

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

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ABSTRACT

Information access is one of the most significant challenges faced by d/Deaf signers due to a lack of sign language information. As machine-driven solutions face challenges, we seek to understand how d/Deaf communities can create, share, and 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 a content analysis of 360 d/Deaf videos, we reveal how d/Deaf communities co-create information accessibility through collaboration in online content creation. We uncover two major challenges that creators encounter, i.e., difficulties in translation and inconsistent content qualities. We propose potential opportunities and future research directions to support d/Deaf people's needs for sign language information through collaboration within d/Deaf communities.

CCS CONCEPTS

• Human-centered computing → Empirical studies in accessibility.

KEYWORDS

deaf, Deaf, d/Deaf, d/Deaf community, accessibility, information access, online content creation and sharing, sign language, online collaboration

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[†]MaoMao is the translation of the author's sign name. Mao ("猫") means cat in Chinese.

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1 INTRODUCTION

The priority of written and spoken languages in hearing-dominated mainstream society has long posed challenges to 70 million deaf¹ people [99] in information access worldwide [68, 129, 149, 151]. The lack of information has caused barriers to d/Deaf people's full participation in all aspects of society, from education [65] to health-care [114] to employment [110]. Although many d/Deaf people have better access to text-based information as Information and Communication Technologies (ICTs) advance [134], those who prefer to use sign language still face challenges in information access [1, 79] due to sign language's unique grammar and vocabulary [136]. Moreover, d/Deaf people often emphasize the significant role of sign language in Deaf culture and their Deaf identity [152]. Therefore, access to sign language information is widely recognized as one of the most fundamental human rights of d/Deaf people [43, 95, 136].

In particular, the diverse variants of sign language often make sign language information provision challenging [43]. For instance, Chinese Sign Language (CSL) has vastly different variants [31]. While the Chinese government has been promoting the Lexicon of Common Expressions in Chinese National Sign Language (LCEC-NSL) [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"), an artificial sign system created based on the structure of Mandarin by borrowing words from CSL, rather than CSL [65]. However, d/Deaf people who prefer to use CSL often face challenges in understanding Signed Chinese because Signed

¹d/Deaf people 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 emphasize hearing status [102]. In this study, we use "d/Deaf" to refer to people who identify as deaf, Deaf, or both and use sign languages [28] to represent the fluidity of identities [88] except for several situations – when emphasizing cultural and audiological issues, conforming to the sources, or at the insistence of the person referred to. We use "d/Deaf and Hard-of-Hearing" (DHH) to refer to people with hearing loss in general [28].

Chinese is not a natural language and lacks linguistic features of natural sign languages (e.g., facial expressions) [47, 150]². According to a survey with over 10,000 Chinese d/Deaf people, only about 8% can effectively understand sign language interpretations in official TV news because of the use of Signed Chinese [77]. Similarly, hearing stakeholders also often use signed written/spoken languages rather than natural forms of sign languages in other countries, e.g., Japan [34, 47, 94], South Korea [66], Indonesia [27], and Spain [109] (see Section 2.2 for details).

To improve d/Deaf people's information access, HCI researchers have worked on automatic sign language generation, interpretation, and translation systems [25]. However, no existing machine-driven computational system is reliable enough for real-world adoption due to a lack of training datasets, limitations in computational models, and so on [23, 25]. Given these challenges in machine-driven solutions, we aim to understand **the current situation of sign language content created by d/Deaf communities and explore ways to support them in growing online sign language content**. We focus on d/Deaf communities because of the communities' strong collective culture and central roles in d/Deaf people's information access [35, 103, 151]. d/Deaf schools, clubs, and online social networks are all important places for information and support exchange in the d/Deaf world [35, 103, 134]. Therefore, understanding d/Deaf communities' information practices can bring design opportunities to support d/Deaf people's information needs.

With the abovementioned research motivation, we conducted semi-structured interviews with 12 Chinese d/Deaf people to understand their access to online sign language content and the roles of d/Deaf communities in sign language content creation and dissemination. 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 scale³. During the interviews, we found that 9 participants watched online sign language videos created by and for d/Deaf people (we will term them d/Deaf videos hereafter). These videos are essential information sources and educational materials, compensating for the lack of official CSL information. We then conducted a content analysis of the videos mentioned by the participants to strengthen our understanding of d/Deaf videos and better interpret the interview data. Based on results from both sources, we present a landscape of the d/Deaf videos, including the video content, collaborative efforts exemplified in the creation and sharing of d/Deaf videos, and the challenges in d/Deaf video creation and sharing. We found that while d/Deaf videos can provide CSL information, they are not always enjoyed by d/Deaf people because of difficulties in translation and inconsistent content qualities. d/Deaf video creators may also have negative experiences caused by online trolls and (micro)aggressions.

The main contributions of our 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 highlight how d/Deaf people address their information needs through community efforts and the challenges they encounter. We suggest HCI researchers and designers not only design assistive technologies for individual use but also consider supporting d/Deaf communities in content creation. Community-driven information will be crucial in contexts where variations of sign language are considerable [31, 37, 78, 90] or where sign language standardization is challenging (e.g., emerging fields such as science [29, 82]). Such a community-based approach is also important to empower information access in d/Deaf communities. (2) Future directions for HCI researchers and designers to better support d/Deaf communities in sign language content creation: a) treating online sign language content creation as a *Community of Practice* [139]; 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., being born deaf or being late-deafened [152], holding different values about d/Deaf identity and culture [94]. Although deafness has been traditionally treated as a medical problem or disability, people have found other ways to understand it (e.g., the cultural model of Deafness [35, 103]). d/Deaf signers often emphasize their cultural identity of being Deaf [152]. Sign language, along with shared life experiences, provides a strong bond and collective identity for d/Deaf communities [152]. Many deaf people, especially those who do not use sign language, do not identify as Deaf or feel belonging to the Deaf culture [131]. 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 [64], some are also proud of being d/Deaf [76]. In this study, we focus on people who identify as d/Deaf and use sign language. 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 [81], d/Deaf people in China may face more challenges in information access due to fewer educational opportunities, a lack of trained teachers [65], and less access to accessibility services such as TV captions [75, 148]. For instance, Li found that captioning was only provided in 29.03% of TV news programs of the ten most-watched Chinese TV channels [75].

