

Sensing Their Presence: How Emerging Adults And Their Parents Connect After Moving Apart

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ABSTRACT

When emerging adults move out of their parents' homes for the first time, their needs for togetherness and connection evolve, as do their parents'. In co-located homes, people often experience togetherness passively by sensing one another's presence in their environment. However, when no longer living together, methods of experiencing togetherness change. Thus, we conducted an interview and co-design study with 16 pairs of parents and emerging adults that explores this concept across distance. The study uncovered differences in the connection needs of emerging adults and their parents, including their goals in connecting, the amount of communication they needed, and their needs for privacy and transparency. We additionally found that passive connecting factors included ambient sounds of the home, visual shared experiences and traces of one another in the home, ambient home smellscape and smell memories, touching left-behind objects or gifted objects, and the taste of family recipes and the ambience of family mealtimes. We discuss suggestions for designing for passive co-presence based on this new knowledge.

CCS CONCEPTS

• **Human-centered computing** → **Collaborative and social computing design and evaluation methods.**

KEYWORDS

parents, emerging adults, young adults, passive togetherness, sensing presence, codesign study

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1 INTRODUCTION

When emerging adults move out of their parents' homes for the first time, the relationship between them and their parents evolves. *Emerging adults* are adults who are beginning to gain independence from their parents [23, 52, 60]. They no longer see each other every day, and they must implicitly or explicitly renegotiate their independence from one another. This shift may result in evolving needs for togetherness and connection. Technology plays a role in this process - whether by connecting parents and adult children through video calls, phone calls, or family text chains. This is notably different from the way that they may have experienced connection when they were co-located, where families experience togetherness passively, without necessarily relying on conversation alone as the main shared experience. A major part of the interactions people share in a co-located household are passive actions rather than active interactions, such as hearing someone walking around in the kitchen while you are in the living room, or being present in the same room while you each engage in separate tasks. Naturally, these types of passive interactions are difficult if not impossible to achieve when people live in different homes.

Baldassar describes the concepts of “imagined co-presence” and “proxy co-presence” [5]. Imagined co-presence is a sense of togetherness that people experience when they are not actively connecting over technology, such as when remembering a family member. Proxy co-presence is a sense of togetherness that is felt when interacting with “proxy” objects, such as gifts, photos, or recipes [5]. Intersecting with these concepts, we introduce “*passive co-presence*”, which is a sense of togetherness that is felt - whether the pair are co-located or separated by distance - through sensing each other's presence and without actively engaging with one another. Previous research has suggested that passively sensing one another's presence can create a heightened sense of closeness [14].

Designing technology for passive co-presence presents an interesting opportunity for connecting distance-separated emerging adults with their parents; in many ways, it has the potential for increasing the sense of closeness while preserving privacy and independence. This is because passive connections do not rely on the exchange of *information* as the primary focus; instead, these connections rely on *sensing* the presence of another person. Here, we examine the specifics of how presence is sensed passively between emerging adults and their parents, breaking the experiences down into the five senses (sound, sight, smell, taste, and touch).

While past research has extensively explored family communication over distance through a variety of technological approaches

[1, 2, 6, 37], HCI research about the communication needs and patterns of emerging adults and their parents is limited. Research from the field of health science has shown that maintaining a positive connection between emerging adults and their parents has positive health impacts for the emerging adults, for example impacting dangerous drinking behaviours and physical activity [50, 51]. Some of the limited HCI research about this demographic only explores the perspective of the emerging adults and investigates how they choose between existing active communication tools [52]. Munoz et al. explored the perspectives of both the emerging adults and their parents [36]. Though the focus of this work was on contributing a method for empathetic co-design and understanding of one another's perspectives, the research additionally explored how technology could enrich the emerging adult-parent relationships - primarily through active interactions. Our work makes a contribution at the intersection of emerging adult-parent communication technology research and passive co-presence technology design. In this research, we extend the field of emerging adult-parent communication research by diving deeper into the differences in their needs, challenges, and behaviours. We anticipate that emerging adults and their parents may have different - and perhaps conflicting - views and needs on their communication practices and technology-supported connection. To learn more deeply about these differences, we conducted a co-design and interview study where we worked directly with pairs of emerging adults and their parents over several weeks. We contribute to the field of passive co-presence technology design by exploring how feelings of connection and togetherness - often experienced passively when co-located - are perceived through each of the five senses. We investigate how these sensory experiences can be used to guide the design of technology for passive co-presence over distance.

In this work, we set out to answer the following research questions:

RQ1: What are the similarities and differences in the perspectives of parents and their adult children towards technology-supported connection?

RQ2: How might we design technologies for the home that support passive connections between adult children and their parents over distance?

Through our study that combines interviews, an in-home activity, and design sessions, we contribute knowledge of communication habits and needs from the perspectives of emerging adults and their parents. Additionally, we contribute a method for investigating togetherness through the lens of the five senses. Finally, we contribute a set of design suggestions based on this new knowledge.

