Socio-technical Opportunities in Long-Distance Communication Between Siblings with a Large Age Difference

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ABSTRACT

Siblings play a crucial and long-lasting role in family connections and relationships. However, with the older sibling transitioning out of their parental home, maintaining a close sibling relationship can be challenging, especially if siblings have a large age difference. We conducted a diary and interview study with nine families in China which have spaced siblings, to identify design opportunities for technology to better support their communication and connection needs. We contribute to the HCI community in three aspects. First, we contribute an empirical understanding of current communication patterns from distributed families with large age gap siblings in China. Second, we identify current facilitation roles, practices, and challenges regarding sibling relationships from different stakeholders' perspectives. Last but not least, we present technological opportunities for supporting the large-gap sibling relationship, informing directions for future research and design for distributed families.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **Empirical studies in collaborative and social computing**; • **Social and professional topics** → **Children**.

KEYWORDS

siblings, children, computer-mediated communication, non-Western, distributed families

1 INTRODUCTION

Sibling relationships play a crucial part in many people's social life and are often long-lasting compared to other relationships [55]. Such relationships are often different from other connections in the family. From children's perspective, parents and primary caregivers generally act as a secure base providing support and comfort in a family when children experience negative emotions [6]. In contrast, siblings help fulfill children's social needs and engage in fun and playful interactions [55].

However, maintaining a close sibling relationship can be challenging when siblings have a large age difference, which usually leads to vastly different social circumstances and statuses between siblings [98]. For example, unlike a more equitable relationship with close-age peers, older siblings in large-gap relationships often serve as models for upward comparison [25]. These siblings increasingly spend more time living apart as the older siblings transition out of the parental home to pursue higher education or enter the workforce. While a substantial body of research has investigated many types of technology-mediated family communication, such as divorced families [103], work-separated families [101], and left-behind families [33], there is little understanding about the socio-technical challenges and opportunities for family communication between large-gap siblings.

In this paper, we aim to address this research gap through a qualitative investigation to identify the challenges and opportunities in the area of remote siblings communication and connection. Our work is driven by two core research questions:

- **(RQ1)** What are the unique needs and challenges of communication faced by large age gap siblings?
- **(RQ2)** What kind of facilitation occurs or is missing from long-distance large gap sibling communication from different stakeholders' perspectives?

To answer these questions, we conducted a set of diary and interview studies with nine Chinese families. For each family, we recruited one parent and two siblings with a large age difference (i.e., more than 5 years). Our work builds on and contributes to the growing body of literature on supporting geographically-distributed families. Two unique elements of our investigation are a focus on sibling relationships and a non-Western perspective on mediated sibling communication. We provide challenges and considerations in the area of siblings' connectedness in family context which inform directions for future investigation and technology design for distributed siblings. In summary, our work makes the following contributions:

- An empirical understanding of large-age gap siblings' communication and relationship in the context of families in China;
- A rich description of current facilitation roles, practices, and challenges regarding siblings relationship from a multistakeholder perspective;

- Technological opportunities for supporting large-gap sibling communication and connection.

We begin by summarizing prior literature on sibling relationship and dynamics, technology design for distributed families connectedness, and for siblings' connectedness. Then, we describe our investigation context, participants background, and multi-method approach. In the results section, we present themes that address our research questions. Finally, we reflect on our method and context, then discuss design implications that facilitate and encourage remote siblings' communication and connection.

2 BACKGROUND AND RELATED WORK

We first provide a summary of literature on sibling relationships and dynamics in the family context, describing how sibling relationship is contextualized in family communication, what differences exist between regular siblings and large-gap siblings, and how these differences influence large-gap sibling communication. Then we present an overview of prior work in technology design for siblings and distributed family connectedness.

2.1 Sibling Relationships and Dynamics in Family Context

Siblings' relationships influence both the individuals involved and the whole family system. Many studies discussed the importance of sibling relationships: it significantly affects children's development, particularly in social and emotional aspects [4]; it is a pervasive and long-term relationship [55] - most adults maintain their contacts with siblings throughout their lives; a good siblings relationship can alleviate loneliness and depression [36, 86]. The sibling subsystem plays an important role in family structure's continuity as well [18, 53]. Many investigations also found that siblings can play an important role in helping each other when adjusting to family transitions (e.g., foster care placements and parental divorce [23]).

Researchers (e.g., [24, 66, 72, 98]) categorize sibling relationships as unique as they are characterized by both hierarchical and reciprocal elements, but tend to be more egalitarian compared to family members from different generation[24]. Many factors can influence a sibling's role in the family context, including family structures [74], gender and temperament of siblings [90, 92], parental involvement [59], and cultural factors [22, 73]. Research on parents' role in shaping sibling relationships found that "*parents exert direct efforts to regulate and influence sibling interactions*" [98] and "*positivity within the parent–child relationship can also influence the protective nature of positive sibling relationships*" [34].

Although shorter age gaps are more common than larger age gaps among siblings, plenty of families have siblings with larger age gaps (with five or more years). For example, the Demographic and Health Surveys (DHS) [81] in 2011 representing 72 countries showed that 12% children were born after an interval of five or more years. Centers for Disease Control and Prevention [89] found that 22.2% of births occur with age intervals of more than five years in the U.S. in 2014. Birth order and age spacing [27] are significant variables that influence the roles of siblings and the qualities of sibling relationships. With a larger age gap, sibling rivalry and competition for parent and family resources are less of an issue [60]. The big gap also means the older sibling has more power and high

status, and thus can promote modeling [25]. In some regions and cultures, siblings can be a source of support and comfort especially when they have an age gap [9].

Evidence shows that siblings are more often separated when there is a large disparity in their ages, which brings more instability to their relationship [23]. Unlike siblings of similar age, siblings with a large age difference may struggle to find shared interests, especially when one of them lives apart. The situation may be more challenging when one participant is a child and the other is already an adult because transitioning into adulthood often suggests decreasing contact and proximity [19, 97]. In addition, younger children may require parental scaffolding and other help to stay engaged in remote conversation [2]. In our work, we selected a family arrangement that is particularly common in Chinese families due to the recent repeal of the one-child-per-family policy [49] – families with large gap siblings where younger siblings collocated with their parents while older siblings lived apart. While we acknowledge the specificity of this selected family arrangement and settings, we believe that studying a specific arrangement allows for a richer understanding of individualized experience within a non-Western context.

2.2 Technology Design for Siblings

Although the majority of the research in family-related technology focuses on informing the design of future technology to support different relationships (e.g., parent-child interaction [101, 102], grandparent-grandchild interaction [3, 26, 28, 79]), only a small amount of research investigated designing for sibling relationships [35]. Fortunately, some insights into technology for sibling relationships can be found in more general investigations of families that include siblings. For example, in the study of StoryVisit [79], participating families generally had at least three members (at least one child, co-located parent and remote reader) and often had more members (siblings and multiple parents) involved in the system usage. In another study [103], two siblings (11 and 7 years old) who split over their parent's divorce interact with each other by using a ShareTable. They shared playtime and even gave a metaphorical touch for building closeness and communicating love to each other.

