



Figure 1: The Grandtotem.

<i>Term</i>	<i>Definition</i>
Acculturative stress	The distinctive type of stress associated with individuals' cross-cultural encounters [9]
Transition	Changes in grandchild/parent lives that require continuous adaptation and development both individually and relationally [4]

Table 1: Definitions of key terms in literature related to international students.

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Grandtotem: Supporting International and Inter-generational Relationships

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ABSTRACT

The grandchild-grandparent relationship faces unique challenges among international students. We developed the Grandtotem, which functions as a focal point for family ritual, a photo frame, and a relationship media album. Research with international student grandchildren helped to identify three dimensions along which their relationships with grandparents must adapt: (1) technology, (2) physical barriers, and (3) changing roles. Initial design feedback suggests that the Grandtotem is a promising tool for strengthening the social fabric during a difficult time of cultural transition.

KEYWORDS

adult grandchildren; grandparents; international students; intergenerational communication.

INTRODUCTION

The relationship between grandparents and their adult grandchildren is a unique bond with the potential to enrich the lives of all parties. However, an increasing number of students are choosing to study abroad, which introduces challenges in the maintenance of those relationships as students undergo an often-stressful transition. We treat these challenges as opportunities to reduce acculturative stress (see Table 1) by fostering the relationship between students and their grandparents. We present the Grandtotem, a system designed to enable stronger connections across continents and generations.

International students in colleges and universities struggle to stay in touch with their grandparents in their home countries [6]. While the younger generation often maintains social connections using lightweight methods like text and social media, [5] many older adults find these technologies difficult to use, or feel that they lack the capacity to support meaningful relationships [6]. But, successfully maintaining communication can benefit both generations. For students who are managing their stress, experiencing feelings of detachment, and adjusting to a new culture, a relationship with their grandparents can increase the feeling of being nurtured, even at a distance [8]. This relationship also addresses older family members' feelings of loneliness and isolation during aging [5]. Constant and continuous communications allow international students and their grandparents to develop their relationship to fit their changing needs [4] and to tighten the social ties between generations.

<i>Id</i>	<i>Gender</i>	<i>Status</i>
P1	F	UG
P2	M	G
P3	F	G
P4	F	G
P5	M	G
P6	F	UG
P7	F	GP

Table 2: Participants recruited for formative interviews. Status is undergraduate (UG), graduate (G), or grandparent (GP). All but P6 and P7 were enrolled at the University of Minnesota.

RELATED LITERATURE

The HCI community has investigated many technological solutions to address challenges in communication between generations, for example through the use of household objects to visualize family members' status and to provide a sense of connection [7]. For grandparents and grandchildren specifically, research has focused on young children and cast grandparents as playmates, often by engaging children with shared activities during video chat [3]. We focus on adult grandchildren and design for the changing role of both grandchild and grandparent during the grandchild's transition to study abroad. Further, common planning techniques for long-distance communication may be ineffective for college-age students who lack a consistent routine [1]. Therefore, we focus on facilitating asynchronous communication.

FORMATIVE METHODS

Cooperative inquiry

We adapt cooperative inquiry [2] to the context of adult international students and their grandparent relationships. We conducted semi-structured interviews with six international student participants and one grandparent (Table 2), and then recruited these students as co-researchers to brainstorm with their grandparents *in situ* in order to identify opportunities for designs supporting those relationships.

With the grandchildren, we conducted two design activities to further understand their challenges when communicating. The first was a mapping activity—shown in Figure 2—in which grandchildren position their family members according to their importance to the grandchild and identify the role different technologies play in maintaining these connections. The second was a brainstorming activity to identify potential ideas to address communication challenges.

Grandchildren contacted their grandparents to perform a similar interview and activity. To preserve their typical communication context, we had grandchildren run these sessions themselves; they were given a design packet and walked through the protocol, making changes appropriate for their relationship with the grandparent and their usual communication platform. We conducted debrief sessions with the grandchildren to collect and interpret their activity notes and asked clarifying questions about grandparents' communication activities.

Qualitative analysis

We open coded data (Figure 3) from seven interview transcripts, design artifacts, and the results of collaborative design sessions and debriefs. We used an affinity mapping process to identify clusters of related codes. After several iterations, we identified three primary themes describing challenges faced by grandparents and grandchildren that informed our future design.

