space as an important issue for exploration in future research. In a recent study, Mack et al. found that d/Deaf people in the U.S. show a desire to share d/Deaf culture with hearing non-signers [77]. Our findings support that viewers of d/Deaf videos may include hearing non-signers. However, the negative experience of one of our participants (i.e., the online troll P12 met) and some comments under d/Deaf videos imply harmful experiences that d/Deaf people may have because of people's misunderstanding or ignorance of d/Deaf people. Prior research suggested that d/Deaf people often face negative attitudes by hearing people [72, 95]. For some d/Deaf people, d/Deaf communities constitute the only space where they feel equal and comfortable [100]. Designers may thus need to help d/Deaf people maintain a safe space for online sign language content and sharing. For instance, designers can add features to increase d/Deaf video creators' sense of control over their channel, e.g., controlling the visibility of comments, and screening viewers.

6.2.3 Acknowledging Content Creators' (Invisible) Labor. Another challenge in community-driven information accessibility may be sustainability in content creation. Prior research suggested that online content generation involves many (invisible) labors (e.g., relationship building with viewers) [30, 45], and d/Deaf video creation is no exception. As revealed in our findings, creating high-quality sign language content requires a lot of effort, such as information selection, sign language interpretation, discussion, editing, captioning, etc. Content creation may also require emotional labor because d/Deaf video creators may need to respond to the requests of their followers, maintain online connections with them, and deal with negative experiences caused by (micro)aggression.

The intensive labor in video creation may thus bring challenges for sustainable video creation and sharing from d/Deaf creators. Considering the rising trend of professionalization of online video creators [45], there may be potential to support d/Deaf video creators to become professional creators. As seen from the video channels we analyzed, many viewers are willing to pay for high-quality videos. The use of monetization features such as digital gifting may thus be helpful to compensate for the labor of d/Deaf video creators. Designers may also consider integrating crowdfunding platforms to help d/Deaf content creators to raise funding for their channels. However, as Borgos-Rodriguez et al. found, monetization of content created by disabled content creators may be controversial as people may regard it as exploiting disability [21]. We left the labor of d/Deaf video creators and the reward issue for future research.

6.3 Limitations

This study has several limitations. First, most researchers in our team are hearing people. Although a Deaf professional was involved in this work, our analysis of the data may not fully represent d/Deaf communities. The translation from sign language to written language may also lose the original meanings. The statements related to d/Deaf people, communities, and culture outside China in this study are based on prior literature and may be biased. Future work can be done in these contexts for a better understanding. Second, our participants were recruited mainly through purposive sampling, so our findings may not be representative of all d/Deaf population and communities in China. For instance, most of our participants (N=8/12) have received college-level education or above, and most (N=10/12) were from relatively developed regions in China. Future work can be done with more diverse populations. However, considering the sign language diversity [23] and collective culture of d/Deaf communities across the globe [131], we believe our findings are insightful to supporting d/Deaf people in other contexts. Trevisan et al. reported several cases of d/Deaf people in the U.S. watching videos created by d/Deaf media professionals on YouTube to keep informed about the 2016 presidential election [128]. Also, we have already included participants from five cities to increase our confidence of the findings. Third, we only included one d/Deaf video creator. While his sharing provided rich insights, future

work can further investigate d/Deaf video creators' perceptions and experiences to develop a more comprehensive understanding of d/Deaf video creation and sharing. Fourth, the content analysis did not include every detail, such as the information delivered in sign language. Therefore, our understanding of the video content may not fully capture the meaning. Future work can involve signers as coders to present a more comprehensive understanding of d/Deaf videos.

7 CONCLUSION

We present a qualitative study based on interviews with 12 d/Deaf people in China and content analysis of online d/Deaf videos. Our findings suggest that d/Deaf communities can support the growth of sign language content based on community-defined needs. The results show how d/Deaf people collaborate and negotiate information accessibility together online, and the challenges in community-driven sign language content creation. We encourage designers and researchers to support sign language content creation through d/Deaf community-based collaboration and propose promising future research directions.