2 RELATED WORK

2.1 Technological Approaches to Family Connection

Remote family communication has been extensively studied by HCI researchers. Staying connected with family members can influence individual well-being and strengthen interpersonal bonds [13], but experiencing a sense of connection can be a challenge when separated by distance. Tee et al. explored the communication needs and technology-supported practices of extended families, and they found several ways in which technology could better meet these

needs [55]. Their findings highlighted the need to balance the desire for communication with the feelings of obligation, to support ease of use while being meaningful and personalized, as well as providing awareness while respecting privacy [55]. Communicating over technology does not create the same feelings of closeness and comfort that are experienced in a co-located home, and practical issues (such as coordinating schedules) can arise [19]. One possible solution to the challenge of coordinating across time zones is asynchronous communication, such as instant messaging. However, instant messaging is not a perfect solution; a study showed that while asynchronous communication methods were found to be more flexible by distance-separated families, they lacked the feelings of closeness and presence that live video/audio connections enabled [11]. Additionally, the difference in time zones and schedules can lead to unmet expectations for reply times: a study of romantic partners who live apart showed that longer-than-expected response times led to feelings of anxiety [25].

Video connections comprise a significant part of past research on family connection, as they can support feelings of closeness and shared experience [2]. An example of a video connection system for family togetherness over distance is *Family Window* [37], an always-on video connection that allows family members to leave recorded video messages or hand-written notes for one another. A study of this system with distance-separated extended families showed that the constant availability of connection increased feelings of connectedness and involvement in one another's lives, but also created challenges around privacy and feelings of awkwardness when watching the remote household or when being watched [37]. The *Telematic Dinner Party* connects two dinner tables by projecting a video feed of the remote table onto the local table. This system created feelings of embodiment and co-presence for many groups, though this was found to be dependent on social dynamics between the co-located and remote parties [6]. Despite these and other designs and studies of technology for connecting family members over distance, there remains a lack of work that specifically targets designing for emerging adults and their parents.

Another area of past research connects adult children with their elderly parents. For example, "The Messaging Kettle" is a technological design that aims to connect adult children in their 50s and 60s with their elderly parents. This device connects two distance-separated homes by displaying a light when a kettle is turned on in the other home, as well as allowing users in each home to leave messages for one another when boiling water for their tea. The idea of connecting around an object was well-received, but older adults showed some resistance to using new technology [10]. A long term study of the Messaging Kettle's use with four pairs of older mothers and adult daughters (ranging from 2 months of use to over 2 years of use) showed a shift in these patterns, with three of the four pairs continuing to use the device over a long period of time [4]. The researchers identified several factors that led to the long-term success of the Messaging Kettle, including calm communication that was a mix of synchronous, asynchronous, phatic, and informational, and cooperation on glitches and breakdowns, among other factors [4].

In this work, we draw inspiration from existing HCI literature about family communication over distance to inform our design

suggestions, and we contribute to this body of knowledge by shedding light on communication needs and patterns specifically for emerging adults and their parents - a demographic that has not been extensively studied through an HCI perspective.

2.2 Parent - Emerging Adult Connection

When emerging adults first move out of their family home, a process of renegotiating boundaries, privacy, and expectations around communication rituals begins [52]. Maintaining healthy communication can be highly beneficial, for example by reducing the risk of dangerous drinking habits [50] and improving dietary and physical activity behaviours [51] in college students. Sandbulte et al. conducted a study with young adults and older adults and found that family communication over distance could play a role in the collaborative development of healthy living practices such as exercise [45].

Smith et al. [52] conducted a study on communication methods between college freshmen and their parents. They found that the emerging adults expressed a growing need for privacy and control as they began to strive towards independence and shaped their adult identities, but also expressed a growing need for closeness and connection with their parents. Some challenges with connection included parents' difficulties with technology, as well as differing expectations around response times [52].

Past research on communication between emerging adults and their parents is highly informative in regards to the impact of connection on the emerging adults and the connection needs of emerging adults, but this past research focuses only on the impact on or perspectives of the emerging adults [27, 50–52]. Though having an adult child leaving the home is likely to influence parents' communication needs and behaviours as well, the parent perspective has not been extensively studied. In one study, Munoz et al. investigated both perspectives in workshops where parents and their adult children worked together to design futuristic technology to enrich their relationship, with a focus on understanding and accommodating one another's perspectives [36]. Three major themes of interactions that emerged from these designs included sharing everyday activities, parents giving gifts to their children, and mediating long distances and time zone differences [36].

We extend this research area, continuing to investigate both perspectives by working with both emerging adults and their parents in a co-design study. Though there has been limited prior research exploring both sides of this relationship dynamic [36], we take this further firstly by dissecting the distance-separated togetherness of these pairs through the lens of the five senses, and secondly by exploring differences in perspective by maintaining separate co-design groups for parents and emerging adults to encourage open discussion, as well as collaborative discussions within the pairs.

2.3 Passive Co-Presence Technology

Though passive co-presence is a novel area of HCI research, some technology designs have been proposed that support passive or near-passive connection over distance. An example is the MissU (Mini Interactive Shared Sound Unit), which is a device designed to

enable couples in long-distance relationships to share auditory ambience through a combination of synchronous environmental sound sharing and music sharing through a shared music playlist [33]. Lottridge et al. explored how ambient soundscapes could connect distance-separated romantic couples, and found that some partners actively shared sounds (e.g. selecting songs to share), while others passively observed and shared ambient sounds. Additionally, they found that partners often wanted to share the “empty” moments when nothing was happening, but they were thinking of their partners [33]. A visual system with mostly passive interaction is Painting Portals - this prototype included a pair of interconnected picture frames integrated into the decor of a home that display slow-changing digital paintings generated from a camera stream of the remote home, providing peripheral awareness of the other space [46]. Another example is FamilyFlower. This system is a flowerpot display intended to provide subtle, peripheral awareness of human presence, movement, and sound levels in a remote household [15].

