

Participatory Design for Intergenerational Culture Exchange in Immigrant Families: How Collaborative Narration and Creation Fosters Democratic Engagement

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Language and cultural barriers critically threaten the social relationships between grandparents and grandchildren in immigrant families. Cultural exchange activities, like shared storytelling, can foster these crucial connections. However, existing barriers make these seemingly routine interactions challenging for families to navigate. The resulting intergenerational drift places grandparents at high risk of sustained social isolation from their families. Past works have presented technology-mediated supports for grandparent-grandchild social interactions in non-immigrant families and have found that these interventions do foster stronger connections in both physically close and distant multigenerational families. We explore how to support the specific needs of immigrant families through Magic Thing participatory design workshops with grandchildren and grandparents together in order to reveal the social interactions that would support their cultural exchange. We use the Magic Thing to move the standard dialogic grandparent-grandchild relationship into a trialogic one, creating space for comfortable social connection and storytelling through the shared creation of the design. We find that technology-mediated support of intergenerational immigrant cultural exchange must be designed for this trialogic process, consider the role of expressing values as a form of meta-commentary on a story, and shift the perspective on existing “barriers” to consider how they might foster further engagement.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing theory** →, **Collaborative content creation**

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1 INTERGENERATIONAL CULTURAL BARRIERS IN IMMIGRANT FAMILIES

Family memory passes through generations and is successively enriched to create a collective narrative from which families draw a shared sense of identity and place in society. Grandparents play a crucial role as the curators and maintainers of family history [46], as well

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as by passing on cultural knowledge [75]. Migration, however, threatens this critical family practice of social connection through joint remembrance. In Canada, there are 1.7 million immigrants over the age of 65 [38], and children in second generation immigrant families are more likely to be living with their grandparents in multigenerational households than non-immigrant families [11]. Despite this, immigrant children in Canada are at high risk of disengaging from the family storytelling process, as they grow up surrounded by a dominant cultural discourse that is at odds with their families' heritage culture. These children are building their own strategies of cultural resilience at this stage [61], often through the use of socially connected technology [76].

The cultural barrier experienced by across these generations, coupled with the language barrier, places grandparents at high risk of social isolation in multigenerational immigrant family households [9, 75]. In these households, children typically speak fluent English or French with limited heritage language skills, while the reverse is true for their grandparents [24, 57, 62]. These effects of migration continue many years after a family resettles in a new place [62] and are exacerbated by the easier acculturation of younger family members [75]. Without shared lived experiences and a common language, immigrant grandchildren and grandparents experience interpersonal and conversational challenges, which have severe long-term implications for familial social connections, such as struggles with a lack of identity and sense of belonging [75]. These effects can be eased through cultural exchange activities which foster mutual understanding through sharing of significant cultural knowledge (e.g., daily routines, local foods, family history) [69].

Storytelling is an essential part of community and of being human. From ancient oral storytelling to photo albums to modern blogs and social media we have always sought out ways to share our narratives with each other. It is also a cornerstone of family social connectivity [73], is key to fostering and maintaining cultural connections in immigrant families [48, 51, 75, 82], and builds cultural resilience, which allows families to better cope with transitional events like migration [13]. Having access to methods of building and sharing narrative are particularly important for older adults, and has been shown to reduce social isolation and maintain a sense of self identity [7, 30, 64]. While preservation of personal or family narrative, especially for older adults, has been broadly researched through digital storytelling and similar areas [31, 46, 80], less has been done to focus specifically on the needs of immigrant grandparents and the unique cultural and language divides between them and their grandchildren. While some existing work has studied communication patterns within immigrant families [2, 53] or explored families' perceptions of their culture and language [10, 13, 56, 60], there needs to be direct design-grounded investigation of these barriers, in order to move towards the creation of digital tools that support cultural exchange activities. Similar approaches have been used to collaboratively create meaningful digital supports for socialization of non-immigrant skipped generations (i.e. grandparents and grandchildren) [25, 26]. Some previous research has shown that tech-mediated settings, such as social media, can foster socialization and overcome various migration and displacement-related barriers [76]. As such, what is still missing from research is direct collaboration with both grandchildren and grandparents in the design process to create a support tool specifically for them. There is a gap in our understanding of the immigrant grandparent-grandchild relationship, and in understanding how we can design to engage both parties in the storytelling process and cultural exchange process. In this study, we work closely with

grandparents and grandchildren together to ensure their voices and participation in the process are directly reflected in our resulting findings.

We adopt a social constructionist approach to discover how we can support grandparents and grandchildren as co-conversationalists and co-creators of narratives in spite of culture and language differences. We propose that adopting a trialogic approach, in which we introduce a third space for joint creation, will shift the dynamics typically seen in purely dialogic (i.e., conversational) immigrant grandparent-grandchild interactions [68]. We hypothesize that engaging grandparents and grandchildren directly in these participatory design (PD) activities will identify limitations of the existing digital and non-digital supports, expose the social interactions grandchildren and grandparents engage in because of the trialogic process, and reveal opportunities for better fostering meaningful, collaborative cultural and language exchange through tech-enabled mediation. To explore this hypothesis, we observe how families use the shared space to construct meaning, followed by an analysis of the processes that govern these interactions. We identify the interaction gaps in these exchanges, and explore how a technology-mediated solution might help fill those gaps.

We engage grandparents and grandchildren together in Magic Thing style PD workshops [37] in order to explore the processes surrounding the creation of potential novel designs for support tools that motivate families to engage in cultural and language exchange. We build on the grandparent's oral storytelling with sensemaking activities, which engage both grandparent and grandchild in processing the shared story, and, through the Magic Thing, encourage designs that do not need to conform with what participants feel is expected or feasible for current technologies. We focus on this skipped-generation interaction to better understand the intergenerational dynamics that cannot be captured when parents are involved, as immigrant parents often have more immediate cultural priorities for their children [54]. We collaborate with families who have grandchildren in the middle childhood range (7-13) as this is the age when children draw heavily on the socialization patterns they observe to form their own identities and sense of belonging [14]. This process is especially complex for immigrant children [14]. The use of Magic Thing style PD is chosen here to create a space where both grandparents and grandchildren feel comfortable to contribute and make creative decisions in an existing space that is generally the domain of grandparents (i.e., family memory sharing). Past works have shown that children take the lead in the creative open-ended design process of Magic Thing studies [18] and feel more comfortable socializing within families [5]. Our work expands on this to explore how the Magic Thing process in this setting is a trialogic process, resulting in a shared design space between grandchildren and grandparents.

This paper offers three novel contributions that are predominantly implications for system design. We also contribute some methodological and design process reflections.

1. First, we offer design process reflections by illustrating that the trialogic design process creates a democratic, shared space that balances the roles of grandparents and grandchildren, fostering equality of contributions.
2. Second, we highlight that passing on values, reflections on cultural differences, and other meta-commentary are connected to, but distinct, from stories shared within immigrant families. This points to a need for designs that preserve both the stories and their commentary as unique categories of narrative information, creating a rich and complete space for cultural exchange.

3. Finally, we identify the culture and language barriers that influence immigrant family story sharing in ways that would not affect non-immigrant families. However, we propose implications for system design by showing how these “barriers” can be leveraged as technology-mediated prompts for meaningful conversation between generations, presenting options for supports that work with existing interactions, rather than despite existing barriers.

2 RELATED WORK

Intergenerational storytelling is a key activity for fostering social connection in families. In immigrant families, storytelling plays distinctive and crucial roles in maintaining relationships between grandparents and grandchildren. In this section, we review the complex role of storytelling and cultural exchange in immigrant families. We provide an overview of existing supports for fostering familial connectivity, and identify that none of these tools have been designed for the unique context of immigrant grandparents and their young grandchildren living together in multigenerational households. We argue how design approaches should engage all stakeholders in the creation process and survey existing approaches to collaborative design. Finally, we introduce the Magic Thing as a promising co-design technique for engaging multigenerational immigrant families in the design process.

2.1 The Unique Role of Storytelling in Immigrant Families

Storytelling is a powerful activity for fostering family social connectivity [73], and like other such symbolic, affective activities that organize family life, is generally passed down relatively unchanged through generations and serves many critical roles [23]. These activities impart a sense of identity, promote group cohesion, and play a significant role in keeping grandparents involved with their families [59]. For immigrant families, storytelling can play an additionally influential role by cultivating and maintaining cultural connections [48, 51, 75, 82]. Culture is a collection of values, beliefs, and practices that influence an individual's actions and feelings [47]. A shared cultural connection plays a core role in organizing social and family life, and in shaping an individual's sense of self within their larger community [34, 60, 82]. However, cultural knowledge is typically acquired slowly over time as an individual lives and interacts with their society [47]. Migration makes such acculturation with their family's heritage impossible for young immigrants, which triggers language and culture barriers between younger and older generations and leads to the breaking of family practices [23]. In this context, storytelling can be used to build cultural resilience, which allows families to better cope with transitional events like migration [13].

Immigrant families employ storytelling in unique ways to explore culture and language differences. This includes immigrant youth carefully curating their stories to broach taboo subjects with their parents [2], parents passing on cultural-specific morals and values to young children [65], families preserving their historical legacies [82], and for collectively making sense of family identity within in a radically foreign and unexpected landscape [29]. Most of this research on storytelling practices in immigrant families excludes younger children from the conversation, relying instead on discussion with their parents or grandparents, or observation alone to understand children's needs and practices. However, for immigrants who migrate at a young age, childhood is a formative and complex time as they

interact with multiple cultural environments (home and the outside world) to develop their sense of self [14]. During the middle childhood range (7-13), children heavily absorb and adapt the socialization patterns they observe [14]. StoryKit, a mobile storytelling tool, demonstrates that despite a lack of support tools catered to them, children have the skills, creativity, and motivation to create stories that convey their life experiences [4]. Thus, immigrant children have a rich lens into the challenges of negotiating culture and language, and involving them directly in research can reveal novel insights into immigrant family storytelling practices.

For immigrant grandparents, migration can trigger adverse social consequences, such as feelings of disconnect and uncertainty about the value of their contributions to their families [75]. Traditionally, grandparents have served as family historians [46]. With their young grandchildren adjusting faster to the new culture and language [69, 72], immigrant grandparents are unable to share their stories and maintain their role as family historians [52]. These barriers strongly shape the immigrant grandparent-grandchild relationship, such as by limiting interactions to purely functional, which can trigger feelings of hopelessness and isolation for older adults [44]. Jones and Ackerman explore the motivations of grandparent “tellers” and adult grandchild “listeners” to preserve memories together [40]. Listeners were active co-creators of the storytelling process and worked together with tellers to actively seek out and make sense of stories, as well as reconstructing them to meet needs of current and future listeners.

We know the powerful role storytelling plays in maintaining intergenerational family ties. Thus, by investigating the immigrant family storytelling process, we aim to uncover new ways of story sharing that closes the language and cultural gaps in immigrant families and fosters engaged, two-way socialization between grandparents and grandchildren.

2.2 Supports for Intergenerational Family Social Connection

Though there are several examples of HCI research around immigrant family social engagement or cultural connection, most focus on input from grandchildren only in the design and assessment (e.g., [12]). Little co-design work has been done in this area with intergenerational family participants together. However, many digital tools have been proposed to support general social engagement between grandparents and grandchildren in non-immigrant families, and many of these use participatory or co-design methods to gather input directly from the families.