Few works explicitly examined how technology might influence sibling relationships, despite the very important and long duration of these relationships [27]. One exception [35] examined gaming patterns when siblings (with three or four years of age difference) were co-located and played together. They identified challenges in supporting sibling engagement, including age differences and disparity in abilities which made it difficult to play the same games. This study also pointed out that parents' presence influences siblings' relationships and is often involved in their interactions. Parents take the role of scaffolding such as setting up a routine of playing together or scaffolding their children's team play. Children are also motivated by the chance to play with their parents.

To better understand the uniqueness of siblings' relationships and bridge the gap mentioned in the background (see 2.1), we focus on investigating siblings' remote communication experiences where siblings have a large age gap. We provide an overview of the opportunities and challenges from a multi-stakeholder perspective by examining large age gap sibling relationships (i.e., more than 5

years) in the given family context with considerations of the explicit role of the parent as a stakeholder.

2.3 Technology Design for Distributed Families Connectedness

Existing studies in CHI have explored the role of technologies in mediating different types of distributed family relationships (e.g, divorced families [102], extended families [47] or work-separated families [9, 100]). Investigations have focused on both synchronous and asynchronous communication systems to support families living apart. Technology-facilitated synchronous communication can support various activities including storytelling [78], remote gaming [68], and constructing family history [68]. Meanwhile, technology-facilitated asynchronous communication brings flexibility to family communication by allowing people to communicate at different times and schedules [12, 41]. These asynchronous systems are designed to support communication by recorded audio [41], videos or images [21, 42, 43].

Distributed families can face more challenges in establishing and maintaining interactions through remote communication when children are involved in the conversation[33]. In order to solve the challenges like engaging children in conversation and mediating with technology, co-located family members (e.g., parents and grandparents) often play a crucial role in providing facilitation help [33, 35, 51, 79]. However, understanding these situations is still limited by the types of research available. Most prior work has focused on Western families with a few notable exceptions of work investigating non-Western context [9, 33, 105])). One study that has gone beyond Western culture is an investigation that focused on left-behind families in China, identifying a set of facilitation work that grandparents need to adopt for video calls [33], such as positioning and framing mobile cameras to make sure children are on screen and sharing off-screen ongoing interactions to the remote person.

According to the review of technologies for families in IDC [50] and CHI [46], although the IDC community appears to have a growing interest in designing for distant family communication, few works have investigated supporting sibling communications in the distributed family context. Given the non-negligible link between the parents and siblings [31, 84, 95], we attempt to address this gap in technology-facilitated family communications from different stakeholders' perspectives by investigating nine families in China. We contextualize siblings in family relationships, revealing siblings' roles in remote communication and how parents connect, support, and negotiate sibling relationships, and the challenges of such families when developing supportive technologies.

3 CONTEXT OF INVESTIGATION: LARGE AGE GAP SIBLINGS IN CHINESE FAMILIES

Our work investigates siblings with a large age gap in Chinese families because having two large age gap siblings is a common family structure in China. This was influenced by the "Later birth, Longer interval, Fewer children" [15] mentality brought by the One Child Policy in the early 1970s. As the One Child Policy was replaced by the two-child policy in 2015, more than 45% of the babies born in 2016 had one or more older siblings [40]. A National Population and Family Planning Commission report in 2017 showed that

China's second birth interval is more than five years, starting from 1998 to 2016 [39]. Millions of these sibling groups were starting to live apart given the number of life changes that occur after older siblings become an adult (e.g., getting married, going to university, or starting to work). As for the commonly used technology, phone calls and SMS are common channels for Chinese family communication [65]. WeChat and QQ are the two most popular instant messaging products in China [105].

Recent HCI scholarship has foregrounded the need for explicit investigations in non-Western contexts [62]. Chinese families may have similar communication challenges as we summarized in related work (e.g., often separated geographically, lack of shared activities). We anticipate that some aspects of our findings apply to other large age gap sibling families and other child/adult extended family relationships, but we encourage other researchers to conduct conceptual replications of this investigation in other cultural and social contexts.

4 METHODS

In this section, we present our participants' information and study method, as well as our data analysis process.

4.1 Participants

We recruited participants through word-of-mouth and then continued with snowball sampling. We diversified by including participants who lived in different areas (urban, suburban and rural) and from different socioeconomic backgrounds. We stopped recruiting when we reached data saturation, *i.e.,* when we started to hear repetitive themes during the interviews.

To ensure we recruited families with large age gap siblings who have been engaging in remote communication for some time, we specifically selected families with a younger child aged between six and 14 years old and an older child at least five years older than the younger child. The older child should also have lived separately from the family for more than six months and have been communicating regularly (either through remote or in-person visits).

A total of nine families were recruited to participate in this study from Sichuan (in Southwest China) and Shandong (in East China) provinces. Of the nine families, we interviewed three families with same-gender siblings and four families with mixed-gender siblings. Younger siblings (4 females, 5 males, M = 10.78 years old, SD = 7.69) and older siblings (6 females, 3 males, M = 23.44 years old, SD = 3.78) have the average age difference of 12.8 years (SD = 7.25). We also included parents in the interview study (8 females, 1 male, M = 50.44 years old, SD = 17.2). Amongst our participants, two older siblings (O5 and O2) were married and had their own families. Table 1 provides participants' information and their relations with each other.

In this study, we obtained children's assent and the permission of their parents, also gained adult participants' informed consent. Participants were compensated for the study, with parents receiving an equivalent of $15 US dollars in Chinese Yuan, the younger sibling receiving an equivalent of $10 US dollars, and the older sibling receiving an equivalent of $15 US dollars.

Table 1: Participants Demographics (each row represents one family). F7 and F9 were separated into countries with different timezone. Siblings in other families were geographically separated in China and lived at the same timezone.

Family Code (Age gap)	Role (Gender, Age)	Education	Location	Contact Frequency	Long-term Separation Duration
F1 (12)	O1 (F, 24)	Bachelor Degree	Urban, CN	1-2/week	5 years
	Y1 (F, 12)	Middle School Student	Urban, CN		
	P1 (F, 47)	Less than High School Degree	Urban, CN		
F2 (17)	O2 (M, 27)	Bachelor Degree	Urban, CN	2-4/month	7 years
	Y2 (M, 11)	Primary School Student	Rural, CN		
	P2 (F, 54)	Primary or Below	Rural, CN		
F3 (9)	O3 (F, 23)	Graduate Student	Urban, CN	1-2/week	More than 3 years
	Y3 (M, 14)	Middle School Student	Urban, CN		
	P3 (F, 48)	Associate Degree	Urban, CN		
F4 (15)	O4 (F, 21)	Undergraduate Student	Urban, CN	2-4/month	1-3 years
	Y4 (M, 6)	Kindergarten Student	Suburban, CN		
	P4 (F, 47)	Less than High School Degree	Suburban, CN		
F5 (12)	O5 (F, 26)	Graduate Student	Urban, CN	1-2/week	8 years
	Y5 (M, 14)	Primary School Student	Urban, CN		
	P5 (M, 60)	Graduate Degree or Higher	Urban, CN		
F6 (9)	O6 (M, 22)	Undergraduate Student	Suburban, CN	2-4/month	More than 3 years
	Y6 (F, 13)	Middle School Student	Urban, CN		
	P6 (F, 49)	Associate Degree	Urban, CN		
F7 (13)	O7 (F, 23)	Graduate Student	Urban, US	2-3/month	3 years
	Y7 (M, 10)	Middle School Student	Urban, CN		
	P7 (F, 50)	Associate Degree	Urban, CN		
F8 (14)	O8 (M, 23)	Bachelor Degree	Urban, CN	More than 3/week	4 years
	Y8 (F, 9)	Primary School Student	Urban, CN		
	P8 (F, 49)	High School Graduate, Diploma or the Equivalent	Urban, CN		
F9 (14)	O9 (F, 22)	Undergraduate Student	Rural, CA	1-2/week	2 years
	Y9 (F, 8)	Middle School Student	Urban, CN		
	P9 (F, 50)	Bachelor Degree	Urban, CN		

4.2 Data Collection

Our data collection process had two main phases: diary collection and interview. We used diaries to let participants record when a remote communication happened between siblings, which we used to record true contexts and as "memory introducer" to help children recall recent sibling communication events during interviews. Following the diary study, semi-structured interviews let us collect in-depth information about participants' motivations and challenges behind their communication practices.