While each of these example systems provides some insight into the benefits and drawbacks of specific designs, the field of passive co-presence technology currently lacks broader design guidelines grounded in research. Through our work, we begin this research into design guidelines for passive co-presence technology with a specific demographic - namely emerging adults and their parents. Though this study addresses one specific demographic, we believe that our proposed method of investigating passive co-presence through the lens of the five senses can be used by future researchers to shed light on passive co-presence needs of other demographics as well.

Understanding how togetherness is experienced through the five senses is important for several reasons. Past research shows how the five senses are relevant to information processing and interaction design [39], but the impact of these senses on feelings of connection and presence are still unexplored. Gentile et al. describe human-human connection as involving sensing and expression (e.g. actions, gestures, speaking) [21]. Our focus on sensory signals is due to the sensory nature of passive co-presence. Passive connections do not rely on the exchange of *information* as the primary focus; instead, these connections rely on sensing the presence of another person. Noticing someone's presence in one's peripheral vision, sitting together without actively interacting, hearing their footsteps, or similarly subtle sensory experiences create feelings of co-presence in the home. Here, we focus on the sensing in parent-emerging adult connection, investigating how presence is passively sensed through sight, sound, touch, smell, and taste. Though passive technology design for togetherness is limited, active connection through most of the senses have been extensively explored, providing insights that may apply to passive co-presence technology to some extent.

For the sense of sight, for example, video calls have been extensively researched and established as a method of creating a sense of closeness [20, 26, 29, 32]. In addition to the need for conversation, families want to share aspects of their daily life with one another in an impromptu manner, and need to assess mutual availability for video calls prior to initiation, respecting one another's needs for autonomy and solitude [29]. Similarly, Kirk et al. found that the primary value of video communication for families was more in the creation of feelings of closeness and familiarity rather than sharing

conversation [32]. VideoProbe shared sporadic photo snapshots between homes and encouraged playful interactions [26].

Audio has been shown to be a key sense in creating a feeling of passive and active togetherness. Past research has shown that during video conferencing, audio is often given priority over video - if the quality of the call is poor, video will be turned off to allow for a clearer audio connection [32]. An exploration of how ambient soundscapes connected co-located families, uncovering the themes of “sounds of existence, action sounds, location/distance sounds, sound of others interacting, and personally meaningful sounds” [47].

The sense of touch has also been shown to be an important method of creating an active sense of connection [7, 48, 58, 59]. For example, Flex-N-Feel is a pair of gloves that transmit vibrotactile signals to indicate a remote partner’s hand movements, which was found to increase feelings of emotional connection and intimacy, while also supporting playful interactions and a shared sense of presence [48]. Basdogan et al. found increased feelings of togetherness when touch was introduced in shared virtual environments, even though the pairs in the study were strangers [7].

The senses of smell and taste have been identified as being important areas where there are opportunities for technology design [40, 44]. For example, Obrist et al. conducted a study investigating how people experience smells, and proposed technology design suggestions based on those experiences [40]. Example suggestions included designing for remembering through smells, considering how smells affect moods, and creating expectations through smells [40]. Smell-O-Message is a scent-delivery system that employs different odors as notifications for digital messages [34]. With olfactory interaction design being a relatively new field, the purpose of the Smell-O-Message design and user study was to investigate the effectiveness of smell in communicating specific, recognizable information to a user. The smell notifications produced a similar reaction time to visual notifications, with an increased ability to identify the urgency level of the message [34]. Ranasinghe et al. explored the potential for taste to create immersive experiences, and created a device to physically trigger different tastes [44]. However, technology that connects people through these senses is still lacking.

Though active engagement is supported for some of the senses, many of these past works examine interactive behaviours relating to specific technologies. We draw from these works and extend them in creating our design implications. We contribute the novel exploration of the passive perception of connection and presence through each of the senses. Additionally, we explore how these feelings of togetherness through the senses apply to emerging adults and their parents specifically.

3 METHOD

In conducting this study, our goal was to investigate the perspectives of parents and adult children and to learn how to design technology to support the experience of connecting over distance, especially as emerging adults and their parents may have different - and perhaps conflicting - views and needs for technology-supported

connection. We conducted a co-design study with interviews, in-home activities, and design sessions to answer our research questions. In the following sections we describe our participants followed by detailed accounts of each component of the study and a description of our data analysis.

3.1 Participants

We recruited 32 participants through word of mouth and by advertising our study on Facebook groups for undergraduate students at our institution. Participants were recruited in parent-child pairs, with 16 emerging adults between the ages of 18 and 27 ($M=21.6$, $SD=2.26$), and 16 parents between the ages of 39 and 64 ($M=52.76$, $SD=6.39$) at the time of recruitment. We specifically targeted our recruitment at emerging adults between the ages of 18-35, because in North America this is typically when emerging adults move out of their parents’ homes for the first time in order to start college or when they get jobs away from home [35]. Of the parents, two identified as male, 13 identified as female, and one identified as non-binary. Of the emerging adults, five identified as male and eleven identified as female. We denote participants according to pair and parent or emerging adult, such that P1 is the parent from the first pair and EA1 is the emerging adult from the first pair (i.e., P1’s adult child).