Forghani and Neustaedter used a diary study with grandparents to understand the communication patterns of distance-separated grandchildren and grandparents, including several immigrant families [25]. Based on these findings, an assessment was conducted of G2G, a shared calendar and messaging system, to find that its targeted support of skipped generation interactions reduced the need for parental scaffolding of socialization [26]. Vetere et al explore how to support distance-separated play between grandparents and grandchildren through observations and Magic Thing cultural probes, followed by a technology probe with one family. They uncovered the need for flexible support of the different roles played by both grandparents and grandchildren [77]. Jones and Ackerman identify limitations of existing storytelling preservation tools, which include not saving enough context to allow for meaningful interpretation by future generations, especially in terms of social signals within stories [40].

Storytelling through book reading is a common skipped generation social activity that is fundamental to linguistic development, and is a role frequently taken on by grandparents [28]. ICDL is a browser app to support distance reading of picture books created through cooperative inquiry sessions with co-located grandparent-grandchild dyads with an emphasis on support of multilingual collaborative reading [21]. However, ongoing assessments has not yet focused on skipped generation use. Family Story Play engages young readers with intergenerational reading through a tangible book, rather than a screen. Video interaction includes a grandparent and a third party, Elmo from Sesame Street, who supports the young child through the technical tasks and helps engage both parties in reading [63]. This project is based in observations of grandparents and grandchildren attempting to read physical books via video conferencing, and incorporating the Elmo character creates a collaborative process between grandparents and grandchildren [63]. While much has been done to address the needs of remote grandparent-grandchild interactions, little has focused on the needs of immigrant families specifically. Our research targets these families and their specific needs directly.

2.3 Intergenerational Participatory Design Methods: A Trialogical Perspective

It is well known in HCI research that designing with potential users is essential to creating meaningful designs. Especially when working with underrepresented groups, a lack of participant input will likely lead to solutions that do not support their needs and that build on external assumptions rather than their own experiences [17]. Recent research has been working to remedy these issues [83]. Co-design or participatory design (PD) is a commonly employed method with underserved groups [79] as it is designed to directly elicit participants' input and voice through hands-on design workshops. PD workshops reveal the specific needs and desires of the included participants beyond the immediate aspects of technology adoption, and have been used to design supports for health and wellness with immigrant women [8] and to assist in rebuilding social capital with recent refugees [1]. Participatory methods have been employed to empower children's voices in both the design and evaluation processes (e.g., [22, 27]). Though PD has also been employed in research with older adults (e.g., [78]), it has not been leveraged to explore the needs of older immigrants specifically, including fostering cultural identity, preserving value-rich stories, and maintaining social participation through enabling meaningful family connections [45].

Some work has developed co-design methods specifically to facilitate intergenerational interactions between unrelated older adults and children [85]. Others have investigated the intergenerational interactions in PD between adult researchers and child participants [3, 22, 85]. Birch and Demmans Epp find that power differentials and misaligned values can be significant barriers to the effectiveness of PD, and that these challenges can be mitigated methodologically through better communication of shared values and by strengthening the role of the design mediator [3]. Yip et al emphasize the need to develop meaningful partnerships across the entire co-design cycle in order to address the imbalances between adult researcher and child participant [87].

Technology probes are a form of PD designed to engage families in design work [36]. Families work directly with simple functional prototypes early in the design cycle and provide both qualitative and quantitative feedback. In this way, participants across generations (and

cultures) can contribute to the iterative improvement of an envisioned technology [36]. Technology probes have been used to design diverse tools, such as for fun communication between grandparents and grandchildren [58] and for family management of a child's asthma [88].

In our study we apply a trialogical lens for analyzing the PD process [68]. Technology introduces an additional dynamic to social interaction by creating a shared space where families must collaborate to construct a joint product. This facilitates a move from social interaction as a dialogic process (where collaboration entails discussion but not necessarily the creation of shared artifacts) to a trialogic one which brings artifact creation to the centre of the collaboration [68]. Research on remote communication identifies benefits of a shared collaborative space. Introducing a third space, such as a shared tabletop, has been found to enrich interactions between geographically parents and children by shifting focus to the activities rather than conversations, encouraging the dyads to work together, and by pushing families to identify new ways of interacting [86]. Family members, particularly older generations such as parents, are also pushed to find new roles and ways of contributing when in technologically unfamiliar spaces [66]. By observing how objects evolve over time, the trialogical approach reveals insights into the collaboration process. To uncover these insights in the under-explored context of immigrant grandparent-grandchild social interactions, we adopt a trialogical perspective to analyze the PD process and its resulting artifacts.

In this paper, we ground our research in these PD methods, especially Magic Thing PD [37] (discussed in detail next), to empower grandchildren and give them a space to express their thoughts, beliefs, and needs for intergenerational culture sharing and knowledge exchange. In our study, we operationalize cultural knowledge as the familiarity an individual has with the artifacts, practices, and values of their heritage country. To our knowledge, our research is the first to employ PD with grandparent-grandchild dyads, and as such we build on the work with non-related intergenerational participants reviewed here. To support our approach, we draw methodological knowledge from intergenerational co-design research.

2.4 The Magic Thing

The Magic Thing PD methodology, developed by Iacucci et al and sometimes called Dream Design, uses co-design methods to guide participants to create designs that, rather than being based in an existing form factor (e.g., a smartphone), are based either in a magical form (e.g., a magic bracelet or button) or are unlimited in order to encourage diverse designs [37]. This has been used to engage participants in a broad variety of spaces. This method is particularly effective when potential users are unfamiliar with standard technology use and design and when seeking designs that go beyond users' and researchers' expectations of what is technically feasible or "good" design [27, 42]. Magic Thing and other related role-playing-based co-design methods are often used with children and families as adults are generally less comfortable with the idea of imagining a magic design while young participants produce creative, meaningful designs [18, 22, 32].

Past works incorporating magic ideation have demonstrated how the process creates a space for socialization between users, especially children and families [5, 22]. In this research, we directly investigate this effect of Magic Thing PDs and leverage it to create a trialogic process between immigrant grandchildren and grandparents in order to expose the potential

social interactions within and stemming from cultural exchange activities that could be prompted by a digital (or magic) support tool. Though the role of Magic Thing as a method to create triologic processes has not been directly investigated previously, there are examples of past works that have similarly investigated the role of PD in fostering family social change in other ways [5, 18].

3 METHOD

We investigate the processes of cultural exchange that can be prompted by the Magic Thing workshop, especially as a triologic process that introduces a third space, through ten workshops with grandparent-grandchild dyads from immigrant families in locations across Canada. These locations range from small rural communities to large metropolitan areas. The grandchildren's parents provided informed consent for their children, and all parties (grandchildren, parents, and grandparents) had the opportunity to review the consent form together and ask questions. After signing the consent form, parents were not present for the study. Ethical considerations informed all aspects of this research design, with protocol provisions to avoid unpleasant memories that may cause stress to participants and to protect the consent of the children who could feel pressured to participate by family. No participant withdrew from the study. This protocol was developed following the TCPS2 principles and is approved by our university's Research Ethics Board.

3.1 Participants

Families were recruited through flyers posted in community centres, distributed by community partners working with immigrants, or through a researcher visiting events held at community centers (e.g., language learning classes held at the library). Cash compensation for grandparents was \$30, based on the average part-time hourly rate in our area, and grandchildren were compensated with a gift card (value of \$15) to a business chosen by their parent(s). Parents received a small cash amount (\$10) for facilitating the session set-up. Participants could withdraw at any time during the study with full compensation.

Children were required to be between 7 and 13 years old, as is standard for similar participatory design studies [5, 87], and had to have spent all or most of their lives in Canada. Grandparents were required to be visitors or have immigrated to Canada as adults. In two families, grandparent were visiting on a six month visa. In the remaining eight families, grandparents were permanent residents or Canadian citizens. Grandparents ranged in age from 63 to 85 ($M = 71.5$, $SD = 5.4$). Nine grandmothers and five grandfathers participated. Grandchildren ranged in age from 7 to 13 ($M = 9.4$, $SD = 1.9$). Nine girls and five boys participated. Participating families included immigrants from India, Pakistan, Afghanistan, the Philippines, and South Korea. In total, 28 participants took part in the study (14 grandparents and 14 grandchildren). Table 1 shows participant demographics. In this paper, for brevity, when we refer to families, we are referring to the grandparent and grandchild relationship (i.e. parents are not included unless explicitly stated). Additionally, though some families had two grandparents and/or two grandchildren participating, we use both in the singular form for conciseness. We use GP as shorthand for grandparent and GC as shorthand for grandchild throughout. Finally, to protect families' anonymity, we do not identify the ages

and genders of specific participants within a family, and will refer to individuals generally as, for example, *the grandparent in F4*.

3.2 Procedure

Sessions were held in person at participant homes, and lasted approximately 1.5 - 2.0 hours. Families were informed beforehand that the session would be audio recorded, and participants had the option to choose to either allow video recording or to occasionally pause the interview to allow researchers to take pictures of the design artefacts. When video recording, it was done from overhead to provide a bird's eye view of the table in order to capture the design activities while protecting participant faces. Participants were informed that recordings could be paused at any time during the study. All data were fully anonymized, and collection of personal data kept to a minimum.

Table 1. Participant demographics

| Family ID | # GPs | # GCs | Heritage Country | Heritage Language |
|-----------|-------|-------|------------------|----------------------|
| 1 | 2 | 1 | India | Punjabi |
| 2 | 2 | 1 | Pakistan | Urdu |
| 3 | 2 | 2 | Pakistan | Urdu, Punjabi |
| 4 | 1 | 1 | India | Punjabi |
| 5 | 2 | 2 | India | Punjabi |
| 6 | 1 | 2 | Afghanistan | Farsi |
| 7 | 1 | 1 | Philippines | Tagalog / Pangasinan |
| 8 | 1 | 1 | Philippines | Tagalog |
| 9 | 1 | 2 | Philippines | Tagalog / Ilocano |
| 10 | 1 | 1 | South Korea | Korean |

In this section we describe in detail each of the seven steps in our study procedure, which we carried out to understand cultural exchange across generations and to analyze the processes emerging from this intergenerational engagement. This procedure was lightly revised after our first two sessions (F1 and F2), which were not as explicitly structured. As we noticed all of these steps emerging from the workshops with both families, we formalized the structure moving forward. These differences are indicated in the relevant steps.

3.2.1 Part One: Introduction

At least one researcher (the first or second author) was present at every session and the grandparent-grandchild dyad were present for the entire session (i.e., there was no individual interview). When only one researcher hosted a session, a research assistant was present to help facilitate the set-up and the video/audio recording. For seven of the families, an

independent interpreter also attended the session (F1, F2, and F3 did not require an interpreter). The researcher met with the grandparent, grandchild, and parent to go over and sign the consent forms, after which the parent left the session.

3.2.2 Part Two: Demographic Interview

We started by capturing demographic information on our participants as a group (age, education level, heritage language). We also asked participants to self-report their fluency in English and their heritage language. Grandchildren were asked about their familiarity with their heritage language and grandparents were asked about intentional efforts they have made to preserve their cultural heritage and language. Finally, we touched on the level of connection between the grandparent and grandchild through questions about their daily routines and shared activities.

3.2.3 Part Three: Memory Hinting Activity

The goal of this activity was to help participants identify stories they were interested in sharing. The researcher guided participants in creating hints by prompting them to draw or write small clues on index cards that both reminded them of the story and would let family members tell the story again later. The researcher handed out a fresh index card to each participant for each new hint prompt and read the prompt out loud. The researcher or interpreter provided clarification as needed. Once all participants were done, the researcher went around the table and asked each participant to share their hint, emphasizing that they should not share the whole story as the hint was intended to remind the rest of the family of the story. The four prompts for the hints are listed next. Hints that were modified for the grandchild's perspective are shown in parentheses.