4.2.1 Diary Study. Since sibling communication is dyadic, we relied on older siblings to record entries for sibling communication during the two-week diary study. We provided each older sibling with a diary template and asked them to enter a diary record of any communication that happened with their younger siblings. The diary entry recorded the medium used (audio, video, text), the length of the communication session, what went well or didn't go well in that session, and an optional field for additional comments or reflection. We sent daily diary reminders to each participant and they replied with their entries through WeChat. A total of 25 diaries were collected from nine older siblings in this session (M = 2.78, SD = 0.83). In addition to the diary template, for each entry we collected, we asked participants follow-up questions to learn who initiated the communication, who else participated, and overall how communication changed before and during the diary phase (*i.e.,* uncommon decreased communication frequency).

4.2.2 Semi-Structured Interview. We conducted separate interviews with each of the two siblings and one of their parents in order to learn different perspectives regarding technology-facilitated sibling communication and connections. We collected their background information and demographic information (age, education, location, contact frequency, etc.) at the beginning of the interview. Interviews were conducted remotely through video or voice call via WeChat. The interview lasted 17 to 30 minutes (M = 23 minutes, SD = 5.63) for younger sibling, 30 to 60 minutes (M = 44.44 minutes, SD = 8.07) for older sibling and 31 to 50 minutes (M = 35.67 minutes, SD = 6.24) for parents.

During older siblings' interview sessions, we asked them about their thoughts on sibling and other family relationship to understand their perspectives on siblings in family context. We asked them to complete an intimacy map by putting each relationship in a bull's eye diagram where the innermost layer presents the closest relationship they feel, and so on. Then, we asked them to map their remote communication frequency on the same map (only those who live separately). After the mapping activity, we asked about their communication experiences, challenges, facilitating work that happened in the remote conversation, and their ideal technology designed for remote communication. Younger siblings had similar interview process and questions, but integrated more activities such as drawing the future technology in order to better engage children and facilitate open discussion (examples are shown in Figure 1). The interviews with parents included questions about parents' considerations on sibling remote communication, current facilitation work they did, and challenges they had with facilitation. Parents' perspective helps understand current practices and challenges in a broader context. In order to make sure all questions are understandable for participants, especially for children, we ran a pilot interview with one extra family (one parent and two siblings with a large age gap) to refine our questions. Interviews were audio recorded and transcribed for analysis.
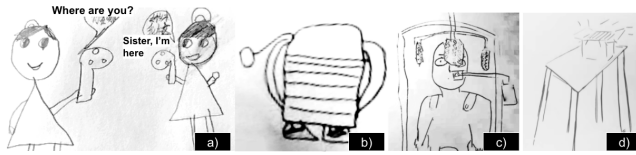
Figure 1: When asked children "Pretend you time travel to the year 2200 and there are all sorts of cool technology. If there is something magical that would let you stay closer to your brother or sister, how would it look?", there are a few drawing examples came up from children: a) when rotating the controller, the younger sibling can talk or hear the sound from the older sibling's side immediately (Y9); b) a backpack with boosters can directly bring one person to meet with his/her sibling (Y7); c) a magic machine allows siblings' consciousness to play together in a shared digital space (Y5); d) a space tunnel lets older sibling transmit physical gifts remotely (Y4).

4.3 Data Analysis

We analyzed qualitative data generated from the diaries, interviews, and associated activities using a data-driven approach inspired by the grounded theory method (following the process described in [69]). Two of the authors, who are both native Chinese speakers and have the capacity to properly translate the data into English, open-coded all textual data resulting from the diaries and interview sessions, including diary entries and interview transcripts in Chinese. We generated over 2000 open codes through this process. All open codes generated were in English. We referred to the Chinese diaries and interview transcripts when we needed to better track their original meaning during the analysis. After generating open codes, the first two authors jointly clustered these codes into themes using constant comparison with affinity mapping. We discussed and placed each code on the affinity map based on its meaning. Contentions and disagreements were resolved through discussion, bringing in a third author when it was necessary. Memos were shared between the two authors throughout the discussion process to identify and refine emerging themes and insights. Through this analysis process, we identified the major themes and the entire authors contributed to the discussion of the significance and novelty of these themes to answer our research questions, which are reported in the next section. We noted that data saturation was reached after eight families, which means we kept hearing similar things during the interview. But we recruited one additional family to confirm that we had achieved data saturation.

5 OVERVIEW OF SIBLINGS' COMMUNICATION PRACTICES

To situate understanding of siblings' communication, we first present a descriptive overview of the participants' communication practices and relational context. There were 25 diaries collected from nine older siblings during the two weeks diary session. All participants except O2 reported no significant difference from regular times, including initiator, participants, and communication frequency. O2 explained that she had less frequent communication with her sibling than regular because of the stress from her schoolwork during

the diary collection. Fig. 2 shows the details of current sibling communication practices recorded by older siblings in nine families. We characterize their communication practices from four perspectives and describe them in the following paragraphs.

Remote vs. In-person Communication: All conversations happened remotely, except O2 who had an in-person session with his sibling. In the remaining 24 direct sibling's remote conversations, the majority of communications (N = 18) were facilitated by WeChat video or audio call, three were regular phone calls, and one was a QQ [88] (another Chinese-based instant messaging software service) video call. Three diaries described the text-based message through WeChat.

Communication Frequency and Duration: Our participants' sibling communication frequency varied from one time per week to three times per week. In-person communication tends to be longer compared to remote communication, where F2's in-person lasted 2 hours. The remote communication duration varies from 1 min to 1 hour (M = 8.89 minutes, SD = 13.75). All remote communication sessions were under 30 minutes except F4 recorded a one-hour video chat. Siblings in F2 and F4 both noted that parents helped to maintain the long conversation.

Direct Communication vs. Mediated by Parents: 23 out of 25 communication happened between the siblings directly. Two mediated communication by parents were reported by O4. In this case, her mother was the mediator who helped pass on messages between siblings on WeChat.

Communication Initiators and Participants: Most conversations are initiated by older siblings. Only one call was initiated by younger sibling in F1 and two text chats were initiated by parents in F3. In eight out of nine families (except for one session in F1), parents participated in every sibling communication session.