IMPLICATIONS FOR DESIGN

Adapting to technology

The design should have the capacity to support the older generation's adoption of new communication technologies. Participant pairs where the grandparent had invested in learning to adapt to new methods of communication showed increased communication frequency and an engaged connection.

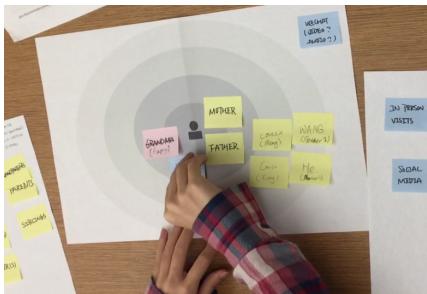


Figure 2: Grandchildren mapped out the family members they communicate with and the technology they use.



Figure 3: Finished maps were coded for analysis of communication patterns.

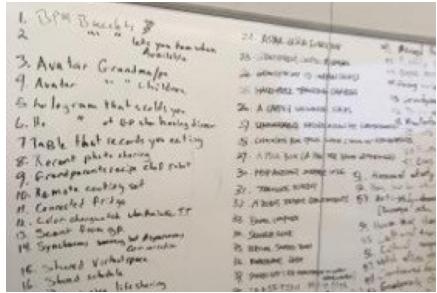


Figure 4: We used the IDEO brainstorming process to produce over 100 ideas and then refined them by how they aligned with our design implications.

[Grandma] has been using (instant messaging) for the past year a lot more. So that makes it easier to just write someone quickly... she's more on my mind because the frequency of contact is higher" (P6).

This adaptation is a collaborative process that involves the whole family. "We ... already successfully taught her how to use WeChat (messaging app), which is our main method of communication. ... But it [the teaching process] takes a while, it takes some iteration. ... my uncle's son taught something about WeChat and she forgot. And my other aunt's daughter taught her again, and she forgot again, and my mother taught her again and she forgot. And after several times she finally got it" (P3). The design should be accessible to grandparents and prompt mutual investment in learning and using the technology.

Adapting to changing roles (for both generations)

Changes in a student's life create barriers for maintaining their connections with grandparents. "I don't have the habit of calling my grandparents, I used to visit them, but now I'm unable to ... [the lack of communication] just kind of happened. So, I got used to it. ... I just kind of feel that this is a different stage in my life, so some changes that happened" (P5). The role of the grandparent within the relationship shifts during the grandchild's transition as well, particularly as both are not present to enact certain family rituals. The design should enable grandchildren to maintain a connection with their grandparents as roles and responsibilities shift.

Adapting to physical barriers

Physical and temporal separation was highly salient for all participants. "I think a year ago [it] kinda started to be more common where I just sent her voice messages through WhatsApp. I think it's more flexible because of the time differences. ... if I make a phone call I have to arrange a time and everything" (P2). The design should help grandparents and grandchildren manage the complications caused by these barriers.

IDEA GENERATION AND SELECTION

Figure 4 demonstrates the idea generation process we used. Three of our favored solutions were: (1) Paired bracelets that signal each other when both parties are available for a call or video chat, (2) a hologram simulacrum-grandchild that translates synchronous conversation into asynchronous messages and videos, and (3) a "digital photo frame" that supports asynchronous and synchronous communication methods, specifically in the context of family rituals, such as gathering for dinner, with an emphasis on the representation of the other side during communication. Combining the strengths of these ideas resulted in a solution blending their features to design a household object for *communication* and *representation*. The device should have a representational purpose—of the grandchild and the grandparent-grandchild relationship—in the home of a grandparent, even acting as a physical surrogate for the grandchild during special events. The device should also enable

communication for both grandparent and grandchild in the manner favored by both, thus easing their adaptation to technology and reducing the strain caused by the physical separation. The proposed design also incorporates some of the physical immediacy of the bracelet by allowing low-pressure communication nudges, aiding both parties in adapting to their changing roles by providing a lightweight means of maintaining a connection.



Figure 5: The Grandtotem features two 7" touch screens (1) (2), a hinged top (4), a capacitive touch sensor (5), notification LED lights (6), and space to display a static photograph (3). A camera (7) under the hinge is activated by a reed switch on the hinge. The primary screen (1), the gallery screen (2), and the peripherals (5) (6) are displayed from a laptop, a Raspberry Pi, and an Arduino Uno respectively.