At the time of recruitment, all of the emerging adults had moved out of their parents’ homes within the last two years. All emerging adults had been living independently for a minimum of 6 months, other than EA6 who had moved out less than 2 months before the study. We chose this range in order to capture the experiences of emerging adults and parents who are still going through the process of renegotiating their relationship. By extending the range to two years, we ensured that some of the participants had moved out prior to the pandemic¹ as well, which we anticipated could be a different experience compared to moving out during the pandemic. Of the 16 emerging adults, eight of them lived alone and eight lived with roommates. Of the 16 parents, two of them lived alone, nine of them lived with their partners, three lived with a partner and a child, one lived with a partner, an adult child, and the adult child’s family, and one lived with an adult child.

The participants were from a variety of ethnic and cultural backgrounds. Of the 32 participants, twelve identified as white, four identified as Middle Eastern or North African, two identified as Hispanic, Latino or Spanish, eight identified as Asian, and six identified as South Asian. For all pairs except P8 and EA8 (located in China and the UK respectively), one or both participants were based in North America at the time of the study.

Each participant was compensated through e-transfer with \$30 CAD for participation in the initial interview, \$70 CAD for completing the in-home activity, and \$50 CAD for participation in the group design session. The study was approved by the IRB of our university.

3.2 Co-design study

The co-design study had four parts: a pre-session interview on individuals’ perspectives on togetherness, an in-home activity to collect

¹This study was conducted between July and December 2021, about 1.5-2 years after the start of COVID-19 in North America.

Table 1: The 15 prompt questions for the in-home activities, focusing on the 5 senses.

	Tasting	Smelling	Touching	Seeing	Hearing
Living Together	How did experiences around food create a sense of connection between you when you lived together?	How did experiences with smells create a sense of connection between you when you lived together?	How did experiences with touch create a sense of connection between you when you lived together?	How did experiences with sight create a sense of connection between you when you lived together?	How did sounds (other than speaking) create a sense of connection between you when you lived together?
Living Apart	How do experiences around food create a sense of connection between you now?	How do experiences with smells create a sense of connection between you now?	How do experiences with touch create a sense of connection between you now?	How do experiences with sight create a sense of connection between you now?	How do sounds (other than speaking) create a sense of connection between you now?
Hypothetical Ideal	How do you wish experiences around food could create a sense of connection between you in the future?	How do you wish experiences with smells could create a sense of connection between you in the future?	How do you wish experiences with touch could create a sense of connection between you in the future?	How do you wish experiences with sight could create a sense of connection between you in the future?	How do you wish sounds (other than speaking) could create a sense of connection between you in the future?

personal reflections on connecting through the senses, group design sessions to generate speculative technology designs for connection, and a post-session interview with parent-emerging adult pairs to discuss and reflect on ideas generated in the design sessions. We describe these parts of the study in the following sections.

3.2.1 Pre-session Interview. Due to the restrictions of the COVID-19 pandemic and due to the geographic spread of the participants, all of the components of our co-design study were conducted remotely using video conferencing software (Zoom). We first interviewed all of the participants individually in order to gain insight into their personal perspectives on togetherness and connection, independently of any gender and power dynamics that may have come into play if parent-child pairs were interviewed together. These interviews were 30.66 minutes long on average ($SD=7.58$), and were all conducted in English.

Our goal with this interview was to learn about the needs of the parents and emerging adults with respect to togetherness, independence, and privacy. We asked participants to tell us about their past and current communication routines and technologies (e.g. “What were some forms of connection that felt particularly valuable to you when you/they lived with your parents/you?”, “How do you experience togetherness when you can’t meet in person?”), and asked them to elaborate on the advantages and disadvantages of these methods (e.g. “What communication technologies have you tried for communicating with your parents/child, and what did you think of them?”, “What has and has not worked well about your communication with your parents/child since you/they moved out?”).

3.2.2 In-Home Activity. After the initial interview, 22 participants (31% attrition) completed an in-home activity over five days. These activities were guided by a set of 15 questions (Table 1) delivered to participants through online surveys sent by email at the beginning of the five days that prompted the participants to reflect on how they experienced passive connections with one another through each of the five senses (1) when they lived together, (2) currently while living apart, and (3) in a hypothetical ideal scenario. By formulating the prompt questions as such, we elicited information

about (1) passive connection behaviours in a co-located home, (2) workarounds or new ways to have these needs met when separated by distance, and (3) unmet needs and priorities for passive connection. We specifically asked participants to reflect on their personal experiences of connection within their emerging adult/parent pair for each of these prompts.

We described “passive connection” as feeling connected to others without holding a conversation or purposefully engaging with one another. We asked participants to focus on one sense for each day of the week by providing them with online forms where they were presented with the three cards for that day, and where they could also submit their daily responses. We grounded these experiences in the five senses because passive togetherness relies heavily on perception rather than action, and by examining each sense independently, we hoped to uncover the nuances and forms of passive togetherness. Participants were encouraged to capture photos, videos, sketches, or audio clips for each of these cards, or they could choose to provide written answers. Across all five days of the study and all participants, we received 345 text responses (mean of 23 responses per question, mean of 15.68 per participant, as some participants submitted multiple entries), along with 110 images (mean of 7.33 per question, mean of 5 per participant), 19 audio files (mean of 1.27 per question, 0.86 per participant), and 6 videos (mean of 0.4 per question, 0.27 per participant).