1. What is a funny memory you have from high school? (What is a memory you have of your first day of school?)
2. What is a memory you have about moving to Canada? (What is something you experienced visiting your heritage country OR What is something you have heard about your heritage country that you want to experience?)
3. When is a time that family was important to you?
4. What is your favorite story? This can be your favourite folk tale, movie, book, soap opera, or religious story.

For families with three or more participants, prompt three was omitted to save time. The researcher also modified prompts to fit the context. For example, if a grandparent had not attended high school, the prompt was modified to "What is a funny memory you have from elementary school?". For F1 and F2, the specific prompts were not used for the hinting activity. Instead, families were asked to think of and create hints for one to three stories they would like to share without structured guidance. These four hint prompts were developed from the stories shared by F1 and F2. These targeted hints allow families to move more quickly to the storytelling and sense making activities without having to choose one story from their whole memory.

3.2.4 Part Four: Memory Sharing Activity

After the hinting speed rounds, participants had a list of hints and cards as a tangible reminder. The researcher asked the grandparent to pick one story from the grandchild's hints.

The grandchild was asked to share the full story. The same process was repeated for one of the grandparent's stories.

3.2.5 Part Six: Memory Board PD Activity

In this main PD activity, participants were guided towards envisioning a tool that could facilitate their cultural exchange. The table was cleared and a blank piece of poster board (24 x 36 inches) was laid down. For F1 and F2, multiple standard pages of paper were provided instead of the poster board. While it was possible to add as many pages of paper as they needed, we found that it was still a too small space to allow families to create a meaningful design together, so we incorporated a poster board in future sessions to encourage further collaboration.

At this point, families had a set of hints on index cards for each participant. They also had one story that was visually represented in detail. These artifacts were shuffled into a random order and spread out on the table. The researcher explained that this large piece of paper was a memory board intended to be a space for the family to remember all their stories in the future. They were asked to work together to figure out how to organize the hints and the full story in a way that made sense to them and would be easy for other family members to access in the future. Index cards, sticky notes, markers, scissors, tape, a stapler, and glue were provided. The researcher explained that there were no rules in how they designed their memory board, and that they were free to cut, glue, tape, draw, and arrange however they wished.

Part-way through the activity, the researcher introduced the Magic Thing. Initially directed at the grandchild, the researcher explained that the memory board was a magical board that will do what they ask it to. As an example, a magic wand that could translate between languages was provided to springboard brainstorming. The researcher emphasized that they could make up anything they wanted, even if it did not exist yet. These instructions were left intentionally open so that the participants could suggest any form factor they imagine, whether or not they believe it to be technically feasible.

As the family worked, the researcher prompted think alouds by asking questions such as:

- How would you find a memory in here? Explain the steps.
- How would that help you tell the story?
- How do you know which memory belongs to who?
- How would you understand something written in a different language?

The grandparent and grandchild were encouraged to discuss their design ideas with each other and to reach a consensus.

3.2.6 Part Seven: Follow-up Interview

Once the entire family was satisfied with their memory board, the session ended with a follow-up interview where participants reflected on the experience. These questions asked them to think more about how they would like to engage with each other through cultural exchange and how their design could support that. As a final reflection, the grandparent was asked to think about their own grandparents. The researcher asked them to think about how, today, they wished they could access and save their grandparent's memories. Participants were then asked if they had any questions or concluding thoughts, and compensation was provided.

3.3 Data

From these sessions we collected several types of data, listed below:

- Audio recording of the entire session
- Video recording or photographs of the design activities
- Artifacts created during the design activities (hint cards, memory boards, magic thing items etc.)

From the ten sessions we recorded almost 15 hours of audio. These files were transcribed verbatim by independently hired translators. The translators transcribed the English portions, translated and transcribed the non-English portions, and provided a transliteration of the non-English portions. The transliterations were used to conduct quality tests of the translations through spot-tests.

In qualitative research with highly targeted research areas, McDonald's et al. recommend that coding be performed by the researchers who conducted the study sessions as they have the required context for making sense of the transcripts that an outsider would not [49]. Following this recommendation, the transcripts were iteratively coded by two researchers (the first and second authors). The inductive coding process was grounded in the approach proposed by Braun and Clarke [6]. The researchers independently coded one transcript each and developed their own initial codebooks. They went through both transcripts and codebooks together to reach a consensus. They then coded one more transcript together to confirm the equilibrium of the combined codebooks. Through this process, similar codes were merged and overly broad codes were made more specific. For example, one initial individual code book had a code "Further storytelling prompted by session", which was clarified during the joint coding to represent what aspect of the session prompted the additional storytelling (e.g., "hinting activity prompts further storytelling", "magic memory board prompts further storytelling"). At this point, the codebook was stable and the researchers split the remaining seven transcripts to code independently. Through this intensive, iterative process, 344 codes emerged. Thematic analysis was conducted on the codes that emerged from the transcripts and the design artifacts as they related to the processes of cultural exchange and socialization between the grandchild and grandparent.

We choose to first focus on the processes and interactions emerging from the families specifically, rather than the designs themselves, in order to understand the social space that surrounds the processes and that would affect the use of a potential digital tool. Our future work will build on this to analyze the resulting designs themselves, grounded in the insights presented here. Before attempting to envision what a supporting tool could look like, this initial focus on process reveals how families presently engage in cultural exchange in this setting, as well as how it could be positively supported by the introduction of a digital support.

During the interactions with participants and carrying into the analysis we observed differences in families when grandchildren seemed to have a stronger connection to their heritage country compared to grandchildren who seemed more removed from that culture. Certain themes highlighted these differences experienced by families with either a cultural connection or a cultural barrier, while other themes clearly bridged these groups by including families both with and without the barrier. These bridging themes show what is consistent regardless of cultural barrier. Similar themes emerged with regards to the language barrier, though to a lesser extent, likely due to the uneven balance of language barriers in our families

and the presence of a translator as part of our process. Based on these initial observations, we define the presence of cultural connection or barrier in families by whether grandchildren had visited, and could remember visiting, their heritage country (cultural connection) or not (cultural barrier), as having a shared point of cultural reference has been shown to minimize cultural gaps and build connections [35]. This is because visits to their heritage country are positively associated with second-generation immigrants' sense of belonging to their heritage culture [35].

This is an intentionally narrow definition of cultural connection and cultural barrier that provides a clear distinction between families in order to highlight one key dimension of how a grandchild approaches cultural exchange activities. Recognizing this pre-existing connection with their heritage culture, or lack thereof, as well as how it is reflected or not across resulting themes, reveals important motivations towards a potential digital support. For example, if themes diverged between these groups, by highlighting a need for creating some equivalent connection in grandchildren who have not already experienced one.

For the purposes of this research, this simple criterion reflects the attitudes seen in participating families. Though only a single point of reference, we selected this criterion as it is an objective one easily applied across all families, rather than attempting to assess, as outside researchers, less visible family dynamics (e.g. degree of cultural elements incorporated into daily routines). We define the presence of a language connection or barrier by whether grandparents and grandchildren had a shared language (either English or a heritage language) through which to communicate (language connection) or not (language barrier). These two groupings of families overlapped with each other, and table 2 shows these overlaps of cultural and language barriers and/or connections for each family. Through the findings section we will indicate when themes are specific to these, falling into one of three categories:

- Connected sub-themes: Based in codes from only families with cultural connections
- Barrier sub-themes: Based in codes from only families with cultural barriers
- Bridging sub-themes: Based in codes with both culturally connected families and those with cultural barriers (at least two each).

These barrier and connected sub-themes highlight the distinct needs of families with and without these barriers, while bridging sub-themes reveal what is consistent regardless of barrier. The bridging themes in particular, are essential to understanding how to best support intergenerational cultural exchange and social connection that includes families across the broad experiences of cultural and language barriers. These definitions of connections and barriers, though simplified, reveal important distinctions and similarities across groups that highlight the importance of this research topic. Future work can expand on these findings to present more nuanced understandings.

Table 2. Overlap of cultural and language barriers or connections across participating families

| | Cultural Connection | Cultural Barrier |
|-------------------------|----------------------------|-------------------------|
| Shared Language | F1, F3, F9, F10 | F2, F5, F6 |
| Language Barrier | F7, F8 | F4 |

For the first five sessions, we recruited participants with South Asian heritage, as they represent one of the largest immigrant heritage origins in Canada [38]. Once we confirmed that the process and initial findings were sufficiently stable, we expanded to include a broader range of heritage backgrounds. Though stories and specific practices differed across families and across backgrounds, we did not find that the different cultural backgrounds influenced the processes and interactions at the high level we discuss in this paper, supporting that our findings apply beyond what may be specific to South Asian families. This is consistent with previous works with similarly diverse family backgrounds [41]. Future work can expand on the represented cultural backgrounds to further confirm this generalizability.

4 ANALYSIS

In this section we present our six high-level themes, which provide insight into the family dynamics springboarded by our storytelling and design activities. Figure 1 shows all themes and sub-themes and how they relate to the design implications presented in the next section. We discuss how grandchildren and grandparents in immigrant families can be supported through technology-mediated cultural exchange activities. We highlight which themes reveal the role of cultural and/or language barriers (barrier, connected, or bridging sub-themes, as defined in 3.3). These identify key interactions between grandparents and grandchildren and how to foster this existing connection to build meaningful cultural sharing connection. We qualify our statement when culture and language is relevant to a subtheme or a quote. Where there is no such qualification, it is because our analysis suggests the finding is not unique to a subset of our families (i.e. the finding spans across families of varying cultural and language barriers, and cultural backgrounds). While the themes are largely system design implications, some encompass design process reflections. For clarity, we mark relevant sections with “design process reflection”. We present a detailed empirical breakdown of each theme and sub-theme, with participant quotes and artifact images to provide context. Quotes have been translated into English when necessary and lightly edited for readability (e.g., grammar), though the meaning is always preserved. In the following section, we discuss the implications of our findings in this section by grounding our findings in literature.

The themes below emerged inductively from the data collected during participant sessions, and provide the empirical evidence to support the contributions of our research. A general categorization is provided below, though there is overlap between categories (e.g., an identified barrier may also have system design implications):

- System design implications via surfacing of empirical evidence showing that passing on values, reflections on cultural differences, and other meta-commentary are connected to, but distinct, from stories shared within immigrant families. (Themes 4.1 “Triologic Process for collaborative storytelling”, 4.2 “Design Process prompts broader interaction”, and 4.6 “Families personalize activities for ownership”).
- Identification of culture and language barriers that influence immigrant family story sharing in ways that would not affect non-immigrant families (Themes 4.3 “Existing barriers dissuade storytelling”, 4.5 “Story sharing as platform for expressing hopes”, and 4.4 “Existing strategies can be leveraged”).
- Subthemes under system design implications that are also design process reflections. These subthemes illustrate how the triologic design process creates a democratic, shared space

that balances the roles of grandparents and grandchildren, fostering equality of contributions, and thus, offer methodological considerations. (Subthemes 4.1.5, 4.2.1, 4.2.2, 4.6.1, 4.6.2, 4.6.3).