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A APPLICATIONS SPECIFIC TO THE CHINESE CONTEXT

ID	Application	Introduction	Medium Supported	Audience	Monthly Active Users (2022)
1	WeChat ("微信")	a multi-purpose application supporting instant messaging, social media, article subscription, mobile payment, etc. [68]	text, images, videos	subscribers or private social networks	1288.3 million [9]
2	KuaiShou ("快手")	a short video sharing mobile application similar to TikTok, with a particularly strong user base in countryside and rural areas in China; also supporting live-streaming [141]	short videos, live-streaming	followers or recommended on personalized recommendation page	597.9 million [3]
3	DouYin ("抖音")	a short video sharing mobile application, which also supports live-streaming; the Chinese version of TikTok [143]	short videos, live-streaming	followers or recommended on personalized recommendation page	715 million [6]
4	Sina Weibo ("新浪微博")	a microblogging application similar to Twitter [142]	text, images, videos	followers or recommended on personalized recommendation page	582 million [7]
5	XiaoHongShu ("小红书")	an image-based social media platform, similar to Instagram [144]	text, images, videos	followers or recommended on personalized recommendation page	158 million [8]

B INTERFACES OF WECHAT AND KUAISHOU

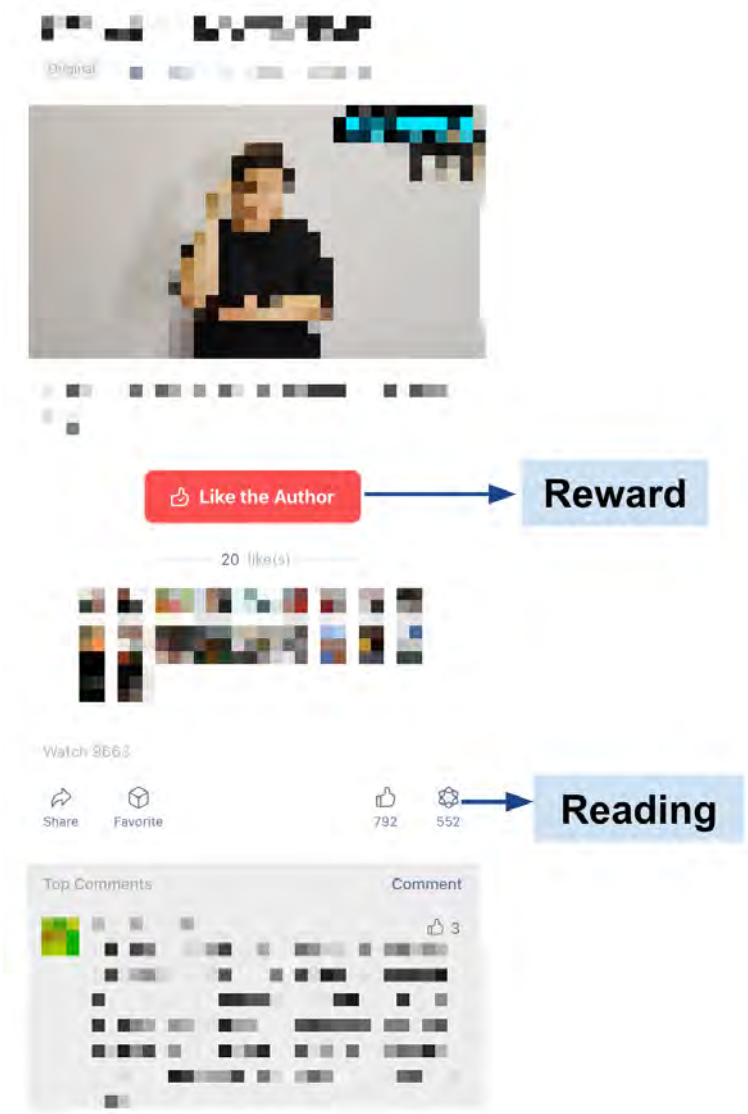

Fig. 1. The interface of WeChat Article. WeChat is primarily an instant messaging application that supports article subscriptions. Users can subscribe to public accounts to read articles posted by the creators. "Like the author" is a rewarding feature that content creators can choose to include in their articles. When users click the "Like the author" button, they can reward the creator with a certain amount of money. The "reading" feature (officially translated as "WoW" in WeChat) is a sharing feature that indicates the user is reading the article. When users click the "Wow" button, their friends will be able to read the article in their Top Stories, a session that displays the articles "WoWed" by others.