The diverse variants of Chinese Sign Language (CSL) also pose challenges to d/Deaf people's information access [78]. CSL has many variants; the northern styles of CSL can be vastly different from the southern ones [11, 31, 78] (see Table 2 in [65] for a visual example). People using different variants of CSL often face challenges in communication in sign language [78]. The Chinese government has been trying to standardize CSL in recent years

²We avoid stating that only CSL is the true sign language because d/Deaf people who use Signed Chinese may consider it sign language. d/Deaf people may also use mixed styles of languages [148]. Nakamura described how d/Deaf people in Japan similarly debate over Japanese Sign Language and Signed Japanese [94].

³Prior research suggested that d/Deaf people in China have a relatively low awareness of Deaf culture [64]. Therefore, we used "communities" to avoid the impression that there is a singular d/Deaf culture and a unified d/Deaf community in China.

| 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 / 那个 that / 长 long / 头发 hair / 女人 woman / 问号 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.

by promoting the Lexicon of Common Expressions in Chinese National Sign Language (LCECNLS) [4]. However, LCECNLS 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 [65] (see Table 1 for the difference between CSL and Signed Chinese). d/Deaf people who do not use Signed Chinese often face challenges in understanding Signed Chinese because it is a manually coded language [117], i.e., an artificial sign system representing spoken language while lacking linguistic traits of natural forms of sign language (e.g., facial expressions) [47, 150]. For instance, while sign language interpretation in TV news seems to provide a form of information access, it receives significantly low ratings among Chinese d/Deaf people because the hearing interpreters use Signed Chinese rather than CSL [12, 77, 148]. Therefore, qualified sign language interpreters are hard to find in China, especially in professional scenarios, such as medical and legal inquiries [10, 13].

Hearing people, including sign language interpreters and teachers at d/Deaf schools, also often use manually coded languages rather than natural forms of sign language in other countries, e.g., Japan [34, 92], South Korea [66], Indonesia [27], and Spain [109]. 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") [92]. Although NHK⁴ 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 partly because using manually coded languages is often believed to support oral education [15]. However, d/Deaf students using JSL as their native language may face challenges in understanding Signed Japanese [58, 59]. On the other hand, some d/Deaf people may regard manually coded languages as part of sign language [94]. Besides, DHH people who do not take sign language as their native language often learn and use manually coded languages later in life [14]. Therefore, while sign language has gained legal recognition in 75 countries as of February 2023 [98], 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 [62], and Japan [92]). The responsibility to ensure the distinction then falls to practitioners in practice.

⁴The only public broadcaster in Japan [96].

3 RELATED WORK

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

Although research with DHH people is relatively active in HCI (e.g., [84, 137]), this population has still received insufficient attention and is significantly under-represented. Only 8.5% of accessibility research published at ASSETS and SIGCHI between 2010 and 2019 exclusively focused on DHH people, while almost half (41.1%) of the studies focused on blind and low-vision people [81]. However, auditory disabilities are more common than vision disabilities in many countries (e.g., U.S. [50], and China [5]). According to census data released in 2006, auditory disability is the second most frequent type of disability after physical disability in China [5]; at least 27.8 million people in China are DHH, including those who live with multiple disabilities [5]. According to the World Health Organization, over 5% of the world's population (i.e., 446 million people) are living with auditory disabilities [101]. The World Federation of the Deaf estimates that there are around 70 million deaf people around the globe [99].

As for accessibility research with DHH people, 64.9% of related studies in SIGCHI and ASSETS from 2010 to 2019 focused on communication issues [81], especially DHH-hearing communications (e.g., professional communications [105, 137], education [84], and online conferencing [72, 115]). To improve DHH people's information access, researchers tended to focus on captioning [36, 67, 69, 123]. Some researchers worked on text simplification tools to facilitate d/Deaf people's reading [2]. However, text-based information can still be inaccessible to d/Deaf signers [79], and an increasing number of studies have pointed out the importance of supporting language diversity when designing for d/Deaf people [20, 79]. While researchers also developed sign language generation, interpretation, and translation systems through computer vision and natural language processing techniques [25], automatic systems are still hard to achieve for real-world use because of limited training datasets, technical limitations, and challenges in avatar design and UI/UX [25]. Our study contributes to a better understanding of how to satisfy d/Deaf people's needs for sign language information through 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, 106, 114, 151] because of the priority of written and spoken languages in hearing-dominated mainstream society [129, 135]. As linguistic minorities, d/Deaf people often find it hard to access information in their preferred language (i.e., sign language) [151], especially incidental or emergency information [51, 106, 114]. For instance, governments often fail to provide information in sign language properly during crises such as COVID-19 [51]. In addition, d/Deaf people may lack the right to decide what information they access since much of the information they can access is mediated by interpreters [114].