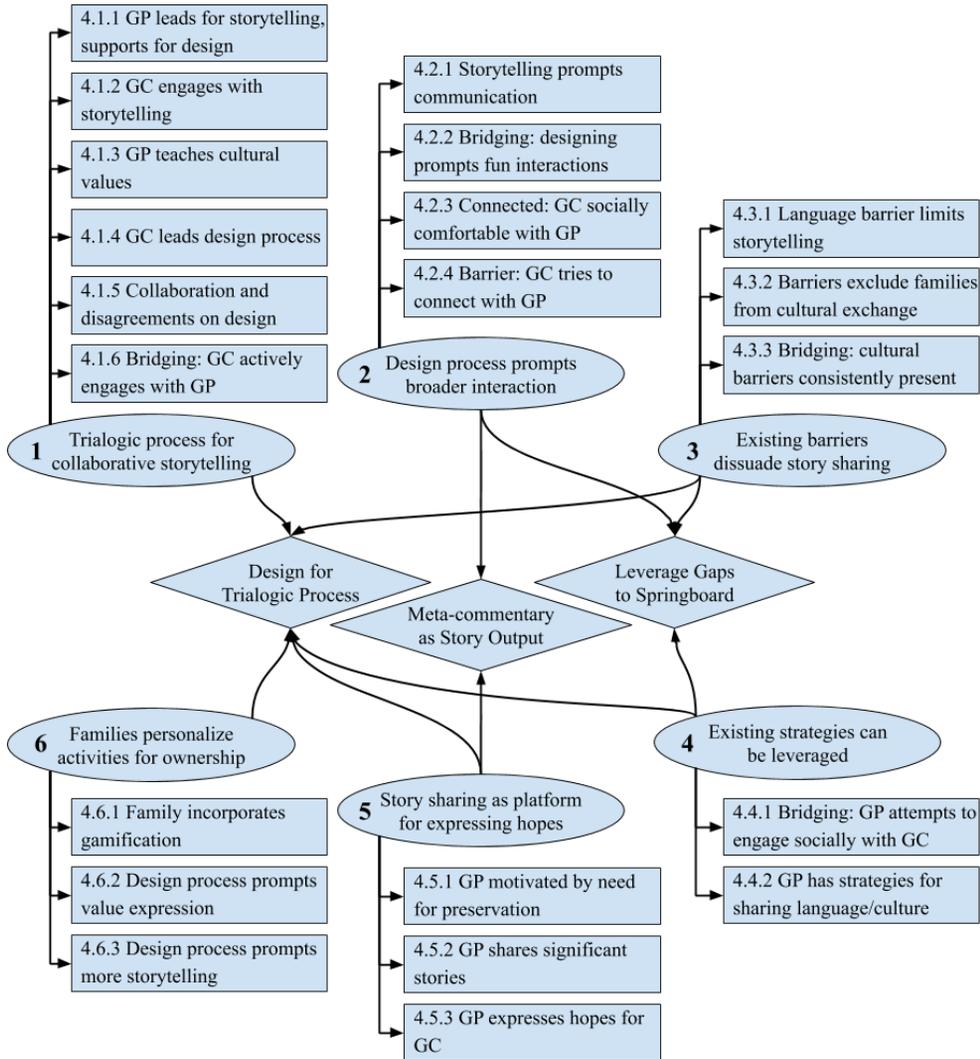


Fig. 1. Mapping of themes (ovals) to sub-themes (rectangles) and the resulting design implications (rhombuses). Grandparent and grandchild are abbreviated to GP and GC, respectively.

4.1 THEME 1: Trialogical design approach prompts consistent, collaborative, two-way interactions and creation of shared storytelling process

Technology introduces an additional dynamic to the learning process by creating a shared space where individuals must collaborate to construct a joint product. This facilitates a move from story sharing as a dialogic process (where collaboration entails discussion but not necessarily the creation of shared artifacts) to a trialogic one which brings artifact creation to the centre of the collaboration, as seen in recent research into distributed family storytelling [68]. This theme highlights grandparent-grandchild interactions that emerged as part of our multi-step design process due to the introduction of the Magic Thing design. The social, storytelling, and creative roles they take on demonstrate how they navigate this potentially unfamiliar space. From these findings, we can see how existing socialization strategies are adapted or new ones are forged where none existed. This informs how designs can foster collaboration and social connection during digital cultural exchange. Thus, the social connections seen during the trialogic process demonstrates that designs should be intentional in creating this space which in turn fosters cultural exchange.

4.1.1 Grandparent takes leadership role for storytelling, supporting role for design process

Most grandparents felt comfortable in the role of storyteller, which is not surprising as older adults are often the curators of family memory [75], and storytelling is a particularly important activity for immigrant grandparents [28]. In all families, the grandparent helped the grandchild by clarifying instructions, providing feedback and encouragement, directing activities, and keeping the child on task. Grandparents in our families were most engaged during storytelling and would often step in while grandchildren were telling or drawing stories to direct and make sure details were represented currently, such as the grandparent in F8 who directed their grandchild's storytelling, "*When you went to [city]... What did you see there? A tarsier? Have you seen tarsier? Or butterflies? Lots of butterflies!*". This storytelling direction by grandparents was seen in all ten families.

This was contrasted by grandparents' more supportive role during the design process, also seen in all families. Grandparents let the grandchild take control and empowered them to create, offering help as needed. The grandparent in F10 followed their grandchild's lead saying, "*Where are you going to put it? Want me to cut the tape? OK. Are you going to put [mine] like this? OK.*" This balance between directing and following suggests that grandparents are comfortable working with their grandchildren through these sensemaking tasks. Figure 2 illustrates the various collaboration dynamics.



Fig. 2. Collaboration in its different forms. Left to right: grandparent directs grandchild drawing. Grandparent and grandchild pause drawing to discuss a plan (note the mirrored body language), grandparent draws while grandchild observes.

4.1.2 Grandchild engages with grandparent's storytelling

Grandchildren in seven families (F2, F3, F4, F5, F6, F9, F10) directly engaged with their grandparent's storytelling, exemplified by a grandchild in F5, who jumped in with each pause in a story to ask, in Punjabi, "*And then? And then?*". Grandparents in four families (F1, F3, F8, F10) felt that their grandchildren were engaged with stories they had told in the past, as a grandparent from F1 described, "*[After] the stories, she will ask, 'What is the moral? What should I learn?'*". This evidence of some pre-existing engagement with storytelling, as well as the increased engagement during our prompted storytelling, shows that the younger generation will be active participants in the storytelling aspect of cultural exchange.

4.1.3 Grandparent takes on teaching role for personal and cultural values

In nine families (all except F8), grandparents used the storytelling or design activities as a platform to pass on cultural, religious, or personal values. Storytelling is used across cultures as a medium for teaching values, legacies, and socialization to children [82]. The grandparent in F6 used the drawing activity to share the personal significance of their religious covering with their grandchild, "*When I go to visit my children in [other country], I don't wear it. When I came here, it became a habit for me. If I don't wear it, I am not comfortable. Because there are Afghan people here and they might see me.*" The grandparent in F9 used the Magic Thing to ask for better-behaved grandchildren saying, "*For you two to be well-behaved, that's all I have to add. For you not to fight, that's it.*" These examples show that access to these cultural exchange activities provide a natural prompt to pass on values and knowledge (figure 3).

In four of the culturally connected families, the hinting and story sharing activities prompted explicit sharing of cultural values (F1, F3, F7, F10). This direct sharing of culturally important information from the grandparent to the grandchild was not seen in families with cultural barriers, suggesting there may be hesitation to openly share cultural values when the shared foundation is missing.



Fig. 3. A grandparent draws a tree that grows in their heritage country as they explain to their grandchild, who is observing and asking questions.

4.1.4 Grandchild takes leadership role for design process

Grandchildren would take the lead during design portions of the interview, balancing the grandparents' supporting role above, and would directly tell the grandparent what to do and how the design should work. The grandchild in F10 told their grandparent, "*You write the rest*" and once they had completed the task, turned to the researcher to say, "*We are done.*" This leadership was seen during drawing activities, similarly to previous intergenerational PD works [85]. Grandchildren in six families (F3, F4, F5, F6, F9, F10) either drew for their

grandparents or told them what to draw. The grandchild in F5 told their grandparent, “*Make a house. You forgot to make something.*” In five families (F1, F3, F5, F9, F10), grandchildren also told grandparents which story they should illustrate first.

4.1.5 Collaborating and disagreements on design for individual stories and story organization (Design Process Reflection)

When designing for their processes, story narrators were not seen as the story owners. Rather, families employed an open source model for the story creation process in which everyone was free to draw, write, and add on to the narrative (figure 4). Our design activities introduced a shared space, moving the traditionally dialogic process of grandparent-grandchild interaction into a trialogic one. Through observation of the artifact creation process, this trialogic process revealed insights into families’ collaboration dynamics as has been seen in similar areas such as computer-supported collaborative learning [68]. In two families (F3, F6), artists had multiple interpretations of a narrator’s story. After disagreement and negotiation, space was found for all interpretations on the board or the family decided which interpretation should be kept.



Fig. 4. Drawings could include multiple artists.

We also observed how control over the narrative shifted from the narrator to the artist as the protocol moved from oral storytelling to sense making, as was seen passing from grandparent to grandchild in three families (F3, F4, F5). In all families, grandparents chose not to correct their grandchild’s drawing, citing reasons such as “*This is their perception*” (F3), or “*[grandchild] puts their own ideas*” (F4). Even when directly questioned about a memory detail, such as when a grandchild from F5 questioned how many friends the grandparent had, the grandparent emphasized that the grandchild was in charge of the drawing process, responding “*Draw as many as you want – 3, 4...*”.

Families also encountered disagreements as they worked to bring their stories together through the design process. Initially, the grandchildren from F3 and F6 did not want to collaborate with their grandparents on organization ideas. There was pushback from grandparents in four families, including these two, who questioned the grandchildren’s chosen organization (F3, F5, F6, F10). Grandchildren from five families struggled to arrange all their stories in the magic thing, leading them to omit some details (F1, F3, F4, F7, F10). The grandchild from F4 explained their design omission, saying, “*I didn’t really translate [grandparent’s stories] in English because there’s not enough space*”. In three families, designs were re-structured after the initial organizations (F6, F8, F9).

4.1.6 Grandchild actively engages with grandparent throughout design process to find balance, regardless of cultural barrier

Grandchildren from both families with cultural connections and barriers consistently make efforts to connect with their grandparents. Regardless of cultural connection, grandchildren expressed that they enjoyed listening to their grandparents' stories (F1, F2, F5, F6, F7, F9, F10), encouraged further storytelling by asking questions (F3, F5, F6, F7), and responded to their grandparents' stories or the ongoing conversation with their own unprompted stories (F4, F5, F9, F10). In F5, the grandchild was so excited to hear the grandparents' stories, that they said at the very start of the interview, "*Tell them right now!*" This consistent desire for connection[77] is further evidence that grandchildren are not simply passive or reluctant audience members, but active contributors to the larger space with a significant role to play.

Despite different opinions during the design process, families worked together to reach a balance. Seven families, bridging cultural barriers, collaborated on the layout for their memory board through discussion (F3, F4, F5, F6, F8, F9, F10). In F4, the following exchange shows this type of friendly collaboration:

Grandchild: We can put this here because we are having celebrations with family, together. Like this or like that?

Grandparent: This also looks okay.

Grandchild: I like it like that. Looks like a caption.

In cases of design disagreements, grandparents always deferred to the grandchild's choice. In three families, grandparents asked for task direction from the grandchild (F3, F4, F10). **We see in all our families that grandchildren want to connect with their grandparents and that our storytelling and design activities foster these connections.**

4.2 THEME 2: Design process prompts broader interaction

In addition to the dynamic collaboration and various chosen roles we noted between grandparents and grandchildren as they engaged in design activities, we also observed how the activities prompted friendly conversation that went beyond what was required for the design. Along with the previous theme, we see here that creating the space for cultural exchange will in turn create space for broader social interactions.