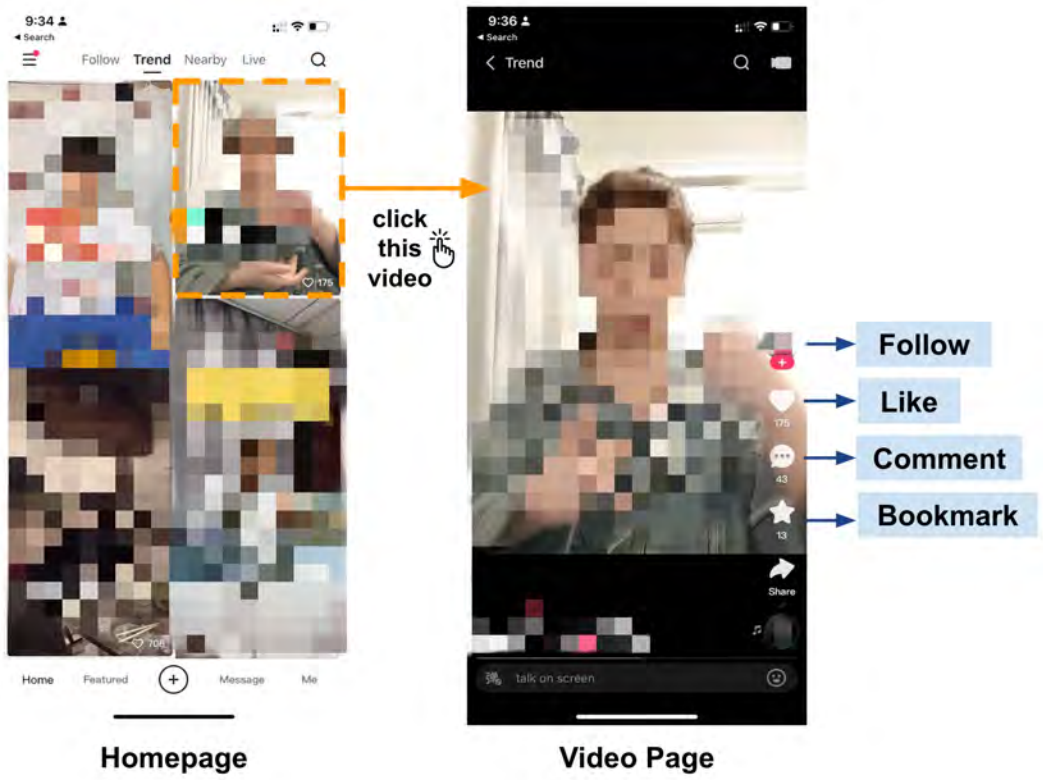

Fig. 2. The interface of KuaiShou. The homepage of KuaiShou (i.e., the "Trend" page) is an endless video feed based on the platform's in-built recommendation algorithm. When users click a video, they can watch the video on the video page. The "Bookmark" feature is officially translated as "Collect" in KuaiShou.

C THE VIDEO CHANNELS INCLUDED FOR ANALYSIS AND DETAILS OF RESULTS

ID	Content Distribution	Captioning	Views	Likes	Comments
V1	60% news, 10% announcement, 10% advertisement, 10% interaction with followers, 3.33% warning message, 3.33% general knowledge (10% require payment)	100% not captioned	mean=23271.36, median=30350, min=1842, max=44200, std=10566.94	mean=2009.33, median=2210, min=9, max=3760, std=1064.01	N/A
V2	30% personal life, 20% advertisement, 16.67% d/Deaf peer support, 10% community information, 6.67% warning message, 3.33% news, 3.33% announcement, 3.33% general knowledge, 3.33% life tips, 3.33% interaction with followers	90% not captioned, 10% fully captioned	N/A	mean=224.6, median=180.5, min=50, max=640, std=134.70	mean=30.37, median=20, min=5, max=154, std=33.74
V3	63.33% news, 16.67% warning message, 10% community information, 3.33% general knowledge, 3.33% entertainment, 3.33% interaction with followers	100% not captioned	N/A	mean=1200.57, median=1100, min=462, max=1900, std=294.12	mean=150.03, median=130.5, min=28, max=418, std=88.44
V4	33.33% news, 16.67% personal life, 13.33% warning message, 10% community information, 6.67% general knowledge, 6.67% life tips, 6.67% entertainment, 3.33% interaction with followers, 3.33% d/Deaf peer support	40% not captioned, 60% fully captioned	N/A	mean=214.43, median=83.5, min=36, max=1500, std=334.00	mean=35.73, median=12.5, min=0, max=273, std=56.15
V5	83.33% news, 10% community information, 3.33% general knowledge, 3.33% life tips	100% not captioned	N/A	mean=152.23, median=158.5, min=65, max=282, std=48.12	mean=9.23, median=8, min=4, max=17, std=4.09
V6	60% news, 10% entertainment, 6.67% personal life, 6.67% warning message, 6.67% interaction with followers, 6.67% life tips	96.67% not captioned, 3.33% partly captioned	N/A	mean=499.33, median=415, min=150, max=2100, std=410.87	mean=79.67, median=54, min=17, max=397, std=78.78

Table 1. The results of video analysis. WeChat supports video creators to hide the number of comments. KuaiShou does not present the number of views.