3.2.3 Design Session. Once we had compiled all of the responses from the initial interviews and in-home activities, we summarized the findings based on the five senses. We used these findings to guide brainstorming in co-design sessions with the participants, focusing on challenges that arose in the responses. Each session was a Zoom call with 2-4 participants and a facilitating researcher. In total, there were 8 sessions. The sessions were on average 49.88 minutes long ($SD=14.93$). Each session was comprised only of emerging adults or parents, so that the resulting designs would be representative of either the parent or child perspective on togetherness. Maintaining the separate groups for parents and emerging adults was important in understanding the unique needs of each group, as well as allowing open discussion without any discomfort caused

Table 2: Eight design sessions with participants spread across them based on scheduling availability. Each session only included either parents or emerging adults.

Session	Participants
1	EA1, EA3, EA4, EA5
2	P1, P3, P5, P7
3	P6, P4, P9
4	EA6, EA11, EA15, EA16
5	P8, P14
6	EA9, EA12, EA14
7	EA7, EA13
8	P16, P12, P11

by parent-child dynamics. We recognized that it could be beneficial to having discussions within the pairs as well; this was done in the post-session interview (section 3.2.4) rather than in the design session itself. The participants were grouped together based on scheduling availability, with the final groups shown in Table 2. In total 25 of the participants took part in the design sessions (excluding EA2, EA8, EA10, P2, P10, P13, and P15).

In each design session, the researcher facilitated brainstorming beginning with discussions around common connecting factors and challenges within the group’s in-home activity submissions. For example for Design Session 1, some of these challenges included connecting with pets over distance, replicating parents’ recipes, guiding parents through camera positioning during video calls, and revisiting the smells of home. The group then brainstormed about potential solutions to these problem areas, and we encouraged them to think about futuristic or even seemingly implausible ideas. Dunne and Raby discuss the different “cones” or design spaces of the future, including probable, plausible, possible, and preferable futures [17]. We encouraged participants to speculate on preferable futures in order to learn about their values and needs rather than focusing on technology implementation. Participants were asked to think of as many ideas as they could in a 5 minute brainstorming window, each individually sketching. Next, participants were asked to share their ideas and explain what aspects of these ideas they personally found most valuable. The facilitator asked unstructured follow-up questions as these ideas were shared to encourage participants to imagine using these designs, thinking about what scenarios they would be best suited to and what the drawbacks might be. Participants were then asked to pick their top two favourite ideas from the group, describing what they valued most about these devices with their own relationships in mind. The idea with the most votes (or in cases of a tie, multiple ideas) was chosen to inspire the direction for the next brainstorming round. Finally, each participant was asked to choose the device idea that they would most like to use with their own parent/child, explaining their rationale.

3.2.4 Post-session Interview. The design sessions resulted in many unique design ideas for potential solutions to experiencing togetherness when living apart. Half of these design ideas were generated by parent-only groups, and half were generated by emerging adult-only groups. To gain insight into how these technology ideas would

play a role in each parent-child relationship given their unique dynamics and perspectives, we conducted 30 minute long interviews with the pairs. In these interviews, we presented several of the generated designs from the second brainstorming round of previous design sessions (which neither participant was a part of) to the parent-child pair, and asked them to reflect on the advantages and disadvantages of each idea (e.g. “Are there scenarios where this technology would be good to use? Are there any scenarios where using this technology would be bad?”).

3.3 Data Analysis

We collected data in this study by audio and video recording Zoom calls for the pre-session interviews, design sessions, and post-session interviews, as well as collecting responses to the in-home activities. Once we had collected data through the individual interviews, in-home activities, design sessions, and pair interviews, the first author analyzed this information by transcribing the recorded sessions and performing thematic analysis on all of the transcriptions. The entire team, composed of four researchers, engaged in extensive discussions to fine tune these 32 initial themes. In doing so, we extracted the set of final themes (Figure 1) from the data that are then used in the next section to illustrate the experiences of the participants. Examples of these final themes include “reminders of family”, “connecting through experiences”, and “privacy and independence”.

Only the first author falls within the age range of the emerging adult participants and had experienced moving out within the last three years. As the first author was the lead on data collection and analysis, to mitigate personal biases from influencing the analysis process, the author engaged in continuous discussions with the rest of the team to ensure an accurate interpretation.

4 RESULTS

We found that there were some key differences in the connection needs of emerging adults and their parents, including their goals in connecting, the amount of communication they needed, and their needs for privacy and transparency. We additionally found that passive connecting factors included ambient sounds of the home and action sounds, visual shared experiences and traces of one another in the home, ambient home smells and smell memories, touching left-behind objects or gifted objects, and the taste of family recipes and the ambience of family mealtimes. In this section we first describe the existing connecting behaviours of the pairs, and discuss the differences in their connection needs. Next, we describe how the pairs connect through the five senses.