The emergence of ICTs has largely increased d/Deaf people's 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 [135]. 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 [91]. However, online accessibility services for DHH people are still often insufficient (e.g., closed captioning in online videos) [79, 83]. Besides, d/Deaf people face significant challenges even with easy access to online information, because this population tends to have a lower literacy level than hearing peers in written languages [1, 89, 111]. For instance, Almeida et al. found that d/Deaf adult students ignored 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 [85, 114], especially those containing medical jargon [48, 132]. 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 prefer to use sign language, as sign language is their first language [20, 151]. Therefore, many researchers have pointed out the necessity of supporting language diversity when designing ICTs for d/Deaf people [20, 79].

Furthermore, effective information access and engagement with information among d/Deaf people is not just a linguistic but also a cultural issue [151]. Young et al. have found that d/Deaf people prefer content structured around visual elements, and d/Deaf people also perceive information shared by community members as more valid than other sources [151]. Their findings indicate d/Deaf communities' significant role in d/Deaf people's information access. However, HCI researchers primarily focused on assistive technologies for individual use, such as captioning [67, 69], text simplification tools [2], automatic sign language interpretation or translation systems [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, 126]. 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]. Therefore, we aim

to contribute an analysis of how d/Deaf community-based collaboration can meet d/Deaf people's sign language information needs in the real world.

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 people⁵ as recipients of assistance (e.g., [18, 54]), a growing body of HCI literature highlighted disabled people's efforts in creating accessibility [17, 26, 39, 60, 137] and ability-diverse teams' collaborative practices in creating accessibility [40–42, 73, 80, 107, 128]. For instance, Bennett et al. introduced the framework of *interdependence*, emphasizing collaborative access and disabled people's contribution in these efforts [17].

Research on multi-person collaborative systems for DHH people often focused on conferencing settings [72, 87, 115, 122], especially online ones [72, 115, 122]. Findings from these works demonstrated DHH people's diverse communication preferences [72, 122] and informed design of features, such as captioning [87] and visual display [115]. 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 members involved in the task [87].

In addition, disabled people were often found to build communities or support networks for accessibility purposes [38, 113, 116, 147]. 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 [116]. Ringland et al. presented a case of autistic youth appropriating Minecraft as an assistive technology, i.e., an online space supporting self-regulation and community engagement [113]. These findings present the potential of community-driven accessibility solutions.

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 [103, 134, 135]. 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]. However, despite the central role of d/Deaf communities in d/Deaf people's information access, information practices within the communities have received relatively little attention in HCI. The majority of d/Deaf-related HCI research focused on individual assistive technologies (e.g., [20, 36, 67, 69, 123]). Our work can contribute empirical knowledge of how d/Deaf community-based collaboration can meet their accessibility needs.

⁵We use identity-first language in this work to reflect the Social Model of Disability, i.e., disability is caused by a mismatch between a person's body and the environment where they live [100].

| 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 d/Deaf high school | 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 d/Deaf high school | 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 collected from our interview participants. The classification of the locations is based on an unofficial yet well-adopted hierarchical classification of cities in China [144]. 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 participants are fluent signers. Complementary information about the participants is presented in Appendix D.

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 sign language information. During the interviews, many participants mentioned the impacts of d/Deaf videos on their lives and communities, so we decided to further analyze the d/Deaf videos mentioned by the participants to better understand their experiences and interpret our interview results.

4.1 Phase I: Interviews

4.1.1 Participants. We set inclusion criteria for our participants as follows: 1) using any form of sign language, and 2) identifying as d/Deaf. The participants were primarily recruited through purposive sampling [86] 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 reached out to d/Deaf people from diverse sources. 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., DouBan⁶, and 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 [144]. 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 either in text or sign language depending on their 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

⁶<https://www.douban.com/>

| 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.

recommended, except the interview with P12. The fourth author conducted the interview with P12 in sign language and translated the conversations. Under the participants' informed consent, we screen-recorded all interviews conducted in sign language to validate the sign language interpretation.

We clarified our backgrounds and intentions during recruitment and before each interview. All interviews were conducted with informed consent. During each interview, we asked our participants about their daily information-related behaviors, including how they seek information (online) for their needs, the information they need most, the challenges they meet in information access, and so on. Given our research question, we paid particular attention to their access to online sign language content, especially 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 [127], reviewing and labelling the emerging codes in an iterative process. The lead author conducted inductive coding of the data [127] 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 sign language information during COVID-19, d/Deaf videos as information sources, d/Deaf videos as educational material, need for negotiation in sign language translation, and so on. The whole research team reached a consensus on the final themes. All quotes used in the paper were translated into English by the lead author and checked by

other co-authors. The translation of the quotes from sign language into written Chinese was double-checked by the fourth author.

4.2 Phase II: Content Analysis of d/Deaf Videos

During interviews, many participants mentioned the popularity of d/Deaf videos among d/Deaf people in China. We then conducted content analysis of the d/Deaf videos mentioned by the participants to improve our understanding of these videos and better interpret the interview data.

4.2.1 Data Collection. Combining the participants' recommendations and suggestions from the fourth author, we included 12 video channels (see Table 3) for content analysis. These channels were from WeChat⁷ and KuaiShou⁸, which are among the most popular social media platforms for information or video sharing in China [70, 145]. We excluded the channels that primarily shared personal life, considering our main research focus on d/Deaf people's information needs. We selected and analyzed the first 30 videos from each channel, which were videos pinned by the creators and the most recently published videos since they represent the channels' current status. The final dataset consisted of 360 videos in total.

4.2.2 Data Analysis. We conducted a thematic analysis of the 360 videos' titles and captions [63]. Two co-authors first did inductive open coding [127] 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

⁷A multi-purpose mobile application in China primarily used for instant messaging; see Appendix A.

⁸A short-form video sharing mobile application in China; see Appendix A.