The normalized results of the intimacy and remote communication frequency map are shown in Fig. 3. More than half of older siblings and younger siblings put their siblings in the first layer, showing that siblings were one of their most important and closest people. In general, we expected the size of the outlined circle to be similar to the size of the solid-colored circle, except with the co-located parents, since a greater intimacy level leads to greater remote communication frequency. For older sibling participants (Fig. 3 left), our analysis shows that they consider siblings as less intimate relationships compared to their partners and parents, but both parents and siblings have a similar amount of communication frequency (based on the size of the circles presented in the first layer). While for younger sibling participants (Fig. 3 right), most of them ranked both parent and sibling relationships as the closest, compared to other relationships. Most younger siblings reported that they communicated remotely with their siblings the most, compared to other relationships and except with their co-located parents (as indicated by the outlined circle on the right of Fig. 3).

Overall, the analysis showed that the communication between siblings was generally lightweight. Involving parents in siblings' conversations is very common and may foster longer conversations. Parents mediated siblings' asynchronous and indirect conversations. Most notably, except for parents, younger siblings had the highest intimacy and remote communication intensity with their brothers or sisters compared to other relationships.
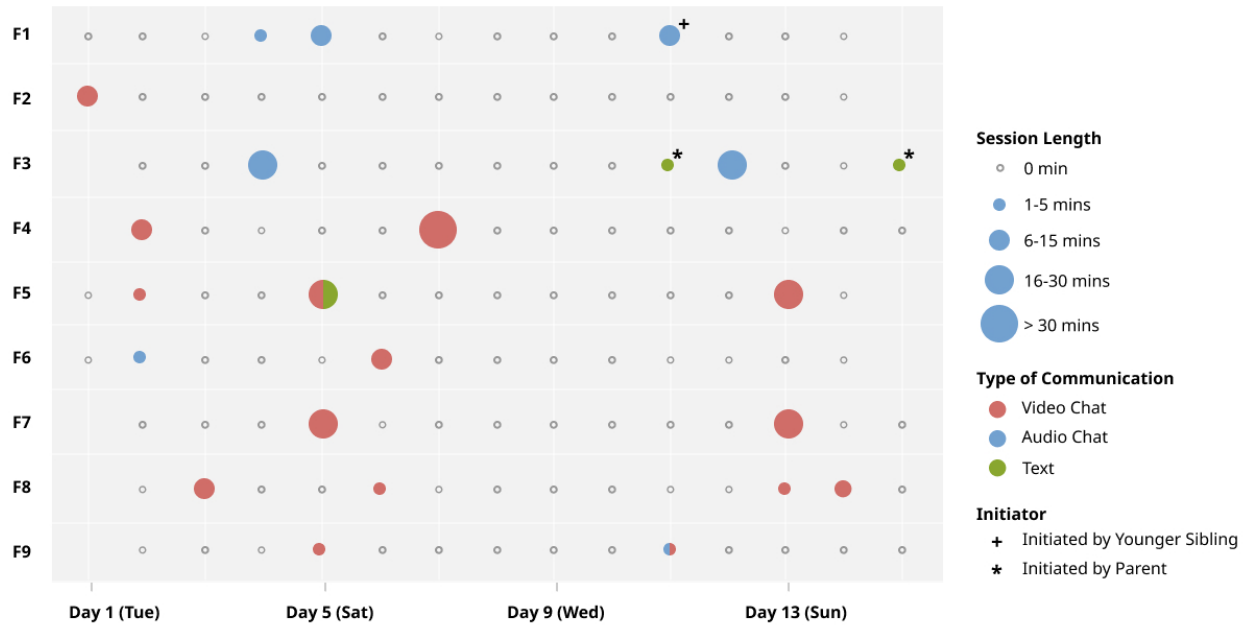
Figure 2: This figure shows all remote communication during the diary session (F1 to F9 refers to the first participated family to the ninth participated family). All diaries were recorded by older siblings. One in-person communication (2 hours) happened in F2 but was not shown in this figure.

6 WHAT ARE THE UNIQUE NEEDS AND CHALLENGES OF COMMUNICATION FACED BY LARGE AGE GAP SIBLINGS (RQ1)

We begin by talking about unique characteristics in large age gap siblings' relationships. Our findings revealed asymmetrical relationship behaviors and expectations of large gap siblings in a family context, which is manifested in two aspects: older-to-younger companionship and care, and younger-to-older rivalry. Under each subsection, we describe the challenges of sibling communication.

6.1 Older-to-Younger Companionship and Care

Larger age differences augmented downward companionship and enabled older siblings' pseudo-parental role. Almost all older siblings (eight of nine participants) described their experience of providing comfort to younger siblings and taking on the role of companion. At times older siblings felt they had a responsibility to make younger brothers or sisters have a better life. As one older sibling mentioned, *"the ancient Chinese had a saying going like this, the older brother is like a father"(O2).* Older siblings had the ability to provide much more support than younger siblings. In the interviews, all older siblings mentioned that they were willing to contribute more and did not expect their younger siblings to give anything back. One example of these caring behaviors is gift-giving. Seven out of nine younger siblings mentioned their excitement when receiving a gift from the siblings. When asked to imagine a future technology

for siblings, one younger sibling drew a magic tunnel that can let older siblings send physical gifts remotely (See Fig. 1 d).

However, older sibling's companionship is often challenged when older siblings move away from younger siblings and their parents, especially when older siblings go through big life events (e.g., finding a job (O5), preparing for an exam (O4), getting married or having a child (O2)) that lead to a decrease in contact and proximity. For example, when O2 got married and built his own family, he had concerns about the time balance between the new family and originating family, as he felt the obligation to *"spend more time with my wife and child than my younger brother."(O2)* The lack of shared living experience could also lead to a lack of shared topics during communication. When asked about the experiences of communication that didn't go well, Y5 said, *"It is embarrassing to say a meme or popular star that my sister didn't know."(Y5)* One older sibling O3 also mentioned the importance of shared living experience in providing context for successful communication: *"Since we don't live together, I don't know what those recent changes are. That's frustrating... I could not really be there with him during this important phase of his life."(O3)*