ID	Content Distribution	Captioning	Views	Likes	Comments
V7	30% d/Deaf peer support, 16.67% personal life, 13.33% interaction with followers, 13.33% general knowledge, 10% announcement, 10% advertisement, 3.33% community information, 3.33% life tips	53.33% not captioned, 26.67% fully captioned, 20% partly captioned	N/A	mean=483.73, median=318.5, min=122, max=2315, std=449.20	mean=75.73, median=59, min=14 max=244, std=67.41
V8	43.33% personal life, 16.67% life tips, 10% interaction with followers, 6.67% announcement, 6.67% advertisement, 3.33% warning message, 3.33% general knowledge, 3.33% community information	20% not captioned, 46.67% fully captioned, 33.33% partly captioned	N/A	mean=1344.63, median=1180, min=161, max=3173, std=784.52	mean=273.23, median=131, min=7, max=1438, std=328.43
V9	73.33% news, 10% personal life, 3.33% announcement, 3.33% community information	100% not captioned	mean=18394, median=20500, min=1725, max=28000, std=7412.55	mean=1613.30, median=1658, min=259, max=3448, std=725.98	N/A
V10	70% news, 13.33% general knowledge, 6.67% life tips, 6.67% d/Deaf peer support, 3.33% announcement	100% not captioned	mean=925.17, median=839.50, min=468, max=1924, std=309.67	mean=54.67, median=57, min=12, max=77, std=15.51	N/A
V11	66.67% news, 23.33% general knowledge, 3.33% community information, 3.33% life tips, 3.33% d/Deaf peer support (6.67% require payment)	100% not captioned	mean=4487.5, median=4376, min=157, max=7585, std=1763.16	mean=350.17, median=343, min=64, max=606, std=119.40	N/A
V12	36.67% news, 23.33% general knowledge, 16.67% sign language teaching, 16.67% life tips, 3.33% personal life, 3.33% d/Deaf peer support	63.33% partly captioned, 36.67% not captioned	mean=8004.93, median=7579.5, min=3568, max=15000, std=2613.08	mean=566.33, median=548.5, min=170, max=1039, std=191.94	N/A

Table 1. Continued

D COMPLEMENTARY INFORMATION ABOUT THE PARTICIPANTS AND INTERVIEWS

ID	Preferred Communication Modes	Information Sources Mentioned	Chinese Fluency	Interview Setting
P1	input: written Chinese, Signed Chinese, CSL, speech reading output: written Chinese, Signed Chinese, CSL	TV news, news application, offline bulletin, newspaper	no explicit difficulties	text
P2	input: spoken Chinese, written Chinese, Signed Chinese, speech reading output: spoken Chinese, written Chinese, Signed Chinese	WeChat, Sina Weibo	no explicit difficulties	text
P3	input: spoken Chinese, written Chinese, Signed Chinese, speech reading output: spoken Chinese, written Chinese, Signed Chinese	WeChat, Sina Weibo, DouYin	no explicit difficulties	text
P4	input: Signed Chinese output: Signed Chinese	TV news, WeChat, KuaiShou, XiaoHongShu	being able to read and write part of Chinese	text and sign language
P5	input: Signed Chinese, CSL, written Chinese output: Signed Chinese, CSL, written Chinese	WeChat, KuaiShou	no explicit difficulties	sign language
P6	input: written Chinese, CSL output: written Chinese, CSL, spoken Chinese if the dialogue is simple	DouYin, Tencent News	no explicit difficulties	text
P7	input: CSL, speech reading, written Chinese output: CSL, spoken Chinese, written Chinese	WeChat, Sina Weibo, news applications, DouYin, KuaiShou, XiaoHongShu	no explicit difficulties	text
P8	input: written Chinese, CSL, speech reading output: written Chinese, CSL	TV news, KuaiShou	no explicit difficulties	sign language
P9	input: written Chinese, CSL output: written Chinese, CSL	XiaoHongShu, Baidu	no explicit difficulties	sign language
P10	input: written Chinese, CSL output: written Chinese, CSL	TV news, KuaiShou	no explicit difficulties	sign language
P11	input: written Chinese, CSL, Signed Chinese output: spoken Chinese, written Chinese, Signed Chinese, CSL	KuaiShou, XueXiQiangGuo, WeChat	no explicit difficulties	text
P12	input: written Chinese, CSL output: written Chinese, CSL	TV news, KuaiShou, WeChat, news applications	no explicit difficulties	sign language

Table 1. Complementary information about the participants and interviews. The information about the participants was self-reported.