Figure 1: A typical example of news-related d/Deaf videos 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 [140]. The underlined sentence is not clear in meaning.

coders discussed the results with the team and finalized the codebook. Specifically, we chose to code the content category, whether including captioning, number of "Likes", number of comments, and number of views. 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 identified the nuances in the videos considering the topics of the videos and the creators' intentions. For instance, we found that some news-related videos are specific to d/Deaf communities, e.g., scams targeting d/Deaf people, and events for d/Deaf communities. We generated more nuanced codes accordingly (e.g., warning messages, and community information). Finally, we identified 11 major content categories (see details in Table 4).

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) [71]. The two coders then evenly split the remaining 330 videos in the dataset for deductive coding. After the coding, the coders discussed with other co-authors and determined the codes based on the majority's opinions to reach a consensus. While we did not code the comments under the videos, we summarized the viewers' reactions to each video. We anonymized all channels in this study to protect the creators' privacy.

4.3 Positionality Statement

Our research team consists of 5 Chinese hearing researchers from hearing-dominated institutions and a Deaf professional. 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 in a Tier 1 city, whose parents are both d/Deaf. She now works as a sign language teacher and interpreter in China and she has worked with d/Deaf communities in China since 2015. She provided input and feedback for the research design, interview guide, and the final findings to avoid potential biases from our research design and data interpretation [124].

5 RESULTS

We found that many d/Deaf people in China have been creating sign language videos online targeting at d/Deaf audiences across the country (Figure 1). These videos have served as important information sources and/or educational materials for d/Deaf people. Next, we present how and why d/Deaf videos thrive online, as well as the challenges in the creation and sharing of d/Deaf videos.

5.1 Why Are d/Deaf Videos Significant?

We found that d/Deaf videos have served as valuable information sources and/or educational materials for d/Deaf people, 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. Most participants ($N=9$, except for P2, P3, and P9) thought d/Deaf videos are important information sources and/or educational materials, though some of them may not often watch them for their own information needs because of their high Chinese

literacy (N=5, P1, P6, P7, P11, and P12). 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. He told us,

"The official news is lengthy and sometimes made me 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 further learned the importance of d/Deaf videos 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 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 d/Deaf high school, often shares d/Deaf videos with his d/Deaf students to broaden their horizons. He compared d/Deaf students now and then,

"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 also 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 a d/Deaf lawyer's channel to learn legal terms in sign language. These participants' experiences show that d/Deaf videos have played essential roles in d/Deaf people's information access and education.

5.1.2 Lack of Official CSL Information. The lack of official information in CSL is one of the most significant reasons for the popularity of d/Deaf videos. Some participants told us it is common that d/Deaf people cannot understand the interpretations in TV news, because the interpreters use Signed Chinese rather than CSL (e.g., P1, P6, and P12), consistent with online reports [12] and prior research [148]. As P1 (the former secretary general at a district-level d/Deaf association) said,

"All d/Deaf people in (a Tier 1 city) complain they cannot understand sign language interpretations in TV news. The interpreters are invited by hearing people who do not understand CSL. It is very common that they don't verify the interpreters' abilities 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 offered instantly in crisis or incidental situations [51]. According to P3, sign language interpretations were not provided in official TV news during the initial outbreak of COVID-19. Therefore, watching TV

news may not be effective enough for d/Deaf people to receive emergency or urgent information, especially those who are not fluent in written Chinese. P1 told us, many older d/Deaf adults regularly attend monthly gatherings that are organized by d/Deaf people in each sub-district ("街道"),

"d/Deaf people fluent in Chinese would share news in sign languages at the events...The older d/Deaf adults who are illiterate in Chinese find these events valuable."

This quote explains 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 CSL information that d/Deaf people need. This point can be supported by comments under d/Deaf videos, in which people often express appreciation towards the use of "natural sign language" (Figure 1). The term refers to CSL to mark the difference from Signed Chinese.

5.2 What Are d/Deaf Videos About 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 participants watched d/Deaf videos from individual content creators; two 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 video creators.

5.2.1 Active Sharing from Individual d/Deaf Content Creators. The video channels that our participants recommended were all from individual content creators, who have actively shared a wide range of information (Table 4) almost every day (Table 3). These results suggest that d/Deaf video sharing is almost a daily routine for the creators. The details of each channel are presented 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 (see "announcement" in Table 4). These messages imply that some creators treated their sharing very seriously. For instance, P12 told us he treats video creation and sharing as his "job".

From the 360 videos, we categorized 11 types of d/Deaf videos (Table 4) and 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, d/Deaf videos also covered a wide range of other topics in which d/Deaf people are interested, e.g., general knowledge such as science (see Table 4 for details). In particular, four types of videos were specific to d/Deaf communities, i.e., d/Deaf peer support, community information, warning messages, and sign language lessons. Among these videos, two types of videos intended to provide support to d/Deaf people, i.e., warning messages, and d/Deaf peer support. P12 told us he would *"emphasize news or*

| 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 messages (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 – (anonymized 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%) | videos for fun | 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.

information about scam to make d/Deaf people cautious." To conclude, d/Deaf videos have covered a wide range of d/Deaf people's life, not limited to sharing news on public media.

In addition, four video channels promoted commercial advertisements. P12 told us video creators might promote commercial advertisements to make money. He said,

"I would sometimes end my videos with ads to get paid for my time...I don't care how much money I can make from the videos, though. I already have a steady pay-check from a full-time job. V1 [another channel creator] does not have a full-time job, so some of his videos require users to pay."

We observed that each of V1's paid videos typically attracted around 10,000 users for payment. These paid videos were much longer (about 1 hour) than the free ones (usually within a few minutes).