In summary, with larger age differences, although siblings accompany each other on an emotional level generally (which echoes the dynamics of sibling relationships highlighted by other researchers [30, 93] – companions and emotional support take the major role in siblings relationship), all participated siblings agreed that rather than providing mutual support to each other, older siblings provide more positive comfort and encouragement, even financial support
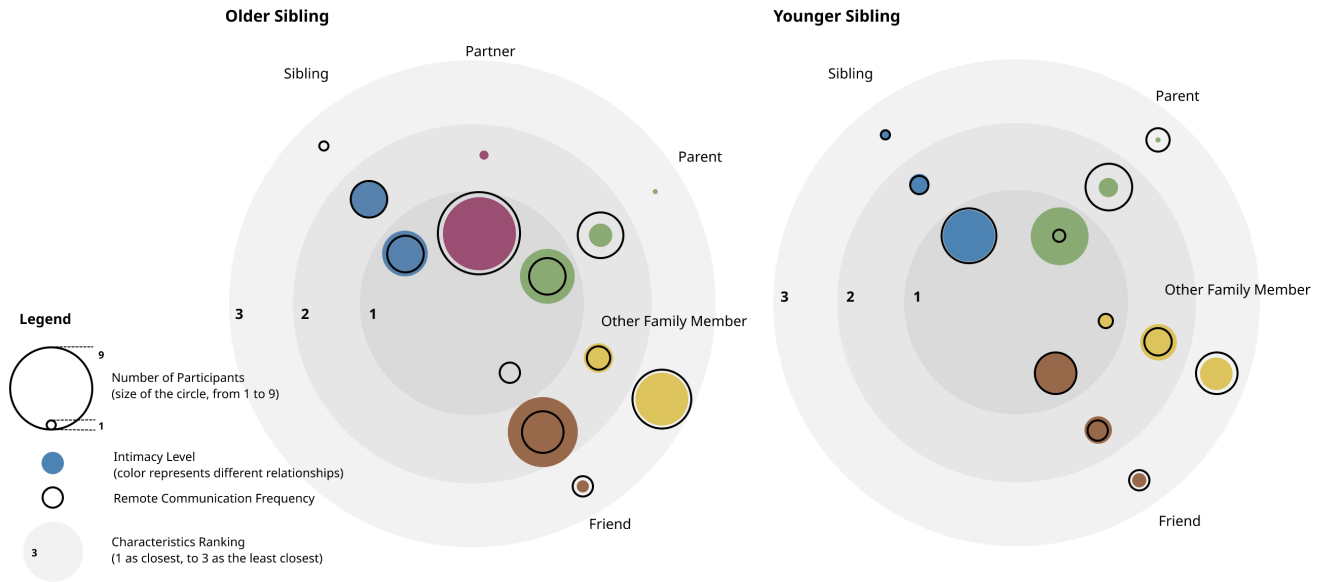
Figure 3: A summary of intimacy level and remote communication frequency reported by participants. Three concentric circles in the background represent the rating levels for intimacy level (from 1 as the closest to 3 as the least close) and communication frequency (from 1 as the most frequent to 3 as the least frequent). Each set of smaller circles represents the summary of ranking activities for different relationships (e.g., sibling, partner, parent), which are also represented by different colors. For each relationship, we reported the number of participants who rank the relationship in a specific category using two legends: 1) the solid circle for intimacy level and 2) the outlined circle for remote communication frequency. The size of the circle for both legends corresponds with the number of participants (from 1 to 9). We see some mismatches between remote communication frequency and intimacy in the summary when the size of the outlined circle does not match the size of the solid-colored circle.

to younger siblings. At the same time, the sense of closeness is challenged by the limited shared living experience, as well as the life transformation of older siblings.

6.2 Younger-to-Older Rivalry

Competition and rivalry for parent and family resources is another typical characteristic in sibling relationships, which was suggested as less of an issue when there is a big age difference by prior work [98]. In our study, although none of the participants explicitly mentioned competitive or aggressive behaviour from older siblings' side, we observed such behaviours from younger siblings when they competed for parents' attention. Interestingly, such rivalry behaviors can reduce the communication quality between the parents and older siblings. When we asked what would influence the fluency of the communication, one older sibling said that her sister felt she *"took too much of mom's time if I talked to my mom for more than 10 minutes. She would interrupt the conversation and the call had to come to an end."(O9)*

In addition, one-child-per-family policy also caused upward competition and tension between the siblings. One YS mentioned that he feels unfair because they were born secretly and need to be cautious because his birth violates the baby birth policy: *"I love the days when my sister is not at home... In that way, no one knows that I was born against the one-child policy... I wish that I were the first child of my parents."(Y7)* In summary, we found rivalry aspects in large gap

siblings' relationship, but only younger sibling demonstrated such rivalry behaviors from our study. Such behaviours might reduce the parent-older sibling's communication quality and may lead a tension between siblings.

7 WHAT KIND OF FACILITATION OCCURS OR IS MISSING FROM LONG-DISTANCE LARGE GAP SIBLING COMMUNICATION FROM DIFFERENT STAKEHOLDERS' PERSPECTIVES? (RQ2)

7.1 Facilitation Asset: Older Siblings' Role

Older sibling takes on multiple responsibilities as a primary participant in the conversation, including initiating communication, engaging younger siblings, and providing support in less ideal technical conditions.

7.1.1 Initiating the Communication. Our older sibling participants initiated almost every remote conversation. From the dairies, all remote conversations were initiated by older siblings except F1 (two out of three were initiated by older siblings and one was initiated by younger siblings). Younger siblings only called when they had specific news to share. For example, O9 described, *"She (Y9) only calls me when she has something to share, like buying new toys, but it's relatively rare."(O9)*

Although older siblings initiated most communications, they hoped their younger siblings could initiate their communication spontaneously. In this way, siblings are *"more likely to have more interesting and longer conversation"(O3)* and older siblings feel *"easier to maintain the chat based on the topic proposed by my sister"(O1)*. An older sibling talked about a time that her younger sibling initiated a call but she unfortunately missed it – *"You can call back later, but you are from a more active process to a passive one."(O4)* On the other hand, younger siblings also wanted to initiate conversations by themselves more spontaneously. For example, Y9 came up with a communication controller where she could talk to her sister when she met something interesting immediately in her idea sketches (Fig. 1 a). This finding highlights the necessity of encouraging younger siblings to initiate communication spontaneously, which echoed the results from the prior work on distributed families [103].

7.1.2 Engaging Younger Siblings During the Conversation. During the conversation, older siblings often need to engage younger siblings by relating to their interests, and have shorter conversations in order to balance their own time and keep children's attention. The topics younger siblings might be interested in are often different from older siblings' interests. One older sibling stated her concerns when choosing a topic: *"I usually choose straightforward topics. I won't talk about those topics about adults' life. She is not interested either."(O9)* This consideration on topic selection was further confirmed by younger siblings. Six out of nine younger siblings (Y1, Y2, Y3, Y6, Y7, Y8) mentioned they didn't want to listen too much about older siblings' work or study as they cannot understand. One younger sibling (Y2) stated that he would feel bored when his brother spoke too long. Younger siblings' attention could also be affected by their surrounding environment during the video chat. Five out of nine older siblings (O2, O4, O5, O8, O9) raised concerns about the distracting environment caused by digital devices, toys, or games. For example, O5 shared her frustrating experience when her little brother was attracted to a TV show during the call.

Siblings also engage in other activities besides talking when they connect with each other. For example, older siblings help with homework while younger ones cannot get a good solution from their parents. When asked younger siblings what co-located activities with their siblings they would like to continue in a remote way if it is possible, they showed preferences for those embodied activities (e.g., going to an amusement park, playing sports and cooking together) because they were more engaging. Our results suggest that children preferred shorter but more engaging communication that catered to their interests and aligned with their attention span.

7.1.3 Facilitating in Less Ideal Technical Conditions. Previous work highlighted that co-located parents or other caregivers play key roles in child's technology usage [5, 33, 35]. A large gap age between siblings usually means they have older parents, who might have difficulties operating mobile applications [77]. In this situation, older siblings would become the person for providing support in less ideal technical conditions. When asked what kind of facilitation work older siblings did, three families (O1, P2, Y3) answered technical support. For example, one younger sibling described a situation when he needed to find an electronic book online, he often sought his sister's support: *"my mother is a non-technical person... So most*

time I will let my sister (O3) teach me or operate it if she can."(Y3) As Y3 mentioned, older siblings would be more familiar with new technologies compared to parents and try to teach younger siblings remotely. Similar to prior work that children would influence their parents' adoption of technologies [20, 104], we also observed older siblings' facilitation work on supporting parents in understanding and using technology, in addition to the technical support they provided to their siblings. A mother pointed out that school teachers use WeChat or school applications to assign tasks for children, expressing her lack of confidence regarding using the phone - *"I can ask those young parents (about how to use the smartphone and software), but I will ask his brother (O2) to help do it first."(P2)*

7.2 Facilitation Asset: Parents' Role

While the original goal of this study was to focus on siblings, through our diary and interview, it became clear that parents hold a critical role as communication facilitators. Often, siblings' chat was seen as part of the family chat. Parents served as facilitators of this communication, including enriching the communication and providing logistical support.