4.1 Existing Connection Behaviours

Among the 16 emerging adults, 11 of them had moved out to pursue post-secondary education. Though all of the emerging adults are students (undergraduate students with the exception of three post-graduate students), two of them noted that their reason for moving out was to gain independence, two of them moved out for a combination of schooling and independence, and one moved out due to incompatible COVID-19 safety measures with her parents.

Most pairs communicated with one another daily (11 pairs), while a few (four pairs) communicated weekly. One pair had an always-on

Reminders of Family	Technology Challenges	Privacy and Independence	Connecting Through Experiences
Reminders in media	Different tech preferences	EA's need to fully immerse in their new lives	Memories of shared experiences as connection
Things they would like	Parents' difficulties with new technology	Enjoyment of newfound independence	Togetherness through co-watching
Learned habits as reminders	Parents' difficulties positioning camera	Different social norms over technology	Gameplay as a connector
Left-behind traces	Parents' distrust of technology		Living vicariously through EAs
Sensory themes:	Sensory themes:	Sensory themes:	Sensory themes:
Seeing traces and signs of life	Camera positioning problems	Dislike of being constantly seen and heard	Togetherness through co-watching and shared experiences
Smell memories as reminders			Smells as reminders of past experiences of togetherness
Sound memories as reminders			
Comfort, Home, and Routine	Effort and Access	Worry, Guilt, and Duty	
Need for comforting and being comforted	Scheduling challenges	Needing to know about EA's wellbeing	
Sense of touch for providing comfort	Communication overwhelm/guilt	Needing to reassure parents	Sight
Associating parents with home	Need for reacting rather than responding	Guilt over not responding to parents enough	Smell
Smell memories associated with family	Need for lighthearted small-talk	Guilt over not being there for EAs or overstepping	Sound
Shared mealtimes as connection		Ensuring that parents still feel important	Touch
Cooking/recipes as connection		Duty to give EAs advice and instill good values	Taste
Acts of love and caring as connection			
Sensory themes:			
Connecting through touch			
Mealtime routines, recipe sharing			

Figure 1: The 32 initial themes from our thematic analysis were further analyzed to extract higher-level themes. Here we show how each theme relates to the senses.

video call on their phones, so they were always in contact. This frequency of connection was not constant, and changed depending on school schedules, travelling, temporarily higher needs for connection, or other life changes. Most pairs noted that they were in contact more frequently in the first few weeks after moving apart, often several times per day; this gradually decreased as they both became more comfortable with the change. In fact, decreased communication was sometimes seen as a good thing by some emerging adults and some parents, as it was a sign of wellbeing and contentment (though many parents did not feel this way). P13 explained,

"If he doesn't call me that much, I feel better because I know he's fine because if he calls me every day, I know something's wrong. Either he feels lonely or he's sick, or I don't know. So believe me, if he doesn't call me, I feel happy."-P13

Though almost all pairs had multiple methods of communication that they used, nine pairs mentioned texting (or text-based messaging) as a frequent mode of contact, eight pairs frequently used video calls (such as FaceTime, Skype, Google Hangouts), and four pairs frequently used phone (audio) calls. In many cases, the pair had conflicting opinions about how to connect, but compromised or used a technology that one of them preferred.

A challenge that was common for many pairs was the difficulty of scheduling communication. Naturally, for pairs who were living in different timezones, finding times when they were both awake and available to communicate synchronously was a challenge. Pairs who were living in the same timezone experienced this challenge as well, as their school, work, and sleep schedules were often not aligned. EA16 described the difficulty of sharing and coordinating their schedules,

"There's been a couple times where I've been in the middle of lecture and my parents don't necessarily understand that my schedule has changed from semester to semester. So they'll call me and my phone rings really loud in the middle of the lecture."-EA16

Participants also explained that planning and coordinating phone and video calls required too much effort, and they would prefer to have lower-effort access to one another, recalling the ease of walking by someone in the home and striking up a conversation. EA11 described this experience,

"When you're kind of just hanging out, like in, in the same room, you can have kind of more sporadic, like conversations than over the phone or even over dinner. Because like something can just come up

and you can like say it out loud, but you don't have to like call them up and then hang up and then call them up, over and over."-EA11

4.2 Differences In Connection Needs Between Emerging Adults And Their Parents

In this section, we describe how the communication needs of the emerging adults and their parents differed. Here we focus primarily on their active connections; that is, interactions that occurred purposefully.

The emerging adults and their parents had different goals with their communication. For the emerging adults, connecting with their parents was a way of connecting with the concepts of home, family, and comfort. These concepts were frequently mentioned in the interview when they were talking about their parents. In the co-design sessions, it became apparent that the emerging adults designed the communication technologies differently between the two homes. When a hypothetical device required an instance in the parent's home and an instance in the emerging adult's home, they valued having the parent's device being grounded in the home and having portable and flexible devices on their own side. Additionally, many of the emerging adults highlighted that they spent the majority of their time away from their homes, and would want to carry connection devices with them. EA1 illustrated this through the example of texting,

"Text is a good way of communicating, you know, wherever you are and whatever you're doing because you can basically text, you can text on transit, you can text in lab, you can text anywhere."-EA1

On the other hand, for parents the goal of connecting with the emerging adults (aside from checking on their wellbeing) was to share in the new experiences that the emerging adults were going through. Many of the designs created by parents also centered device portability on the emerging adult side and groundedness on their own side, as connecting with the emerging adults as they go about their day was a way of experiencing life from their perspective, especially as they embarked on new experiences such as college or moving to a different part of the world. P6 explained,