Even though V12's videos are free to watch, around 10 followers would usually donate to this channel, demonstrating their support for the video creator⁹. As mentioned by one comment under V1's video, *"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 content. I'll study hard. Thank you! I'll be there for you!"*.

5.2.2 Collaborative Content Creation by d/Deaf-led Organizations. Besides individual content creators, interview results suggest that some d/Deaf people joined d/Deaf-led organizations to promote information in sign language. According to P3 and P7 who volunteered in an organization run by d/Deaf people, organization-led content may have the advantage of combining different people's expertise. For instance, P3 said that she collaborated with others in

⁹WeChat includes a feature to enable people to reward the creator (see Appendix B – Figure 1).

the organization to provide pandemic-related sign language information in WeChat and KuaiShou 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 that were 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,

According to P3, each WeChat group they maintained for the sharing events attracted 200 high school students. She answered many questions from the students, such as how to select universities and majors, the information about 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 in sign language,

"We regularly talk about sign language translation 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 translation of unforeseeable words in sign languages is challenging, requiring 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 translation and inconsistent content qualities. Because of the two reasons, two participants did not enjoy watching d/Deaf videos very much, though they did see the potential benefits for d/Deaf people (P1, P6). Besides the two challenges, online trolls and (micro)aggressions can also cause negative experiences for d/Deaf video creators.

5.3.1 Challenges in Sign Language Translation. One significant challenge in d/Deaf video creation is manifested through the difficulties in sign language translation due to 1) sign language diversity in China and 2) translation of unforeseeable words in CSL.

Language Diversity. One of the most significant challenges in translation 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, and P11). Even in the same region, the sign language that d/Deaf people use can be very complicated. P6 mentioned the sign language he uses is a mixture of local sign language, Signed Chinese, and 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 translation. 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 captions so that d/Deaf people could check the original words if they can read Chinese. According to P5 and P12, some d/Deaf video creators adapted their signing 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 this 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 I realized that d/Deaf people with limited Chinese literacy may not understand Signed Chinese. According to my observations, only very few d/Deaf people are fluent in written Chinese."

As reflected in these two quotes, translation from Chinese into CSL is a complicated process that requires negotiation within the community.

Translation of Unforeseeable Words in CSL. The difference between vocabulary in Chinese and CSL also makes sign language translation 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 translation. P3 told us how they dealt with translation during COVID-19,

"The COVID-19 outbreak brings many unforeseeable words. The interpreters in our group would consult older d/Deaf adults to translate Chinese into CSL more properly and help people understand the information more clearly."

Some participants told us translation from Chinese into CSL was often based on the creators' personal understanding (e.g., P1, P6, P7, and P11), and could *"lose original meanings of the Chinese word if it was not clarified"* (P6). P6 further gave us an example, *"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 use 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 translations are wrong or confusing. The translations from Chinese into CSL are often based on the creators' own understanding. Many creators are not fluent in Signed Chinese."

Given this issue, we noticed that some d/Deaf videos added the original Chinese words of some keywords (e.g. proper nouns, and jargon) in the videos 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 *"translation of words that are not commonly used in the d/Deaf world needs discussion. [I] use Signed Chinese in these situations if possible. Translations during the pandemic could be an example."* However, given the language diversity among d/Deaf people as noted above, using Signed Chinese is often just an ideal. P7 told us there are four typical types of d/Deaf people in his mind, who 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 translations 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 translations)."*

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

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, translation quality, information trustworthiness, and so on. P6 mentioned 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 sign language translations (P1, P12). 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. He commented,

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

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

d/Deaf people may also hold concerns about trusting the information from the d/Deaf videos. P12 told us he received messages from his followers asking whether the news in his videos was trustworthy, although he *"only picked news from reliable sources such as CCTV¹⁰ and Tencent news rather than personal media"*. He said,

"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 did 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 were 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 not supported by the platforms 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 one of his videos violated the content policy of 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 then got my channel back."

This quote from P12 reveals that viewers of d/Deaf videos also included hearing people who do not understand sign language at all or were online trolls. Echoing P12's experience, we noticed that some comments under d/Deaf videos were not friendly enough. Take the following comments as examples,

"How can deaf-mute people¹¹ drive? How can you drive since you can't even hear the sound?"

¹⁰China Central Television, a Chinese government-owned broadcaster [143].

¹¹deaf-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.