7.2.1 Enriching the Communication. Parents played a critical role in facilitating siblings' communication, and actively participated in sibling conversations by providing context, suggesting topics, and providing updates. Almost every participant mentioned that siblings know each other's status through their parents. During siblings' communication sessions, parents also helped raise topics for siblings to chat about. Eight out of nine families (except F1) mentioned parents joined siblings in conversation and enriched the conversation, often leading to a longer conversation between siblings. Most notably, when asked children if they would ever want to communicate with their brothers and sisters alone, none of the younger siblings mind having parents listening or joining their conversation. Therefore, parents act as the intermediator, enriching the current conversation and helping with indirect and asynchronous communication.

7.2.2 Logistical Facilitation. Parents not only engaged actively in the sibling discussions, but also facilitated the logistics, such as reminding the younger siblings to participate, scheduling the call, and providing the necessary communication devices. All families mentioned such facilitation practices *"my parents turned the camera to my brother and let him talk with me."(O5)* or *"mom told me it's a good time to ask questions for my sister ."(Y3)* to remind children to answer the call. Since children might live in boarding schools (Y1, Y2, Y4) or older siblings (O7, O8) lived in another country, parents needed to consider the boarding school schedule or time differences to set up the call. Besides that, parents also needed to make sure the time was not violating each side's work, study and other schedules. For example, two parents (P4, P7) said that *"unless there is something very urgent, I will not call older sibling actively"(P4)* for the similar reason of *"I'm afraid that she (O7) was in class or doing something else."(P7)* Parents would also check with older siblings to see whether they are available for the chat.

When asked whether younger siblings have their own devices, six out of nine (except Y1, Y7, Y8) participants didn't have one. All parents expressed their concerns about the children's device overuse, including the influence of social networks, screen fatigue,

and potential addiction to mobile devices. For example, when asked about future technology for sibling communication, P7 said, *"I hope games or chats can be timed."(P7)* It is clear that giving children devices can potentially promote sibling communication; however, from most parents' perspectives, their supervision is necessary for children's device usage.

7.3 Facilitation Challenges

7.3.1 Conflicting Values Between Parents and Older Siblings. Parents and older siblings often had different or even conflicting values and practices regarding sibling relationships. Influenced by Confucianism in China [1], learning is not only in terms of acquiring knowledge and skills but also connecting with morality as it is the process that involves acquiring virtue such as diligence, persistence, and concentration" [61]. Therefore, academic achievement has important social meaning for Chinese children [64]. We noticed this cultural tradition varies among different generations in our study's context – parents tend to encourage instrumental communication between siblings, particularly about providing updated insights on academics and education technologies, while older siblings responded to that need in practice but still want to prioritize relational elements (i.e., more relaxing and casual social communication) such as helping each other with stress. All parents talked about their expectations hoping older siblings could help educate the younger one and often reminded their older child to help with improving the younger one's academic performance or interpersonal skills. However, older siblings don't agree with these expectations. For example, O8 shared his experience of helping his sister to prepare for a math test: *"When she (Y8) did not understand what I said or kept making mistakes, I would be less patient and sometimes blame her carelessness. There is no doubt that we both feel more relaxed if we just have a casual talk. " (O8)* Similarly, one child described that, *"During the call, I enjoy mutual teasing with my sister. I don't like to talk about my homework or grades, especially when I don't get a good score."(Y5)* This tension between the parents and older siblings is further increased if siblings have been influenced by different cultures. Another parent P7, stated, *"I feel [O7] is greatly influenced by western education, different from traditional Chinese education. In terms of education, I have different ideas from [O7]. She doesn't want her brother to take out-school classes, but I think it is important to learn more in today's society."(P7)* Her child talked about similar conflict between them. When asked what expectations are on the siblings' communication, O7 said, *"I don't have any expectations on his (Y7) study because I think learning is not that important in family communication."(O7)*

We also noticed that the ideal communication frequency is different between parents and siblings. Although both sides of siblings were willing to increase communication frequency, parents (P1, P4, and P8) often worried that increased frequency might interfere with siblings' daily lives. As P1 discussed, *"I would like to see that they communicate more frequently, but two or three times more is enough because her sister needs to work and can chat only in the evenings or on weekends. The younger child has academic pressure and needs to do a lot of homework when she goes home."(P1)* These conflicts in communication priorities and frequency between parents and siblings may introduce tension that needs to be considered during technology design.

7.3.2 Adult-led Rather Than Child-led Conversation. In many cases, children didn't have full control or ownership of the communication technologies, which made it hard for them to lead a conversation. Although involving parents in siblings' conversations can enrich the family chat and provide logistical facilitation, the chat between older siblings and parents could take over siblings' communication easily. From diaries, we observed that older siblings mostly talked directly with their parents during co-presence conversations. Only a small amount of time was allocated to direct dialogue with their younger siblings, even though the call was initiated by the older siblings when they wanted to hear more from their sisters or brothers. O3 and O7 reported during the interviews that they did not specifically call the younger sibling since the younger sibling *"is too young to communicate individually. If I want to know something about my sibling, I can ask my parents directly." (O7).* In one older sibling's diary, DO4[1] recorded *"my parents want to talk to me which influences my brother's talking time" (DO4).* Similarly, one younger sibling said, *"Once I wanted to ask a question, but my brother (O8) ignored me and started to talk with my mother about his work.... So I have to wait until they end their talk." (Y8)*

For child-led conversations, younger siblings and other members often have different preferences regarding privacy. Unlike most older siblings and parents who preferred video chat, younger siblings liked audio chat because it is *"more relaxing without seeing faces" (Y1)* and *"face-to-face chatting is not always necessary" (Y4).* Five children (Y1, Y3, Y4, Y5, Y6) indicated that they felt uncomfortable when their parents turned the camera toward them during a video call without their permission, since they didn't have full control over the devices. Younger siblings also mentioned other potential privacy concerns with the usage of video chat, especially in a shared environment. Y3 said that *"I prefer to use audio rather than video as I am in the dorm room and usually wear pajamas during the call."* Hence, children tend to have fewer opportunities to influence the conversation when parents unconsciously take on roles as active speakers instead of being facilitators in a co-presence meeting. In this situation, children's needs and concerns could be easily ignored.