GRANDTOTEM

We introduce the Grandtotem: A representation of the grandparent/grandchild relationship and asynchronous communication device. The totem itself is a crafted wooden box that provides several ways for grandparents and grandchildren to connect, as shown in Figure 6. The Grandtotem can be given as a gift from the grandchild to the grandparent, a ritual that serves to mark the start of the period of transition. The physical components of the Grandtotem are outlined in Figure 5. The Grandtotem has three active faces: a non-digital photo frame (3) to establish the object as a representation, a digital photo frame (1) that displays a dynamic slide show of the grandchild's new life abroad, and a thumbnail gallery (2) that functions as a photo album of images received from the grandchild and a timeline of the grandparent-grandchild relationship.

Images and videos are captured by the grandchild and sent via email or mobile app, where they appear in the Grandtotem's gallery (2) automatically. These new images or videos are highlighted in the gallery and trigger white LEDs (6) to softly pulse to unobtrusively draw the grandparent's attention to the device. New images join the rotation of the dynamic slide show (1). Video messages are recorded and sent by the grandparent to the student by lifting the lid of the Grandtotem. The grandparent can also send a lightweight "touch", by physically touching the base of the totem (5), sending a low-obligation notification to the grandchild that their grandparent is thinking of them.

Our medium-fidelity prototype is fully functional, with the images and videos served from a web server. When the lid is open and the camera is active, we use WebRTC to change the primary screen (1) to the camera's view and feature two buttons: Record and Send (Figure 7(b)). The grandchild receives video messages as emails. Physically closing the lid returns the Grandtotem's primary screen to a slideshow (Figure 7(a)), reducing the need to learn additional digital interactions. The gallery screen (2) was added to serve as a visible timeline of the grandchild's recent experiences (Figure 7(c)) and to limit the confusion caused by incorporating multiple functions into a single interface.

EVALUATION

We solicited feedback from potential grandparent users, performing one in-person demonstration for a local grandparent with a grandchild abroad and two demonstrations over video call for local students with remote grandparents. To evaluate the Grandtotem from the student's perspective, two



Figure 6: Primary interactions with the Grandtotem. (Top) The grandparent touching the Grandtotem notifies the grandchild. (Middle) Images and videos sent by the grandchild appear in the gallery and can be viewed by the grandparent on the main screen. (Bottom) The grandparent can quickly record a video message from the Grandtotem and send it to the grandchild. Video messaging was selected as a comfortable way for grandparents to record their thoughts and send them directly to their grandchild.

participants agreed to receive mock touch notifications over 10 days and to send images and video messages to a mock Grandtotem.

One interesting finding during the system evaluation was that, while both parties would be happy to receive video messages, neither was very excited to record and send their own. "... *a lot of people are familiar with [video chat service] they would be OK with this, but it would be limiting... if they're not yet comfortable with [video chat] that would make a nice transition.*" (G6) "... *not that comfortable with using camera... don't like to send video...*" (G4)

Both generations responded positively to the concept of touch notifications. "*I like the fact that all this does is notify them that I'm thinking of them ... so this doesn't obligate anybody...(to respond)*" (G6). "... *she must be thinking of me at that moment, I am OK with that... I will take a picture and send [it] to her.*" (P1)

Grandparent participants found the design to be intuitive and simple to use. Images were easily selected from the gallery to display on the main screen, and the camera opening and closing to start/stop the video seemed sensible. Some participants felt that the device would benefit from being more compact and portable.

Grandparents and students felt that the notifications for new interactions should be more visible and persistent. It is too easy to miss them and thus lose some of the immediacy.

CONCLUSION

We designed and built the Grandtotem, an interactive media display that represents the grandparent-grandchild relationship and enables asynchronous communication. Our design incorporates the key findings of our formative work that communication is difficult for grandchildren because they must adapt to (1) technology, (2) physical barriers, and (3) changing roles. As a gift from grandchild to grandparent, the Grandtotem offers an approachable interface for grandparents that changes as the relationship changes and offers asynchronous communication to overcome time-zone differences. The Grandtotem creates space for ritual and tradition in the transition to studying abroad. It enables the exchange of media for cross-cultural knowledge transfer, which strengthens the social fabric by creating continuity and common ground for societal communication.

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Figure 7: The three screen views of the Grandtotem.