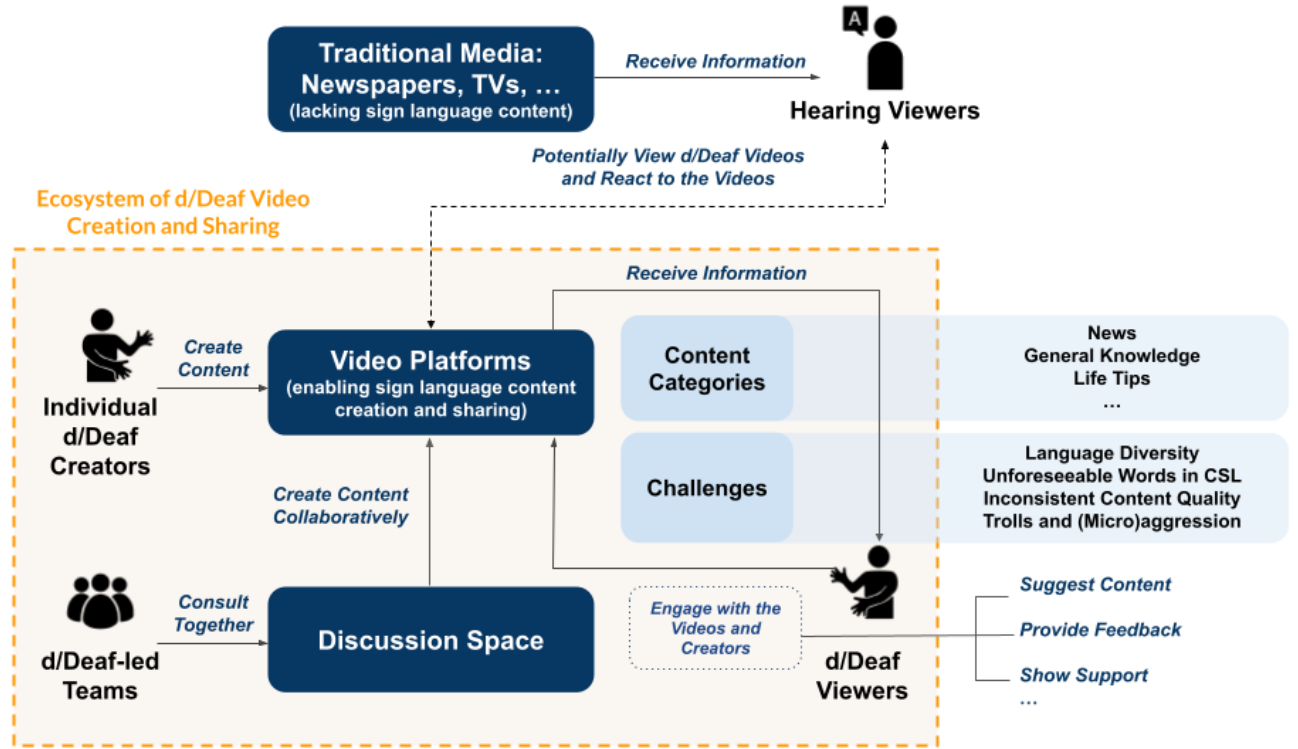


Figure 2: The ecosystem of d/Deaf video creation and sharing.

"What is the purpose of having hearing aids since you are deaf? Hearing aids are only useful to people with bad hearing ("耳背"), right?"

"You're so pretty, but unfortunately, you can't speak."

These comments imply potential (micro)aggression that d/Deaf video creators experience during content creation and sharing, which could lead to unpleasant experiences [57] and additional emotional labor [45].

6 DISCUSSION

Our 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 designing assistive technologies for d/Deaf individuals to support their information needs (e.g., captioning [20, 36, 67, 69, 123] and automatic sign language interpretation or translation [25]), our study identifies the potential benefits of supporting collaboration within d/Deaf communities to meet their information needs. Given d/Deaf communities' strong collective culture and long tradition in information exchange [35, 103, 134, 151], we highly encourage HCI researchers to further study the information practices within d/Deaf communities. Next, we discuss the importance of

community-driven information for d/Deaf people and 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 videos can improve d/Deaf people's sign language information access for a wide range of purposes, e.g., news, education, peer support, and so on. Although sign language has gained legal recognition in many countries [98], there is still a global shortage of qualified sign language interpreters [10, 118, 119], especially in certain contexts (e.g., crisis times [51, 129]). d/Deaf people may also often lack access to education and information in their preferred forms of sign languages because of sign language diversity [43] or the use of manually coded languages [12, 34, 58, 59]. 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 discuss opportunities for future design and HCI research in Section 6.2.

Our findings have potential to be generalized across the world. d/Deaf people outside China are similarly creating sign language access online, including signed arts, signed news, and other types of signed information (e.g., [46]). YouTube has many sign language news videos produced by d/Deaf people (e.g., ASL, and JSL news),

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.

available for viewing through searching on the site. Trevisan 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 [130].

As shown in this study, community-driven information may be particularly important for d/Deaf people because it 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 [104]. Even in countries where sign language has a standardized official form, sign languages still have considerable variations within the countries because of socio-cultural influences [23] (e.g., racial segregation [103], and d/Deaf education backgrounds [94]). Often, the information needs of d/Deaf people from sub-communities are not well met [43]. For instance, currently, of all signed languages used in the U.S. (e.g., Black ASL), only ASL gains legal recognition [93]. Sign languages may also lack standardized signs in professional or emerging fields such as science, technology, engineering, and mathematics [29, 82].

More importantly, supporting d/Deaf communities in content creation can increase d/Deaf communities' control over their information access. Currently, in most cases, accessibility service for d/Deaf people is represented in the form of providing interpreters [43, 114]. However, sign language interpretation provided by hearing people might be ineffective because hearing interpreters are often unfamiliar with d/Deaf communities' culture and communication norms [61]. d/Deaf people around the globe are often dissatisfied with interpretations by hearing interpreters [56, 138]. Even highly-skilled hearing interpreters may struggle in sign language interpretations in certain fields (e.g., science) [82]. As revealed in prior research, meaningful information access for d/Deaf people is more than having interpreters; it requires knowledge of Deaf culture, communication norms, and life experiences [49, 125, 151]. Our findings suggest that community-generated accessibility solutions can be effective since the contents are generated by d/Deaf community members, meeting their diverse needs [116]. Moreover, supporting the growth of community-driven information may further empower d/Deaf people's information needs in education, peer support, community connectedness, and so on. However, community-driven information may still encounter difficulties in quality control and sustainability, 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 (Figure 2). Our findings support the idea that accessibility should be treated as a result of human collaboration and negotiation [17, 40, 80, 137], which requires negotiation within the communities (e.g., dealing with language diversity) and collective efforts of all community members (e.g., discussing translation). We propose the following directions that researchers and designers can work on to better support d/Deaf communities in co-creating information accessibility in the future.