7.3.3 Technology Obstructs Fluent Communication. We found problems around family communication technologies that influenced the fluency of communication. Our findings reveal challenges as the current technologies were not set up for "co-present involvement". Most families (DO3, DO7, O5, Y7, Y8) mentioned issues with multi-speaker sound quality: *"My younger brother always got words in edgewise. It is noisy when many people talk at the same time. I couldn't hear the specific content clearly, and sometimes he was unwilling to repeat what he said. I hope the software can automatically identify the speaker and who the key speaker is."(DO7)* Screen limitation is another challenge. The current screen size is usually too small to capture everyone, which caused positioning and framing issues mentioned in [33]. Larger screens without handholdings were preferred by most families (DO3, O4, O7, P3, P6). We also identified some general technology issues from diaries. O1 and O9 mentioned issues with bad lighting and environmental noise from the space where communication happened in their diaries. All

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[1]DO marks the quotes from older siblings' diaries.

families mentioned reduced communication quality caused by the sound quality and poor internet connections.

8 DISCUSSION

Our findings shed light on social-technical opportunities in communication among distributed families who have siblings with a large age gap. We utilized diary and interview methods to study the communication patterns between remote siblings and to inform potential technology designs. In this section, we reflect on our research methodology, discuss our findings in the specific study context and provide design implications based on our results. Finally, we discuss the limitations of this study and future work.

8.1 Reflection on Methods

This work was conducted during the COVID-19 pandemic, requiring creative adaptations of commonly-used in-person qualitative methods for remote delivery. One positive side effect of remote methods was expanding access to participants, including geographically-distributed ones. However, a major challenge was designing for study to engage child participants and decrease power differences between researchers and children. The importance of engaging children in the conversation was highlighted during our research since in-depth conversations were more challenging in the remote interview format (compared to the face-to-face format). There were two strategies that worked well in our study to engage children: diary records and visualized questions. First, we obtained two weeks of diary records from older siblings before interviewing the children and used these records to recall children's memories. We observed that children were better able to start conversations, describe communication scenarios and reflect when they could recall relevant memories. Second, we visualized abstract questions and encouraged children to draw their answers. For example, we used the bull's eye diagram to help the child articulate their intimacy priorities among different relationships. Then we continued the interview by engaging them in a more in-depth conversation based on their drawing. Another example is that, at the end of the interview, we asked children to design the ideal communication technology by drawing (See examples in Fig. 1). Based on these pictures, we considered how these may speak to specific needs and desires younger siblings have (e.g., immediacy, physical contact, embodiment, etc.) The preceding interview steps could serve as a reference to help children focus on the problem, concentrating on the remote communication technology design. We encourage other researchers to consider their techniques in carrying on remote formative investigation with young study participants.

8.2 Reflection on Specific Study Context

Our findings are affected by the specific context we chose to investigate, as many cultural and societal factors can influence sibling relationships [63, 91, 94, 96]. In this section, we examine the extent to which our findings can be extrapolated to other contexts.

First, education has long received recognition and respect from Chinese society [57, 58, 75]. Chinese parents often place great importance on their children's education, that their children need to study hard from an early age in a competitive environment [71].

Older siblings also take on the responsibility to teach younger ones. Although both sides are influenced by this societal expectation, our results suggest a divergence of communication preferences in different generations. Siblings and parents often have conflicting values when facilitating conversations, such as different priorities and preferences on activities siblings should engage (see 7.3.1). These specific values are often influenced by societal expectations, which might be different from context to context. However, parents and siblings might still have conflicting values in other contexts [8, 9, 16, 67], due to the generation gap [80, 83], and create challenges for siblings' communication.

Second, Chinese parenting is rooted in Confucianism, which shapes the ethical norms and members' hierarchy (i.e., parent-child, sibling-sibling) in Chinese families [37]. Parents often play an authoritative figure in Chinese family and can influence siblings communication [13, 14]. "Ti (悌)" culture ("younger brothers deferred to older brothers while older brothers nurtured junior siblings") [11, 56] directly defines the interaction norms among siblings in China and establishes the hierarchical structure in sibling relationships by setting the ranks [87]. Many technologies highlight parents' facilitator role in children-involved communication [7, 10, 21, 51]. Our findings reveal that depending on the family's norms and context, parents might become too involved in the siblings' communication and reduce siblings' opportunities to connect. Such family hierarchy together with the lack of device ownership can make it difficult for children to initiate and maintain a remote conversation on their own. Context might influence families and hence lead to different relationship dynamics. When investigating siblings' communications in other contexts, we encourage researchers to contextualize sibling relationships and communications in their investigation context and be aware of the influence by siblings' family relationship dynamics.

8.3 Translating Findings into Design Implications

Our work reveals different stakeholders' needs and challenges in remote communications between siblings with a large age gap, as well as their current facilitation practices in remote communication. For our first research question regarding large age gap siblings' relationship and communication characteristics (RQ1), we found that:

- Large age gap siblings relationship consist of an older-to-younger companionship and care, where older siblings also take on a pseudo-parent role to the younger sibling;
- Large age gap siblings relationship consist of a younger-to-older rivalry, which might reduce the family communication quality and lead a tension between siblings.

For the second research question in understanding different stakeholders' facilitation practices and challenges (RQ2), our findings highlighted that:

- Older siblings take many facilitation responsibilities, including initiating communication, engaging younger siblings, and providing technical support;
- Parents also help enrich siblings' communication, and provide logistical facilitation;

- Current facilitation challenges include managing conflicting values between parents and older siblings, promoting child-led conversations and technology obstructions.

Based on our findings, we identify three design opportunities for technology to better support different stakeholders' needs and current practices in siblings' remote communication:

- **Support Co-present Involvement in Remote Meetings:** our findings in RQ2 highlighted parents' role in communication facilitation as well as siblings' relationships. As parents are often co-located with the younger siblings, the communication among the stakeholders can happen in both the co-located context (between parents and younger siblings) and the remote context (between parents and older siblings, and between younger siblings and older siblings). It is important for technology to support co-present involvement for different stakeholders' requirements and needs in remote settings.
- **Scaffold Child-led Conversation under Asymmetric Relationship Expectations:** the insights in RQ1 and RQ2 revealed that the asymmetric relationship and expectations occur between the younger and older siblings and there was lacking the opportunities for children to lead the conversation. Future technology designs need to consider these asymmetric expectations and support child-led conversations to better support remote siblings relationships.
- **Negotiating Values between Older Siblings and Parents:** in RQ2, we found that although both were influenced by cultural and societal context, parents and older siblings have a divergence of values, which affect siblings' communication and their relationships. For technology to better support siblings' relationships, it must consider these value conflicts and help negotiate them during siblings' remote communication.

In the following sections, we provide a detailed discussion of each design opportunity identified with detailed examples and relevant literature.

8.3.1 Support Co-present Involvement in Remote Meetings. Our findings show that even before the pandemic, co-present setups were a common practice in spaced siblings' families. This suggests co-located parents, younger sibling, and remote older sibling usually appear in the same setup for a call (mostly video calls, but also audio). Prior work [33] emphasized the importance of facilitation work for three-party (child-grandparent-remote parent) co-present involvement. Gan et al. [33] found that children were at a very young age (under 5 years old) and less able to perform routine aspects of a video call, so remote communication heavily relies on the co-present adult. Our work echoed the significant role of facilitation, however, our unique context brings different insights for family co-presence meetings. We found the facilitation work is more distributed between older siblings and parents. Besides, siblings' conversations can shift within the multiple participants' co-present format, between parent-older sibling meeting and siblings-only meeting. Besides, many families in this study mentioned the different timetables between siblings, which made it difficult to schedule a synchronous call for both siblings.