4.2.1 Prompted storytelling prompts further two-way communication (Design Process Reflection)

Family storytelling is a known method for fostering intergenerational social engagement [67]. Similarly, starting with the storytelling prompted by our research, grandparents and grandchildren alike expanded on that to have further conversation and storytelling. In seven families (F2, F3, F4, F5, F6, F9, F10) storytelling led to questions and further conversation, which could then prompt further storytelling by other narrators (F3, F10). This shows that most of the required effort is just to get storytelling started, after which conversation and further storytelling continues and builds easily.

Grandparents appreciated the work their grandchildren were doing as part of the design process. In eight families (F1, F2, F3, F4, F5, F6, F9, F10), they bragged to the researchers about their grandchildren, usually about artistic ability, and in four families (F1, F2, F6, F10) said they cherished their grandchildren and being able to be near them.

4.2.2 **Storytelling and design process prompts fun and friendly cross generational interactions despite barriers (Design Process Reflection)**

Across five families, bridging the cultural barrier, the trialogic process prompted a positive, casual interaction which was not directly tied to the activities (F5, F6, F8, F9, F10). For instance, the grandparent from F6 when engaging in drawing for the first time during the session, criticizes their own drawing saying, *"I have drawn your father, but it is not beautiful."* The entire family laughed, and the grandparent's engagement in the process grew as they became comfortable. Improved comfort with the process was also tied to improved comfort between grandchild and grandparent, with storytelling prompting questions and side conversations in seven families (F2, F3, F4, F5, F6, F9, F10).

The process also prompted positive interactions by serving as a process for cultural learning in both directions. The grandparent in F10 asked their grandchild to name a magical cartoon character they liked, to which the grandchild answered, *"The Grinch"* (a popular North American Christmas character). The grandparent asks *"What is Grinch? I do not know that,"* prompting the grandchild to explain, *"He steals presents and his fingers look like a tree."* The grandparent then asks, *"Can you draw that?"*

4.2.3 **In culturally connected families, grandchildren are comfortable socially with grandparents**

Grandchildren in culturally connected families were more at ease socially with their grandparents, including openly pushing back against grandparents' comments (F3, F7, F8, F9). When the grandparent in F8 told their grandchild that they were taking too long on the drawing, the grandchild responded, *"You do it."* They also showed more comfort in directing the process than grandchildren in families with barriers. They told their grandparents which kinds of stories they preferred to hear (F3, F9) and which specific stories they should tell for the study (F1, F3). **This type of social comfort can easily build to cultural exchange and storytelling activities and can be fostered by a digital support tool.** This observation, only seen in culturally connected families, does not imply that this is absolutely a result of only said cultural connection as we have defined it, but does demonstrate a distinct difference between families and in their socialization. In contrast, in families with a cultural barrier, we observed less direct disagreements, though there were still demonstrations of social connection. We discuss the nuanced differences in how these social interactions manifested in the next section, and future work can continue to explore the complex distinctions and similarities using various representations of cultural barriers.

4.2.4 **In families with a cultural barrier, grandchildren still try to actively connect with grandparents**

We see some unique behaviours in the families with cultural barriers. The positive interactions in this group included question asking and increased opportunities for engagement. For example, the grandparent in F5 interrupted a story by the grandchild to ask a question. The hinting activity brought back an old memory for the grandparent, who commented *"I just remembered this scene after writing about it."* The grandchild then asked their grandparent to tell a story because they recognized one element on it (drawing of rain), but not the words (written in Punjabi). Similarly, in two families (F4, F6), the grandparents picked up cards to read over their grandchildren's hints. These earlier activities provided a

space for these families to ask questions, engage, and reach a shared understanding before they moved on to the more intensive design activities. **Despite cultural disconnect, grandchildren in these families tried to connect culturally with their grandparents in a variety of ways**, including engaging with the storytelling activities by asking leading questions (F2, F5) and actively trying to learn their heritage language (F2) and traditional games (F5). Compared to the families in the previous section, these families did not express strong feelings of disagreement or annoyance as explicitly, but rather, found more measured ways to engage with one another.

4.3 THEME 3: Existing language, culture, and social barriers dissuaded story sharing and preservation

The presence of various barriers creates an expected barrier to storytelling. These sub-themes are expressions of these barriers and highlight what may be currently preventing cultural exchange as well as what may limit the effectiveness of a digital tool. These are expected limitations to cultural exchange in these families, and the specific way they are reflected here support the need for designs that intentionally support the needs of these grandparents and grandchildren together.

4.3.1 Existing language barrier is barrier to storytelling and design process

Language barriers provided general limitations to the ability to share stories, unsurprisingly, but even weaker language barriers, for example when grandchildren could understand, but not speak, their heritage language, led to other process barriers. Grandparents in five culturally connected families (F1, F3, F7, F8, F10) openly commented on the language barrier, such as the grandparent in F1, “[grandchild] *doesn't like to speak Punjabi*”. On the other hand, grandparents from four families, bridging the cultural barrier, reported that there was a minimal language barrier between them and their grandchildren (F4, F5, F9, F10). F10 appears in both groups as the two grandchildren had significantly different heritage language fluency.

All families, across language and cultural barriers, showed evidence of clear language barriers. Children often lose their heritage language when they start school, and the language transfer within the home from the heritage language to English is usually initiated by the children [24]. In our research, grandparents are aware of the gap and openly discuss its implications with researchers. Additionally, grandparents and grandchildren from four families (F1, F5, F6, F9) gave differing reports of the grandchild's heritage language ability, with the grandchild always claiming a higher fluency than the grandparent reported, further demonstrating the disconnect across language differences.

In three culturally connected families (F3, F6, F10) grandparents were concerned that they should not use their heritage language for the storytelling or design activities because their grandchildren may not understand. The grandparent in F3 asked before adding to the memory board, “*How about I write it in Urdu? Is that OK?*” In six families, bridging the cultural barrier (F3, F4, F5, F6, F7, F9), grandparents stopped paying attention to the conversation when their grandchild was speaking only in English. When the grandchild in F4 finished telling their story, the translator asked the grandparent if they had understood, to which they replied, “*I didn't listen.*” In four families (F2, F6, F8, F9) also bridging the barriers, grandparents switched to English so that their grandchildren could understand.

4.3.2 External barriers exclude families from cultural exchange and prompt resignation

Along with general pressure to put in the effort to preserve family memories, expressed by grandparents in two families (F1, F2), grandparents in four families (F6, F7, F9, F10) said that physical distance, along with further barriers to visiting like war, limited their ability to share stories. The grandparent in F7 explained that they were actively passing on values to their other grandchildren who lived with them in the Philippines, but *"with [grandchild] I am not because we are not together."* **Our research shows how language and external barriers, along with the effort needed to work around them, can lead to resentment in grandparents, presenting further barriers to motivation.** In six families (F2, F3, F5, F6, F7, F8) grandparents expressed disappointment in the generational loss of heritage language: even though their children do speak it, their grandchildren do not. When asked who in their family spoke Punjabi, the grandparent in F2 said, *"I have 12 grandchildren, none of them."*

Conflict between generations can cause barriers to storytelling as well. In six families (F1, F2, F3, F4, F6, F7) grandchildren forgot stories they had recently been told, even stories told earlier in the interview, and grandparents in two of those families (F1, F2) felt that old stories were not relevant to grandchildren. Of their own grandparents' stories, a grandparent in F1 said *"The stories are related to their past. Long ago. These children have no interest in that."* **Lack of existing family documentation (F3, F10), difficulty remembering stories from long ago (F1, F3, F6, F7, F8, F9), and the pressure to perform stories well (F1, F3) all contribute to lack of motivation to engage with cultural exchange due to the work involved.** A grandparent in F3 said, *"They are more creative than me. I just told the story and I don't know what to do after."* Grandchildren were also aware of the barriers and pressures on them, such as passing on their heritage language to younger siblings (F4, F6, F10) and feeling the need to embellish their cultural knowledge (F1, F3), which can keep them from actively engaging with grandparents. When asked to repeat part of their grandparent's story, the grandchild in F1 vaguely described it as, *"He was like um praising God or something?"*

4.3.3 Evident cultural barrier is present regardless of other cultural connections

Our families were consistently aware of the cultural barriers between generations, even in families with an existing point of cultural connection. The presence of this barrier across all families is not unexpected, as immigrant children almost always have a weaker connection to their heritage culture relative to their parents [16]. Grandparents from six families, bridging the cultural barrier, reported a cultural gap (F3, F4, F5, F6, F7, F8). Grandparents insightfully reflected on this gap, like the grandparent in F3, a culturally connected family, who said, *"Actually this is not only the language difference but also a cultural difference. Because they are more westernized they are born over here, and we are little bit more easternized so some gaps are there in the interaction"*.

4.4 THEME 4: Migration prompts grandparents to create tools, strategies, and resources for fostering social connection that can be leveraged by a digital tool

This theme identifies the techniques families have adopted to preserve cultural connection and foster social connection between grandchildren and grandparents. The creation of these tools, strategies, and resources are often a direct result of migration as older adults attempt to navigate familial relationships in an entirely new context. These techniques which are already employed by families provide, insight into the types of support families are

ready to incorporate into their routines. This provides direction for designs that do not disrupt existing connections while building space for new ones.

4.4.1 Grandparent expresses strong desire, and makes attempts, to engage in routine social activities with grandchild, regardless of cultural barriers

For many of the grandparents, migration had prompted them to develop strategies for developing a social connection with their grandchildren and for preserving culture and language. Seven grandparents (F1, F3, F4, F6, F7, F9, F10) explicitly expressed the high value they placed on family connection, and all families alluded to this importance. The grandparent in F9 explained, "*Family is truly important to me. Of course, I have no one else to rely on but my children.*" Grandparents from six families that spanned cultural connections and barriers expressed a desire to instill religious and cultural values in their grandchildren, showing an existing interest in intergenerational knowledge exchange (F1, F2, F4, F5, F7, F8). A grandparent in F1 said, "*Faith and these types of things will last forever and I want [my grandchildren] to have faith.*"

In a similar vein, grandparents from five families reported sadness and regret at not knowing their own family history, which indicates they generally believe there is value in knowing one's roots, histories, and beliefs (F2, F3, F5, F7, F8). One grandparent from F5 expressed this desire, explaining "*We also wish that they'd tell us about our childhood, what we used to do as a kid, how we used to stay [Punjabi].*" The other grandparent from F5 wistfully commented on lost intergenerational wisdom, saying, "*Our grandfather, he'd have taught us how to live life.*" In six families, bridging the cultural barrier, grandparents had previously shared stories about their own lives which the grandchild remembered (F3, F4, F5, F8, F9, F10). **This suggests that storytelling is a consistent platform for positive interaction that bridges the cultural barrier.**

4.4.2 Grandparent has developed some strategies for teaching grandchild language and cultural reminiscence

Grandparents from five families (F1, F2, F5, F9, F10) actively taught their heritage language and culture to their grandchildren. Collecting language learning resources was one common approach. As there were no formal channels for accessing these resources, families often relied on informal means of gathering language learning material. For example, a grandparent from F5 says "*they had books from school [in India], which they gave to the children.*" Teaching strategies employed by grandparents were often inspired by traditional classroom methods, such as the grandparent from F10 who explained their plan for ensuring their granddaughter could independently learn new Korean vocabulary: "*[grandparent] has a plan to teach [grandchild] how to use a dictionary.*"

The importance of heritage language was seen across families, regardless of the grandchildren's existing connection to heritage culture. Six families (F3, F4, F5, F6, F8, F9) included their heritage language on their memory board, and in seven families (F1, F3, F5, F6, F8, F9, F10) grandchildren switched from English to their heritage language during storytelling activities. **Language ability may be seen as more attainable than cultural connection, and more resources are available to support it**, as seen by five families (F4, F5, F6, F9, F10) who had heritage language books or media in their home specifically for grandchildren.