"Well as a parent, it's fun to see, you know, starting the next phase of life. And so that gives you a little bit of joy too and it's exciting to hear, you know, kind of living vicariously through her and you know, hearing about what she's doing and new experiences and stuff. So that's kind of fun."-P6

A recurring sentiment across the emerging adult participants was that they needed mechanisms for acknowledging or reacting to communication from their parents without a written response. Parents would share content - such as articles, news items, or social media posts - as a way of connecting with the emerging adults. The parents appreciated receiving this type of content from the emerging adults, and felt that the emerging adults would appreciate receiving it as well. Often, this type of exchange was because certain content reminded them of the emerging adult. P3 explained in an in-home activity submission,

"We regularly share photos of things we see which we think the other one would find interesting or would get a chuckle out of [...] the other day when I stumbled upon a video of a young person dancing and their dancing reminded me of my child's dancing and our last New Year's Eve spent together. Of course I had to share the video with them immediately!"-P3

However, though they would also occasionally send such content to their parents as well, the emerging adults found that they were overwhelmed by online communication, they would forget to respond, or they were simply too busy to read and respond to everything. EA3 explained in an interview that this can create negative feelings for the emerging adults:

"Sometimes I just see like some messages that my mom sent me like an Instagram post or something like that. And sometimes I don't respond. This is what I feel bad about."-EA3

EA9 explained that over time, her mom stopped sending the articles,

"I've barely ever read that text and my mom always used to send me like articles of things and, but she stopped because she realized she's like, you have so much to do with school. Like there's no, like you're not gonna read them."-EA9

A common, but limited, solution that emerging adults noted was using the "react" feature that exists in certain messaging applications, which allows users to respond to messages with an emoji.

Another area where parents and emerging adults had conflicting needs was in their needs for reassurance and autonomy. A prominent challenge that faced many parents was their sense of worry over the wellbeing of their children who had recently moved out of the home; while this affected the majority of parents, a few did not experience significant worry. Parents who were highly worried about the emerging adults and who had daily communication routines explained that response time played a major role in their short-term perception of their children's safety and wellbeing, though other parents did not feel this way. P4 explained,

"I almost suffered like an anxiety attack or something. And you know, I would message her and say, if I send a message to her, like now, and she doesn't respond in an hour, I'll do it again. And then if she doesn't respond, I'll do again."-P4

However, the majority of emerging adults valued their newfound autonomy and privacy, especially when inviting others to their homes or when leaving the home. Several emerging adults noted in the interviews that the most positive change in their lives since moving out was the ability to go out without telling their parents or without needing to ask permission to invite friends over. Despite this positive change, parental worry created a sense of guilt among the emerging adults. They felt bad when they were not able to respond in a timely manner, and felt a duty to get in touch in order to ease their parents' worries rather than out of a need for connection. Others felt a sense of frustration about their parents' worrying. EA16 explained,

"It was kind of frustrating sometimes because I, I don't know. I've tried telling them that I'm staying away from the areas that I need to stay away from and like keeping myself safe, but I don't know how else to explain to them because they're so far away."-EA16

4.3 Changes in Home Life After Moving Apart

In this section, we discuss how home life and daily behaviours shifted for emerging adults and their parents after moving apart. In the interviews with emerging adults, autonomy was often an important topic. For some participants this included enjoying a newfound ability to control and personalize their living spaces. This was especially a change in the common spaces of the home, where previously compromises had to be made with other family members. EA12 explained,

"That's honestly another reason why I like living alone, because I get control of how I want my things organized and where I wanna place things. Cause if I move my parents' stuff, they can't find it and they'll get frustrated."-EA12

Other participants experienced a change in how they used the communal spaces of their homes. Emerging adults living with roommates often found that they considered their bedroom to be their own space, and they did not frequent the communal spaces in the same way they would when living with family. EA5 explained,

"The living room mostly is just used either if I'm doing something there on my own, or if me and like one of my roommates or a couple of roommates are deciding to do something together in there. But it is less like when I was living with my parents where like the living room was kind of where all the living happened, where just like we were sitting there, everyone was doing their own thing. I think that's like the major difference."-EA5

However, this additionally depended on the emerging adults' relationship with their roommates. For example, EA7 and her roommate were close friends, which led to a different experience in the public spaces.

"I feel like I have more freedom with just all of the space in my apartment. My roommate is a lot less concerned with who I have over than my parents are. My roommate like knows most of my friends. Like we, we share like a few friend groups, so it's like [...] it feels like still my own space, if that makes sense. We've also decorated it. We have like Polaroids up everywhere, like everywhere in the apartment sort of feels like our space."-EA7

Though emerging adults described more significant changes in their home lives (as they had moved to a different home), the change in lifestyles and in the use of home spaces was experienced by some of the parents as well - most notably for the parents who no longer had any children living at home. Changes in lifestyle included increased freedom in planning activities, meals, and trips, as well as a shift in how the home spaces were used. P4 described this experience,

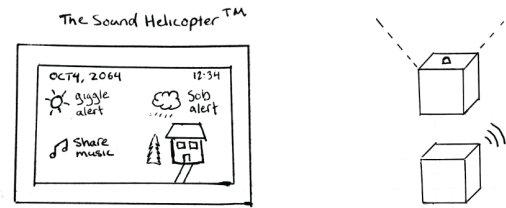


Figure 2: Participant ideas for connecting through the sense of sound: (left) a device that collects the emerging adult's ambient sounds and shares salient parts (such as music, laughter, crying) with the parent, proposed by P3, and (right) a sound collector and paired speaker for sharing soundscapes, proposed by EA3. Sketches redrawn for clarity.