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 [139]", is a compelling framework that can be adopted in d/Deaf communities' online sign language content creation. Next, we propose how researchers and designers can support d/Deaf people in different roles based on their varied abilities and availability to achieve community-driven information accessibility.

1. Creators: Facilitating Collaborative Content Creation.

Findings from this study validate the importance of accessibility design in sign language content creation, e.g., facilitating captioning for signed content [79]. Additionally, we reveal two major challenges in creating translated 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, and law) should be involved in creating and sharing sign language content. Designers and researchers 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, 112]).

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 face challenges in selecting high-quality content for 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., [120, 121]), 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 [120], is hard to achieve considering the lack of qualified moderators (i.e., bilingual in sign language and written language).

Community self-governance and self-moderation thus can be necessary to moderate sign language content [120]. Similar to Reddit, future work can support d/Deaf people to assign qualified content moderators [52] and establish community norms for self-governance [121]. The opinions from community members can 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]. Future work can implement voting systems such as the karma system in Reddit [108], and weight experts' opinions or those who make more qualified contributions to the communities.

3. Viewers: Supporting Viewers in Information Reception.

Our study uncovers many challenges d/Deaf people face in information reception when watching user-generated sign language content, e.g., misunderstanding, and misinformation. As suggested in our findings in Section 5.3.1, d/Deaf people sometimes cannot fully understand the translated information. Therefore, captioning the signed content will be helpful to both hearing people [79] and d/Deaf people, if the content contains non-standardized words in sign language [29]. Besides, since d/Deaf people felt it challenging to trust user-generated content, future work can consider strategies to support cross-checking information from multiple sources. One

possible approach is to include a section for curating related information from reliable sources for d/Deaf people who are literate in written language. Text simplification tools can also be considered to support reading written language [2].

4. Viewers as Co-creators: Encouraging Peripheral yet Important Co-creation. The viewers can also make significant contributions to divide the labor in content creation. For instance, designers can enable viewers to add captions for signed content. Besides, d/Deaf people can provide feedback for the videos, which was significantly helpful in improving content quality. Future work can add features that empower d/Deaf viewers to achieve community-driven content quality control, such as enabling viewers to point out mistakes.

6.2.2 Maintaining a Safe Online Space for d/Deaf Communities. Our findings reveal that d/Deaf-hearing relationship in online space is critical to investigate in future research. In a recent study, d/Deaf people in the U.S. showed a desire to share d/Deaf culture with hearing non-signers [79]. Our findings support that viewers of d/Deaf videos may include hearing non-signers. However, the negative experiences (e.g., online trolls), negative attitudes of hearing people [74, 97], and their harmful comments to d/Deaf videos can prohibit d/Deaf people's willingness to share. For some d/Deaf people, d/Deaf communities constitute the only space where they feel equal and comfortable [102]. Future work may thus consider helping d/Deaf people maintain a safe virtual space for online sign language content creation and sharing. For instance, designers can add features to increase d/Deaf video creators' sense of control over their channel, e.g., the visibility of comments or screening viewers.

6.2.3 Acknowledging Content Creators' (Invisible) Labor. Another challenge in community-driven information accessibility is maintaining sustainability in content creation. Prior research suggests that online content generation involves many (invisible) labors (e.g., relationship building with viewers) [30, 44], 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 translation, discussion, editing, and adding captions. Besides, content creation also requires emotional labor because d/Deaf video creators need to respond to their followers' requests, maintain online connections with them, and deal with negative experiences due to (micro)aggression.

The intensive labor in video creation thus brings challenges for sustainable video creation and sharing from d/Deaf creators. Considering the rising trend of online video creators' professionalization [44], we propose several approaches to support d/Deaf video creators to become professional creators. As seen from the video channels analyzed in this research, many viewers are willing to pay for high-quality videos. Monetization features, such as digital gifting, could be helpful to compensate d/Deaf video creators' labor. Future work may also consider integrating crowdfunding platforms that allow d/Deaf content creators to raise funds 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, although a Deaf professional was involved, 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. Second, our participants were recruited through purposive sampling, so our findings may not be representative of all d/Deaf populations and communities in China. Future work can be conducted with more diverse populations. However, considering the sign language diversity [23] and collective culture of d/Deaf communities across the globe [133], we believe our findings are still insightful to supporting d/Deaf people in varied contexts. Third, we only included one d/Deaf video creator in the interviews. While his sharing provided rich insights, future work can further investigate d/Deaf video creators' perceptions and experiences. Finally, the content analysis did not include every detail, such as the information delivered in sign language, so our understanding of the video content may not be holistic. 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 a content analysis of 360 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 faced by d/Deaf content creators in sign language content creation and sharing. 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. [70] | text, images, videos | subscribers or private social networks | 1288.3 million [9] |
| 2 | KuaiShou ("快手") | a short-form video sharing mobile application similar to TikTok, with a particularly strong user base in countryside and rural areas in China; also supporting live-streaming [145] | short-form videos, live-streaming | followers or recommended on personalized recommendation page | 597.9 million [3] |
| 3 | DouYin ("抖音") | a short-form video sharing mobile application, which also supports live-streaming; the Chinese version of TikTok [146] | short-form 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 [141] | 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 [142] | text, images, videos | followers or recommended on personalized recommendation page | 158 million [8] |