4.5 THEME 5: Grandparents utilize story sharing as platform for expressing hopes and significant information

This theme explores the ways in which grandparents leveraged the process to share personally meaningful information, such as their hopes for their grandchildren, the importance of preserving language and cultural values, and stories with emotional weight. This role is commonly taken on by grandparents in immigrant families [43, 75] and can facilitate other dimensions of connections, such as fostering heritage language [56]. We observed this passing on of values bridging the cultural barrier, demonstrating the consistency of value sharing as a sub-activity of storytelling and cultural exchange. As gaps in cultural values between grandparents and adult grandchildren in immigrant families have been shown to reduce social connection [69], prompted value expression in this setting may have the potential to sustain intergenerational interactions long-term. This meta-commentary that surrounds and permeates story sharing represents a vital aspect of cultural exchange that designs must include equal to the storytelling itself.

4.5.1 Grandparent motivated by desire for generational culture and language preservation

Grandparents want to preserve culture and language, though what preservation looks like and the motivations for doing so differ between families. Grandparents from eight families reported that they hoped their grandchild would speak their heritage language fluently (F1, F2, F3, F4, F5, F6, F9, F10). However, two families were aware that there was a lack of interest from the grandchild's side (F1, F2). A grandparent from F1 shared *"We have stories from our past but these people [our grandchildren] don't have interest in that"*.

There were a variety of motivations behind language preservation. For some, language was a means of communicating and maintaining ties with their grandchildren, expressed by a grandparent from F1, *"If they will talk to me in Punjabi that will be good but after me they will speak anything. That makes no difference to me."* Others were thinking ahead to when their grandchild reached adulthood, and the additional opportunities of multilingualism were available to them. The grandparent from F10 explained that *"[grandchild] can live in Korea and speaking it well can be a positive trait."* For others, preserving language was a way of preserving cultural knowledge. The grandparent from F6 explains:

"Everyone must know their mother language. There was some time in Afghanistan, it was during the duration of President Najib, when Afghanistan looked like European countries but when Taliban came to Afghanistan, they forced women to wear long blue coverings. I would like to say about that time. I would like them to know more about foods and special fruits like cherries and apricots and specific bread that we had. We can find such fruits here but the taste in Afghanistan is much different from here [Farsi]."

There are a diversity of stories and each type of narrative serves a unique purpose. In a study of Afghan women in Canada, it was important to them to ensure that the struggles they had gone through was not forgotten. This shaped how they told their stories and they employed narrative devices that made visible their pain and situated their experiences against the backdrop of a collective story [19]. The motivations shared by the grandparent from F6's is similar to the motivations of the wounded storytellers from that study, with the grandparent directing their grandchildren to ensure their pain was represented accurately the drawings, *"draw my tears correctly, I cried a lot at that time. Draw something that shows how much I was suffering."*

This desire for intergenerational culture and language preservation extended both forward and backward through generations, with grandparents from five families

reporting that they wished they knew their family history, or that they had access to the life advice and wisdom of their ancestors (F2, F3, F5, F7, F8), as discussed in previous theme. As the grandparent in F3 said, *"I am wishing to know because I know my father's family but I don't know about my mother's family. So I just want to know where they came from."*

4.5.2 Grandparents share stories with personal or shared significance

The stories families chose to share often had personal significance, which grandparents explicitly conveyed. The story may have covered a major life event and was therefore emotionally charged in some way. Narrators also conveyed the personal significance of a story by framing it through important values, often religious, cultural, or moral in nature, seen in nine of our families (all except F8). This value sharing is a key role for immigrant grandparents [43, 75]. The hinting activity and storytelling prompted sharing of cultural values from four families (F1, F3, F7, F10), usually expressed as a moral statement to conclude a story. For example, a grandparent from F1 concluded a parable with, *"This was a miracle for us. If you believe in God, whosoever you believe in, He performs miracles and shows you."* For four families, some of the selected stories had shared significance in that both the grandparent and grandchild were characters in the story (F6, F7, F9, F10).

Grandparents' intentional integration of values and other significant motifs into their stories suggest they are motivated by deeper reason for sharing stories. The grandparents themselves explicitly indicate if and how a story is personally significant. For example, the grandparent from F6 emphasized how much they valued the bag they received as a gift from their own grandfather. The personal significance was made clear by the grandparent explaining that such a gift was an expensive treat that their grandfather thoughtfully purchased and highlighted why this might not be significant to their grandchildren living in Canada, *"Now, you have very beautiful bags and very beautiful things for the school, like the stationery things, but we did not have those things when we went to school."* **This suggests grandparents would find value in curating and categorizing their stories along these values. Since the reasons for sharing vary between families, they require the flexibility to organize their stories in a way that is uniquely meaningful to them.**

4.5.3 Grandparents express hopes for grandchildren

Grandparents openly expressed hopes and expectations for their grandchildren, a common role for grandparents in immigrant families [43, 75], motivated directly by their own life experiences and a strong desire for intergenerational improvement. In some cases, these hopes manifested as a desire to maintain family traditions while in others there was motivation to open up opportunities for their grandchildren that the grandparents did not have. Grandparents from five families explicitly stated a desire for their grandchildren to have a better life than they and their ancestors had (F2, F5, F7, F9, F10). This included learning new life skills, such as the grandparent from F5 who described their desire for their grandchildren to learn to swim saying, *"The weakness the parents have they don't want that weakness in their children."* For others (F7, F9) it was important that grandchildren know the hardships grandparents faced in their heritage countries, in the hopes it would foster appreciation for the comparatively easy life the grandchildren have in Canada. The grandparent from F10 explained that their family migrated to give their grandchildren a fun and carefree childhood, saying *"You can play as you like. If you live in Seoul you have to study all day until 10pm"*. Grandchildren were aware of this expectation of gratitude, with a grandchild from F9

commenting, “The title of [grandparent]’s stories should be ‘How difficult life is in the Philippines.’”

Some of these expectations are driven by intergenerational legacies, stories, frustrations, and hopes, which may place pressure on grandchildren. For example, grandparents from two families (F2, F8) shared education and career expectations for their grandchildren. A grandparent from F2 strongly wished for their grandchild to pursue medicine, joking that “we already call [them] Dr. [grandchild].”

4.6 THEME 6: Family takes ownership of the design process through personalization of activities

Families found various ways to make the design process their own and adapt it to their preferences. Grandchildren and grandparents built on prompted storytelling and design activities to share further stories and cultural knowledge. These unprompted interactions show that the cultural exchange process is personal and specific interactions may vary from family to family, but also that the storytelling and passing on of values is consistent. This shows that designing for such personalization, especially by avoiding assumptions of how a story “should” be structured, is essential.

4.6.1 Family incorporates gamification into design (Design Process Reflection)

Throughout the process and especially in the hinting activities, families incorporated game-like elements to engage their audience. In six families (F3, F4, F5, F6, F9, F10), hints were designed to draw in the audience by building suspense or getting them to ask questions. The grandchild in F10 introduced one of their hints saying, “It’s the first day of school. What did the teacher say to everyone?”, and the grandchildren in F6 and F10 placed hints face down to turn selection of stories into a game (figure 5). Story illustrations in five families (F3, F5, F6, F7, F10) included elements designed to get people to ask more in order to hear the story, including small drawings that hint at a larger story.



Figure 5: Placing hints face down to turn the hint selection process into a game

4.6.2 Family takes advantage of design process to share culture and cultural values unprompted (Design Process Reflection)

Seven families (F1, F3, F4, F5, F6, F7, F10) incorporated cultural clues into their hints and story illustrations (figure 6), including culturally distinct objects, like a specialized stew pot,

and symbols that clarify a drawing, as a grandparent in F1 suggested, “you can also hoist an [Indian] flag on this so it's easy to tell that it's a gurdwara [Sikh temple].”

In six families (F1, F3, F5, F6, F9, F10), grandparents chose to share stories to

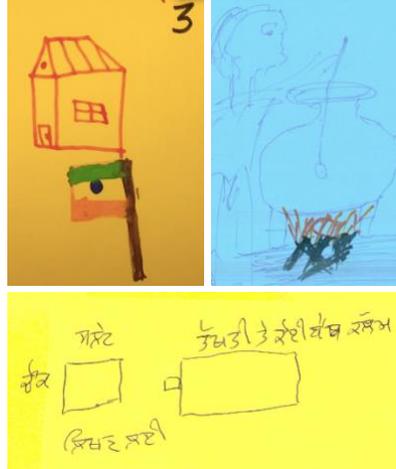


Fig. 6. Examples of illustrated cultural clues

communicate religious and/or cultural knowledge and values, like the grandparent in F10 who shared about a special school bag that their grandparent had bought for them. **Cultural exchange down to the small relevant details was quickly prompted by the sense making and design activities, suggesting that a similar effect would be seen in a functional version of their designs.**

4.6.3 Prompted activities lead family to share more unprompted storytelling (Design Process Reflection)

Grandparents in five families (F1, F2, F4, F5, F6) kept sharing stories beyond the initial prompts, as did grandchildren in four families (F4, F5, F9, F10). Even when instructions, during the hinting exercise, were to wait until everyone was done to tell stories, grandparents in three families (F4, F5, F9) shared their full stories anyway. **We see here how families want to engage in storytelling and will start to do so very quickly and comfortably, when given the space, such as a targeted digital tool.**

Grandchild: “Airplane!!! I love going on airplanes”.

Grandparent: “I feel nervous. Because it was my first time boarding an airplane. Especially when it takes off... Oh my, Lord!”

[Interruption by Grandchild]

Grandchild: “What did you eat there? What specifically?”

[Conversation breaks off to another topic for several minutes before coming back to the story]

Grandchild: “No, you turned pale”

Grandparent: “No!”

[Grandchild translates story for researcher]

Grandparent: “My interpreter is so good!”

Grandchild: “I was going to ask [grandparent] what [they] ate but then [they] forgot.”

Grandparent: “There was chicken curry.”

Grandchild: “The best food I ate on the airplane was udon. But it tasted like plastic. My favourite food that I had was the chicken, the beef and the haagen daaz.”

5 FINDINGS AND KEY TAKEAWAYS

The analysis of the data collected from engaging with our participants revealed several themes and subthemes, which we discussed in the previous section. We present here a synthesis of the key takeaways emerging from this analysis, which we hope to provide designers with insights about the intergenerational dynamics within immigrant families where grandchildren may be acculturated to an environment different than that of their grandparents. Following the structure of the themes from our analysis, we reflect on these takeaways from the perspective of prior knowledge about this or similar relevant spaces. Table 3, presented at the end of this section, summarizes each finding, its grounding in existing literature, and how our study extends what we currently know about the space. In the next section we discuss how these insights can provide guidance for the design of applications supporting intergenerational cultural exchange within immigrant families.

5.1 A shared space helps equalize grandparents' and grandchildren's voices in storytelling

Theme 1 from our analysis illustrated how the trialogic process revealed the dynamics of collaboration, disagreement, and negotiation within immigrant families. By creating a shared third space, the power imbalance that exists in a purely dialogic (i.e., conversational) exchange between a grandparent and grandchild was reduced. In intergenerational PD, children are more engaged in the creation process through “play” activities, such as drawing, while older adults are less likely to participate [85]. However, in our study, many grandparents engaged with their grandchildren throughout the design activities, likely due to the shared motivation of cultural exchange along with the space created for that by the trialogic process. This finding is particularly important as it provides ways to mitigate social barriers caused by digital applications, which as suggested by prior work [25], can often arise in contexts similar to that of our research. Our process supports more at-ease socialization between generations, expanding on similar themes seen in past research, such as real-time negotiation between generations during a Magic Thing probe [77]. Grandchildren were more confident artists, which gave them the opportunity to take on a leading role while grandparents maintained their leading role as family historian. By taking on this leadership role without prompting, grandchildren are actively finding a place in the sensemaking and cultural exchange process. Children often develop novel ideas through PD, and this process can empower them to take ownership over the technology they create, especially in creative settings including music [3]. The grandchildren in our study took this sense of empowerment a step further by taking on a leadership role with their grandparents, flipping the dynamics generally seen in the grandparent-grandchild relationship. Both parties made attempts to engage with each other and took on supporting roles as needed.