For new technologies to enhance such remote co-present involvement, researchers should consider system designs that allow multiple members in the household to participate in the remote conversation at the same time, and address critical challenges in visibility and audio perception of all participants. Given the importance of all stakeholders in siblings' conversation, technology should support multiple speakers as well as capture potential side conversations happening around the current active speaker (also noted in [33, 44, 78]). One potential solution from prior work is Beam Geocaching [70], which used a headset and controllable remote robot with cameras to have a broader view. Another potential solution is taking advantage of 360-degree video [38] to get richer contextual awareness. Second, technology should support asynchronous connections that involve parents as well. Our findings suggest that the wide age gap brings facilitation challenges like scheduling to siblings' communication. Hence, systems supporting both synchronous and asynchronous communications can provide more diverse means of connection. However, prior systems that facilitated asynchronous communication (e.g., [21, 48, 82]) were not specifically designed to support multiple participants' involvement and roles. Thus, we suggest future research consider parents' presence in asynchronous communication to support richer communication experiences. For example, systems could integrate features like specific built-in roles in asynchronous activities to ensure multiple participants' involvement.

8.3.2 Scaffold Child-led Conversation under Asymmetric Relationship Expectations. Although we observed most conversations were initiated by older siblings, both sides did express their preference for spontaneous initiations by the younger sibling. The wide age gap between siblings offers unique challenges to promote child-led conversation under asymmetric relationship expectations. First, unlike the older sibling, it is clear that younger siblings may face infrastructure-poor environments. We found most children did not have their own communication devices due to the digital overuse concerns from their parents, which reduced the possibility of children initiating or leading the communication. Also for children living in boarding schools, it is hard for them to access the internet. Second, while rivalry tends to be more intense and common for close-age siblings [98], only younger siblings showed rivalry behaviours for their parent's attention. Moreover, different social circles and living conditions made older siblings more challenging to accommodate younger siblings' interests at the same time during facilitated remote conversations.

Researchers and designers should consider different relationship expectations, exploring mechanisms that are specifically designed for child-led conversation to promote their engagement in remote settings but also minimize the negative impact of digital overuse to address parents' concerns. One possible strategy to mitigate parents' concerns is providing ways for them to supervise and engage in children's digital use [45]. Moreover, technology designs should support child-centered communication to reduce rivalry and improve engagement. Our findings showed that children tried to grab parents' attention when they could not join the conversation between the parents and older sibling. Thus, unlike prior work designed for close-age siblings suggesting that technologies should balance sibling dominance (e.g., equal view and role control into the system [35]), we suggest that designs should promote

younger sibling's leadership (or reduce the dominance of parents or older siblings). Systems can facilitate children's spontaneous initiation of conversations by reducing barriers to starting a call, as noted in[103], or providing accessible and children-friendly mediums, such as low-tech options (e.g., incorporating low-tech remote activities for younger siblings in creative ways [54]).

8.3.3 Negotiating the Values between Parents and Older Siblings. We found tensions between the communication priorities and frequency of parents and older siblings advocates. Our results show that parents tend to encourage instrumental communication between siblings while older siblings want to prioritize relational elements. The difference between ideal parents' and siblings' communication frequency also noted that tension. Technology designers need to weigh the values of different stakeholders and make the decision on what kind of facilitation or scaffolding to provide. For example, communication systems with direct and formal educational goals (e.g., homework help, exam preparation help) may appear desirable to parents but may go counter to the needs and preferences of the siblings. In addition, most younger siblings can only use mobile devices under supervision. In spite of giving more freedom to children to use digital devices directly can increase communication frequency, there was a desire from parents to avoid the negative part for children of using communication tools.

Furthermore, the set of values and tensions may change depending on the context [63, 96]. As indicated in our context reflection (see 8.2), the role of siblings and the expectations of their relationships are differently affected by the particular culture, society, and history. In many non-Western cultures, older siblings may be even more influential than parents in socializing young children [32, 99]. In some cultures and regions, older siblings may take the role of caregivers. However, in western cultures, siblings tend to be less influential than parents, and some studies even suggest that in industrialized cultures, sibling relationships are typically discretionary in nature [17, 29]. Supporting how families may negotiate differences in values and priorities in culturally-appropriate ways is a critical consideration for socio-technical systems in this space. For example, in our investigated context, technology could support some lightweight learning activities which give both considerations of knowledge acquisition and emotional communication.

8.4 Limitations and Future Work

This paper leverages qualitative methods to gain a rich understanding of the experiences of large-gap sibling families in China. These methods provide an opportunity to engage with the lived experiences of a few families but do not provide a quantitative understanding of how representative these experiences may be. Additionally, our insights are specific and limited to the unique nature of the context (Chinese large-gap sibling families) and the participants. For example, we noticed that most participants were from urban areas and older siblings generally had good educational backgrounds, which may not be representative of other populations. Additional qualitative work would be needed to understand how these findings apply to other cultural contexts from diverse geographic areas and socioeconomic backgrounds, and follow-up quantitative investigations could demonstrate whether and how these findings are representative of the broader population.

We made an effort to include all common relevant stakeholders — older siblings, younger siblings, and parents. However, all families are different. We could not represent the full range of that diversity in a single study. For example, some families may have more than two children but not all children participated in this study. As another example, fathers' participation in this study was fairly limited (one out of nine parents). This has been pointed out in the past as a common issue in HCI works with families [76]. Additionally, while qualitative methods offer substantial benefits, the methodology also contains some inherent limitations. These interviews were influenced by the individual perspectives of both participants and researchers. Some specific results and design considerations might be different if working with a different group of participants or researchers. Future work in this domain may help strengthen confidence in these findings by triangulating findings with other researchers and other methods.

Furthermore, translation is an invisible and integral limitation of cross-cultural research. The first two authors are native Chinese speakers and provided certification of attestation of translation to the IRB. Followed by the suggestions from [52], we made the translation visible to the research team and tried to tap into the richness of the research data through multiple layers of interpretation and meaning construction.

Finally, this work was conducted during the COVID-19 pandemic. This may influence our findings in different opportunities for remote communication, although our participants didn't report any communication particularities and kept their life routines. Affected by the strict quarantine policy of the Chinese government, participants may have longer separation duration, more remote connection needs, more digital exposure, and socio-digital inequalities [85], which may further influence their affinity and communication pattern. Later follow-ups to this study can help establish which elements of our findings persisted post-COVID pandemic and further identification and reduce the digital divide. Despite these limitations, we believe our work provides valuable insights into the design of supportive technologies for large age gap siblings by illuminating the values, specialties and priorities from multiple stakeholders' perspectives.

9 CONCLUSION

The role of siblings and the expectations of their relationships are different depending on the particular culture, society and history. We carried out a qualitative study in China, revealing the unique roles of large age gap siblings in wide-spaced sibling relations and identifying the facilitation work that happened in remote communication for both older siblings and parents. Our findings uncovered the current practice and socio-technical opportunities in long-distance communication between siblings with a large age difference from a non-Western perspective. In our discussion, we reflected on the method and specific study context, then identified three critical design implications, explicating how other HCI researchers may benefit from our study and develop better HCI communication technologies in and beyond the context.

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