B INTERFACES OF WECHAT AND KUAISHOU

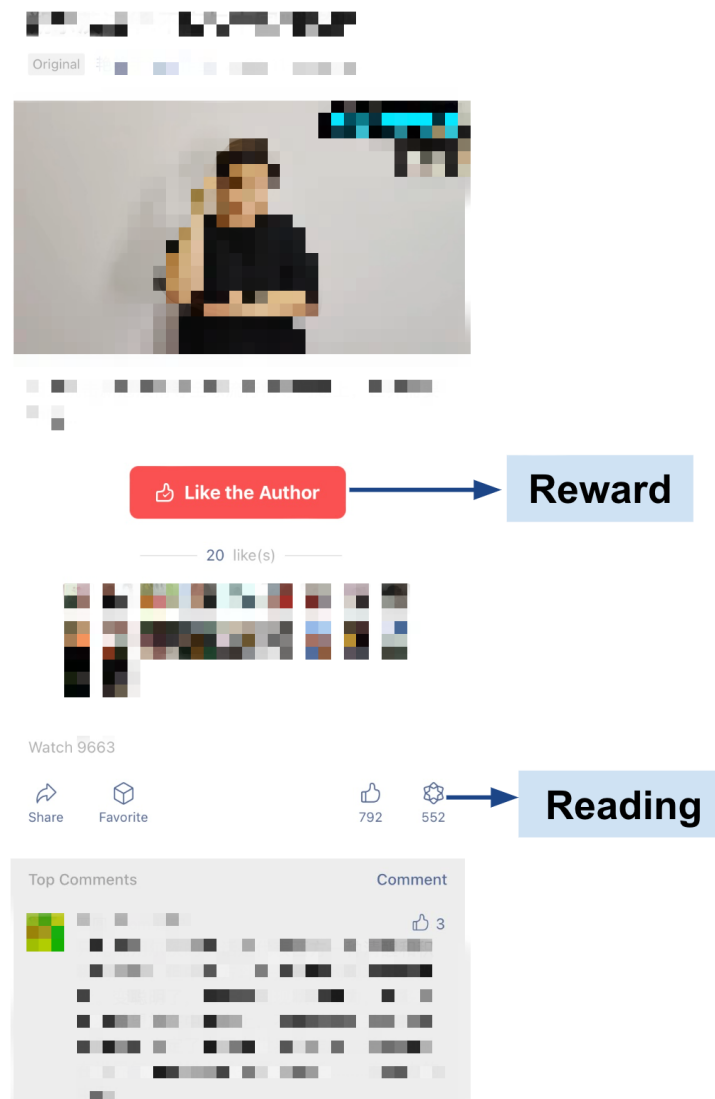


Figure 1: The interface of WeChat Article. WeChat is primarily an instant messaging application that supports article subscriptions. Users can subscribe to public accounts to read articles posted by the creators. "Like the Author" is a rewarding feature that content creators can choose to include in 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. People can check the articles "Read" by their friends in the "Top Stories" session.

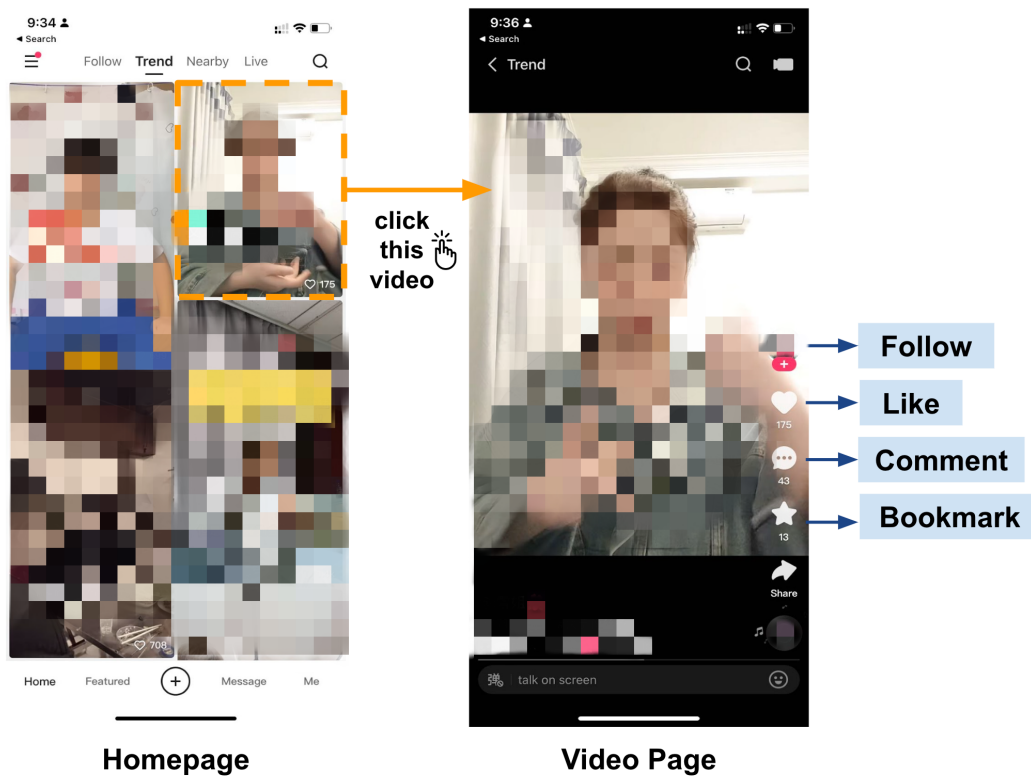


Figure 2: The interface of KuaiShou. The homepage of KuaiShou (i.e., the "Trend" page) is an endless video feed based on the platform's in-built recommendation algorithm. When users click a video, they can watch the video on the video page. The "Bookmark" feature is officially translated as "Collect" 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 messages, 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 messages, 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 messages, 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 messages, 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 messages, 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 content analysis of the d/Deaf videos. 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 messages, 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 Methods | 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 input: written Chinese, CSL | WeChat, KuaiShou | no explicit difficulties | sign language |
| P6 | 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.