These disagreements and negotiations were triggered by differing visions for family stories and how they relate to each other. The stories of immigrant families have a “master narrative”, which is used to form a collective identity [29]. In addition to the shared story, individuals develop their own version of the story [29]. For children and adolescents, these personal narratives can be heavily influenced by the acculturation process and their own lived experiences [72]. Preserving both the individual and master narratives, as we observed in our study, is important for fostering immigrant children's personal identities within their

larger cultural context. From this, along with the other sub-themes within this theme, we see that the process is not solely owned by the grandparent or story narrator but is a communal and collaborative process with different parties taking on different parts of the work. Our analysis of these interactions suggests that a tool that provides a shared space where families can take on fluid roles has potential to foster meaningful social interactions. In the bridging sub-theme (consisting of both families with a cultural connection and with a cultural barrier), we see a consistent effort by grandchildren to engage with the older generation. In this way, cultural exchange is a two-way street managed by both grandparents and grandchildren, further demonstrating the importance of a trialogic process to create a space that gives all parties a meaningful part to play. As illustrated by the next finding, this introduction of a trialogic process prompts further positive, intergenerational interactions.

5.2 Shared activities are a catalyst for positive intergenerational interaction

In our study, we encouraged families to work together on the design activities. However, grandparents and grandchildren went beyond what was prompted by the researchers, and the trialogic process, in their conversations and collaborations. Theme 2 from our analysis highlights how the prompted activity acted as a springboard for broader, positive intergenerational interactions. Past co-design work around family genealogies has found that when children are designing to interact with their family histories they can develop a more general interest in the relevant historical period [12]. Here we see that when this interaction is directly from the grandparent, this develops further interest in their specific stories, creating a stronger social connection. Grandchild actively engaged with their grandparent's stories, which complements known dynamics between young adults and their grandparents, in which grandchildren seek out listening to and preserving stories from their grandparents [41]. Within this young age range, immigrant children actively shape their attitudes towards their own cultural heritage and form their emerging, multiple identities [14]. They do this both by seeking out information and through their lived experiences. The socialization patterns they are exposed to at this age are crucial for how they understand their place and role within their family and cultural space [14]. Our young participants' eagerness to engage with their grandparents' stories is promising and suggests opportunities for creating a shared space where families can explore their sense of self together.

Engagement across family members is a common motivation to employ PD in collaborative family settings [5], and here we see similar effects for both grandchild and grandparent participants. Through this exchange, the grandparent's encouragement of the grandchild's interest led to a cultural learning moment. Drawing served as a crucial step in bridging the cultural knowledge gap between the two generations. This is in contrast to studies with older immigrant children (teenager and young adult) and their parents. These older children report selectively filtering conversation topics with their parents to avoid disagreement and conflict [2]. This theme demonstrates younger children's willingness to engage with their grandparents, even on topics of cultural difference, as well as their desire to connect despite evident cultural disconnects, and hints at how that connection could be encouraged.

Additionally, we see that families appreciate the interactions and commentary surrounding the actual design activities. There is likely value in capturing and preserving this meta-commentary that emerges as a result of the process itself. This finding related to the

role of meta-commentary that goes along with the stories is novel, and enhances prior works which have explored various avenues of digital social storytelling across generations (e.g., [33]). The analysis we conducted under this Theme 2 also suggests that even a small nudge can be a powerful catalyst for social interaction. Though families face language and culture barriers, providing them with a shared starting point for discussion helps to mitigate these barriers and to empower families to socialize on their own terms. This finding enriches prior work that show how providing a common platform allows immigrants to reclaim digital space that enables them to define their own acculturation processes [76].

5.3 Language and culture gaps have weakened families' social connections over time, prompting resignation

Our analysis under Theme 3 showed how different barriers are limiting the potential for cultural exchange between grandparents and grandchildren, yet connection through heritage language is important to them, regardless of the strength of the cultural barrier. In particular, barriers related to language and culture gaps are more strongly experienced by grandparents, leading to resignation. These barriers are known to limit intergenerational socialization [51] and are similar to limited interactions between skipped generations in non-immigrant families seen in other PD studies [85]. All families had some degree of a language barrier. This is not surprising as generational heritage language loss is a well-known consequence of immigration [24]. Immigrant families must contend with these barriers along with the existing deterrents to storytelling. The time, effort, and motivation required of storytelling, particularly through existing digital options, are well-documented deterrents to the process [46, 80].

Past works have sought to strengthen the social connection across these generations when the main barrier is distance [26]. Our findings under this theme expand such prior work, by highlighting the role of cultural and language barriers play in the grandparent-grandchild dynamic. Parents play a critical role in bridging language gaps between children and grandparents, and are more likely to act as translators between the children and grandparents [53]. Thus, excluding parents from our study made clear the communication challenges faced by the skipped generations. Lack of a shared language can lead to social disconnect between the generations (a source of significant pain for grandparents) [44], and can reduce the extent to which grandchildren identify with their heritage culture (prompting grandparents' disappointment at the generational language loss) [51]. Additionally, lack of bilingualism has been shown to lead to heightened family conflict, and reduced psycho-social adjustment among immigrant youth [62]. In our study, these external barriers to grandparents prevent further engagement with their grandchildren, and the additional resentment from trying to mitigate barriers only presents further barriers.

All families expressed some degree of a cultural barrier. One explanation for this consistent expression of cultural barrier may be that cultural divides exist between generations regardless of connection or barriers, due to differences in how quickly each generation adjusts to a new culture, which leads to the acculturation gap in families [72]. However, while grandparents in culturally connected families explicitly shared culturally important information with their grandchildren, this direct sharing was not seen in families with cultural barriers, suggesting there may be hesitation to openly share cultural values when the shared foundation is missing. This hesitation to share in immigrant families can

stem from intergenerational differences in cultural values, which pose a significant barrier to meaningful communication and can trigger conflict [71]. Our study reveals how this reluctance is already emerging in immigrant families with young children.

Grandchildren and grandparents both need to feel welcome in the cultural exchange process in order to maintain motivation and engagement. Support for technology-mediated cultural exchange must ease these barriers to create spaces in which both grandchild and grandparent are able to contribute. However, these barriers are not always limitations. Regular communication with grandparents can help maintain children's heritage language literacy [57], and as indicated in the next section, families have leveraged their gaps to create opportunities for language and cultural connections. Language barriers between generations may limit ability to share detailed stories, but as seen in the other themes, the desire to connect is consistent, and meaningful cultural exchange can still be shared across the language barriers.

5.4 Families are active in seeking creative ways to mitigate language and culture gaps

As shown in Theme 4 of our analysis, despite the limiting effects of barriers and the resentment associated with these, immigrant families (grandparents in particular) actively work to combat these gaps and even leverage them to create a space for language and culture learning. Grandparents who grow up in a different culture than their grandchildren express a strong desire to pass down knowledge of their heritage, but feel that social challenges limit their ability to achieve this in digital settings [25]. Additionally, regret for family history lost or forgotten represents a significant motivation on current grandparents to actively share their histories [50], and can be exacerbated by the physical move of immigration which often necessitates leaving behind family artifacts like pictures. With just the light mitigation afforded by our prompted storytelling and design activities, all families engaged in cultural exchange despite these barriers. This finding contrasts prior work which highlights how immigrant parents' motivation to overcome barriers are largely for supporting their children's educational success [84]. Instead, in our study grandparents had different motivations that are less pragmatic than formal education (heritage preservation), for which we identified specific barriers and mechanisms to overcome them. In intergenerational immigrant families, grandparents often assume responsibility for teaching language and culture to the younger generation, though they struggle to make the learning process engaging for them [75]. Similarly, we see some of the grandparents in our study strongly identify with the role of educator and employ a variety of teaching methods, providing insights into the types of tools and resources grandparents would value. The investment grandparents have placed into teaching language suggests that connection through heritage language can be a starting point for further social and cultural connections between grandparents and grandchildren. In contrast, culture, which is less tangible as a body of knowledge compared to language, is challenging to formally teach [60]. These families' continued effort to connect is a key aspect of immigrant families' experiences with cultural exchange. This could be amplified by a digital tool by building on these existing vectors for intergenerational connection, springboarded by language sharing, to foster further and deeper cultural exchange.

5.5 Families leverage storytelling to share values in an engaging manner

The expression of values, hopes, and expectations seen across this theme are essential to the cultural exchange activities in immigrant families. In our studies they arose naturally from all families without prompting by the researcher, and to our knowledge have not been seen in previous digital storytelling works with non-immigrant families. This is both an important motivation to engage in these activities as a medium for passing on values, and a means of understanding family stories, based on the values they communicate. The explicit calling out of these values during and after storytelling, as a type of meta-commentary, shows the grandparents' conscious intention behind their choice of stories and suggests they would value a platform that supported them in curating and sharing this information. Prior research showed that activity that motivates all family members and that has shared meaning (such as songs) can strengthen the social and family bonds [74], yet various barriers can lead to breakdowns in how such bonds or communications are facilitated across generations [25].

For adult second generation immigrants, family career and education pressures are a significant source of relationship stress, arising from communication challenges due to cultural barriers [71]. However, in our study, we did not observe pushback from the children when grandparents shared these expectations. This may be because the children in our study were young or because grandparents' comments on this topic were directed at the researcher. Designing for younger children and their grandparents together presents a unique opportunity to create a space encouraging healthy sharing and negotiation of potentially conflicting goals held by the two generations, as previous works have explored in non-immigrant families [26]. As observed in the theme, story sharing is a way to convey personally significant information in a fun, easy to understand way, suggesting that storytelling can potentially be leveraged to foster communication between young children and their families before conflicts arise later in life. Through the research presented in this paper, we illustrate how storytelling can act as a motivational activity that overcomes the barriers of cross-generational communication and bonding. In our study, the key findings of Theme 5 show that value expression is a significant dimension of immigrant families' cultural exchange that can be encouraged and leveraged in a digital setting as both motivation and organization.

5.6 When given flexibility, families take ownership of the design process

In past works, participatory design has been useful in providing agency to families, particularly parents [5]. Our participant families similarly took ownership of their cultural exchange, but also of the design activities in ways that were personally meaningful to them, whether this was through sharing of values, culture, or additional stories. This prompting effect leading from storytelling to more storytelling, is common in family narrative settings [55]. Magic Thing probes have seen how grandparents and grandchildren negotiate and create rules in real-time [77]. Here, we seen families also modified the activities themselves to be more engaging for them. These findings emerging in Theme 6 of our analysis highlight the diversity of ways in which families leveraged the design activities to share, collaborate, and have fun with each other. This emphasis on interactivity and fun were brought into the process independent of the researchers, showing how families adapt the presented process to foster engagement across generations. This further shows recognition that this is a pleasant activity to do together, rather than just a duty, similar to previous works connecting

grandparents and grandchildren through video games [15]. Though the ways in which they personalized the activities differed, that desire to exchange knowledge, particularly from grandparent to grandchild, and the initiative displayed by families, was consistent.

6 DISCUSSION AND IMPLICATIONS FOR DESIGN AND PROCESS

In this section, we discuss three dimensions of contributions emerging from our thematic analysis, based in the six themes and resulting findings detailed in the previous section and summarized in Table 3. This includes a process reflection on how the trialogic process creates a shared space that helps balance out the roles of grandchildren and grandparents in immigrant families. System design implications include the importance of distinctly preserving stories and their meta-commentary (especially values) resulting from cultural exchange, and how the unique language and culture barriers faced by immigrant families can be used as a springboard for positive social interactions.

6.1 The trialogic process: Design shared spaces as springboards for collaboration

The initial ideation phase, in which a storyteller must think of a memory they want to share, can be challenging. We found that families needed the nudge from the prompted hinting activity, creating the trialogic process. The resulting collection of their story ideas guided them over that initial hurdle, prompting them to engage in active, two-way story exchange, seen in theme 1. This prompted starting point for storytelling allowed families that otherwise had difficulty sharing stories due to culture or language barriers to lessen their effects and share stories regardless, as seen in themes 3 and 4.

Designers should consider how to support families to **leverage the trialogic process to overcome the initial hurdle of motivation and effort**. The process does not need to begin directly with storytelling, which requires identifying a story to share, whether there is a value to be communicated within it, and how to begin to tell the story. Instead, families can be encouraged to create and use hints as the prompt for storytelling, thereby starting the trialogic process. While some available tools use question prompts for storytelling [39], we find that prompts can be better used for hint creation, which we found to be a critical step in fostering exchange.

Table 3. Summary of the themes, related literature, and novel implications that extend what is currently known about the space.

| Finding | Grounding in Existing Research | Novel Implications |
|---|--|--|
| [1] A shared space helps equalize grandparents' and grandchildren's voices in storytelling | In intergenerational PD, common barriers include grandparents avoiding drawing and children disengaged with discussions [85]. | Through our layered process (hint creation, into storytelling, into designing), grandparents engage directly in the creative process and grandchildren take on leadership roles such as directing the memory board creation. |
| [2] Shared activities are a catalyst for positive intergenerational interaction | Families find initiating conversation challenging in the face of intergenerational language and cultural barriers [2]. | Participants' expressed interpersonal barriers disappear through the process, prompting dynamic conversation and collaboration, and suggesting that a digital support could lessen barriers to allow for stronger social connection. |
| [3] Language and culture gaps have weakened families' social connections over time, prompting resignation | Barriers to culture preservation are a major struggle in immigrant families [51]. Digital tools to mitigate barriers to language acquisition have been explored, as well as generational barriers, but not for cultural barriers [46, 80]. | We observe distinct one-directional external barriers to both grandparents and grandchildren's engagement. There is also a resentment or disengagement from both parties, in which both are waiting for the other to initiate the exchange. |
| [4] Families are active in seeking creative ways to mitigate language and culture gaps | In other contexts, existing reminiscence practices are used to propose new digital interactions often through sharing pictures [81]. | Grandparents' intentional inclusion of language and cultural values reveal strategies specific to our cross-cultural lens. Designs can build on existing language and value exchange activities to prompt broader cultural exchange. |
| [5] Families leverage storytelling to share values in an engaging manner | Various applications of digital storytelling have seen a snowballing effect during prompted social storytelling, in which both narrators and listeners contribute additional stories [55]. | This snowball effect was also observed in our research, even when cultural or language barriers might be expected to limit it. This on-going process of shared story preservation mitigates generational and cultural barriers, and fosters communication. |
| [6] When given flexibility, families take ownership of the design process | Well-designed PD activities can ease perceived barriers to engaging in creative processes [77]. | The PD process allowed families to create a space that matched their expectations for cultural exchange, and through that, encouraged further social engagement between grandparent and grandchild. |

This can take advantage of the broad variety of formats (e.g., drawings or text in heritage language) to create meaningful hint objects that match a family's needs (e.g., lack of a shared language). In our study, the hinting activity helped families first to choose which stories to tell and then built on that to make space for them to individualize their process and build ownership of their hint and resulting story, seen in theme 6. Family-created hints, rather than pre-existing question prompts, create that space for family ownership of both the hint/prompt and the resulting story or stories.

We also observed that, once the initial stories were prompted by our hinting activity, new stories were prompted by the hint cards both while they were being made and later during the design activity, seen in themes 1 and 5. This suggests that stories themselves can become the hints needed to prompt further storytelling, as is common in family narrative practices [55]. These origins and connections between stories are significant to families, and should be preserved as part of a collection of artifacts resulting from cultural exchange.

Theme 1 also shows that everyone is an active part of the cultural exchange process, and that everyone can find their own role or roles within that, beyond the expected narrator/audience roles. Grandparents were, as expected, story narrators, but also curators of stories generally, including guiding what should be included in illustrations. With parent-child dyads in shared technological spaces, parents are reluctant to take the lead, though they are happy to play a supportive role to their children. We observed a similar dynamic with the grandparents in our study [66]. Grandchildren tended to take more of a designer role, driving the interaction with and organization of stories after the stories had been told. However, these roles overlapped, and we often saw grandchildren telling stories and grandparents drawing designs, especially once the other party had offered an example to be followed. Children readily took on a variety of roles, as they do when the space for such independence is made available to them [20]. We suggest fostering the dialogic process in the design of storytelling tools by **designing for grandparents and grandchildren both as active participants and flexible in the roles they can take on**, guiding them to build on the expected roles in order to encourage all parties to learn from each other and experiment with all parts of the process.

With regard to the design process, we reflect on how the dialogic process, fostered by our Magic Thing procedure, created the much needed space for immigrant grandchildren and grandparents to connect socially around cultural exchange, allowing them to express their desire for continued connection. The Magic Thing, with its emphasis on unrestricted creativity, empowered grandchildren to take on a leadership role with an activity in which grandparents felt less comfortable. Constructing a design space that offers opportunities for individuals of diverse backgrounds to alternatively lead and support can foster collaborative creation. This emerging process must be incorporated into a digital setting, in both the design process and in the resulting tools, to support these needs for immigrant families in a meaningful and collaborative way.

6.2 Meta-commentary as valuable story output

A consistent trend in grandparents' chosen stories to share was the passing on of significant cultural, religious, and personal values to younger family. Grandparents may take a brief pause from the story to discuss the value or incorporate it as a concluding summary to the story, making it a form of meta-commentary, as seen in theme 5. This finding, though known to be a significant role of immigrant grandparents' storytelling [43, 75], is not reflected

in the designs of existing family reminiscence tools. Passing on values acts as both a prompt and motivation for storytelling and a conclusion of that storytelling. We suggest **designing for the meta-commentary of value expression as both a significant motivation for and output from storytelling**. To capture the nature of this sharing, we suggest recognizing meta-commentary as a distinct aspect of story preservation during cultural exchange. This include options for “layering” or adding annotations on top of stories to reflect the evolving, self-reflective nature of family stories. Enabling the specific capture of comments from the grandparent that explain why a certain visual element is relevant to their families’ religion/culture (e.g. grandparent closely checking that grandchild draws the temple “correctly”) may help with creating connections across generations through shared values that are important to the grandparent. In this way, grandparents and grandchildren can find support for developing shared values, a significant indicator of later social connection [69] and begin to preserve these values more formally for future generations.

6.3 Leverage gaps from barriers as springboards for conversation

As seen in themes 3 and 4 above, and in previous works (e.g., [75]), there are many barriers to the cultural exchange process that affect immigrant families in particular. The language and cultural barriers are consistently present, our families are conscious of them, and they are taking active steps to try and mitigate them. Beyond that there are additional external barriers that limit both grandparents’ and grandchildren’s ability to engage in these collaborative activities. However, we also see families connecting through cultural exchange and storytelling during our studies, regardless of these barriers or gaps, thanks to the trialogic process which supports the generations to work together towards a common, achievable goal. Prior work has shown that even simple artefacts can facilitate families overcoming barriers to shared storytelling. We also see that families are working with the gaps to create opportunities for social connection, such as using activities that teach heritage language to foster further interest in cultural differences [33]. We suggest designers **identify culture and language gaps, as well as families’ existing workarounds, and leverage these differences as opportunities for discussion and exploration in the design of storytelling tools**. Storytelling can provide a safe space for families to explore their differences [2] and prompting reflection of experiences can encourage social-emotional reflection in children [70].

The presence of these barriers, and families’ awareness of them, creates a unique need for tools that support families through these barriers, knowing there is no easy fix for them. Language and cultural differences require designs that do not expect particular language abilities or recognition of cultural references. Other barriers limiting grandchild and grandparent interactions need to be eased by reducing the pressures on both sides. For instance, one of the grandparents in this study easily communicated a story about a leather bag to their grandchildren in their heritage language. However, they struggled with explaining the significance of the bag as a luxury item to children who had grown up with greater financial privilege. Examples of designs addressing these barriers could include encouraging families to work together to make sense of unfamiliar words and phrases or prompting families to find common ground between aspects of their heritage culture and present culture. In this case, the grandparent grounded their narrative around how the leather bag reflected the deep bond between themselves and the gift-giver to contextualize

the significance for the grandchildren. Existing strategies that families are already leveraging to create opportunities for learning within their experienced barriers can be incorporated into digital setting or extended for further possibilities for growing social connections.

7 LIMITATIONS AND FUTURE WORK

The families included in our research are largely of South Asian heritage, and, though we did not identify differences due to cultural background at the level of our analysis, future work should work to include a larger sample of different backgrounds to confirm this. Additionally, future work can repeat a similar process with non-immigrant families to better understand the potential for a triologic process on their interactions. The presence of an interpreter also affected families' experience with the language barrier, as even families without a common language could communicate for the duration of the study. Further research should directly investigate the language barrier, with and without these supports, to understand how to mitigate its effect on cultural exchange activities.

Our future work will use our understanding of the triologic process between grandparents and grandchildren in immigrant families to complete our analysis of the Magic Thing designs created by these families, leading to design recommendations which we will assess with immigrant families. Finally, the role of Magic Thing as a trigger for triologic processes and as a method to expose the potential social interactions and processes resulting from that needs to be further investigated in a variety of settings. This is a large area for future research that will ideally expand the potential and applications of Magic Thing studies.

8 CONCLUSION

For grandparents and grandchildren in immigrant families, culture and language barriers add complexity to the story sharing and sensemaking process. Without intentional effort, younger generations are at risk of losing their family's stories, parables, values, and cultural history. In this study we explored how families collaborate to exchange stories, knowledge, culture, and language. We ran PD sessions with grandparents and grandchildren, who worked together to envision tools for sharing and preserving their shared collection of family stories. We drew out six themes from our thematic analysis and propose three novel contributions that extend our understanding of intergenerational immigrant family story sharing and cultural exchange. First, the triologic process democratized collaboration around storytelling. By bringing a shared space (i.e., the posterboard) to the forefront, families discussed, disagreed, and negotiated to jointly construct their artifact. Through this collaboration, exchange of cultural knowledge and other positive social interactions naturally emerged in ways they would not in have a traditional conversation. Second, the knowledge or values that were exchanged was often included as meta-commentary to the stories themselves, suggesting a need for distinguishing between these two categories of information. This meta-commentary perhaps serves an important role in maintaining grandparents' roles as family historian and transmitter of cultural knowledge. Finally, families face language and culture barriers which limit the ways in which they interact with each other. However, we propose these barriers can be leveraged to springboard discussion of cultural and language differences between generations. By extending our understanding of the grandparent-

grandchild story sharing and collaboration process, we provide direction for how technology-mediated support can foster positive social interactions in immigrant families.

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