"I've felt like I kind of moved out of my parents home, but it's just my daughter moved out [...] like my whole house is like a playground. And yeah, we can talk about our own personal things without having to worry about, oh, my daughter might hear it or she may not feel good about it."-P4

4.4 How Emerging Adults and Their Parents Connect Through the Senses

In this section, we describe how different sensory experiences fostered a feeling of connection between the emerging adults and their parents when they lived together and after children moved out. Here we focus primarily on their passive connections; that is, feeling a sense of togetherness or presence without taking any action to communicate.

4.4.1 Sound. When emerging adults and their parents described how they connected through sounds when they lived together, they mainly described ambient or environmental sounds. These sounds mainly centred on being peripherally aware of their activities, for example through sounds of their footsteps, sounds of cooking, or typing on a keyboard. Other ambient sounds that created a sense of connection included sounds that were specific to the environment surrounding their home including the sounds of waves on the beach, wind, or birds chirping. Ambient sounds of home generally were something that the emerging adults missed and wanted to reconnect with after moving out. EA8 shared an idea in her in-home activity submission,

"You could virtually go on a walk with someone and instead of being on a phone call and talking to each other, the different bird calls and wind sounds on each of your respective walks would be blended together into a balanced soundscape that then both of you would hear. Sharing an environment with someone makes me feel connected to them and this way I could spend time passively with my parents when we want to share space but not actively talk."-EA8

While these forms of connection through sound were mainly passive and involved hearing these sounds in the "background", the passive awareness of one another sometimes led to active interactions. Recalling when they lived together, participants explained that hearing the sounds of cooking and baking would sometimes cause them to get up and go to the kitchen. Similar passive-to-active

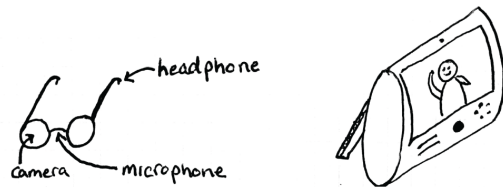


Figure 3: Participant ideas for connecting through the sense of sight from the design sessions: (left) a device that allows participants to stream their outdoor adventures to the other person, proposed by P3, and (right) a portable video call that can be installed on a belt, proposed by EA5. Sketches redrawn for clarity.

triggers still took place when separated by distance, though these would typically depend on “sound memories” - sounds that were strongly tied to past memories of togetherness. P3 wrote in the in-home activity,

“And then there’s always that surprise pop of sound, like a baby crying, little children laughing, that will trigger an emotional connection to memories I have with my child. (and more often than not something as trivial as that will have me send a little ‘I love you’ message not long after).”-P3

In the design sessions, it became clear that emerging adults and parents alike wanted to share environmental soundscapes as a form of connection over distance (Figure 2), but the emerging adults especially were concerned about privacy when sharing passive/ambient sounds from their own house. This was especially true when they discussed always-on device ideas that would share sounds. In one design session, EA1 explained,

“I think that sounds are really important in connection, but obviously having like a live stream of all the sounds in your house is an invasion of privacy.”-EA1

4.4.2 Sight. Emerging adults and their parents felt a sense of togetherness when sharing activities and experiences with one another. They recalled co-watching experiences like watching movies or shows together, playing video and board games together, and sharing outdoor visual experiences like sightseeing. These forms of connection were missed by both the emerging adult and the parent participants. Some pairs had attempted to replicate these experiences over distance with existing tools (e.g. online synchronized streaming tools), but none of them had continued to use these approaches, as they found that it was either too technically challenging for the parents, or it simply did not replicate the experience of being present together adequately. EA3 explained,

“Right now, it feels weird to meet in Zoom and watch some film over Zoom. I don’t know why, but I tried it once. It was okay, but something was missing there.”-EA3

EA6 addressed a potential cause of this lack of togetherness - not

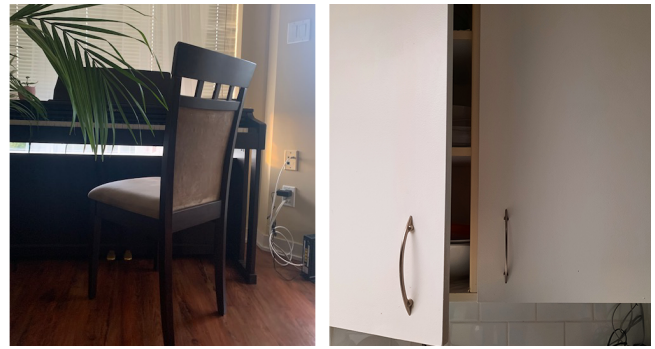


Figure 4: Participants’ left behind traces: (left) EA4 had taken her old family dining chairs with her to her new apartment, and those chairs now act as a reminder of home. (Right) P1’s daughter used to leave cabinet doors ajar, and thus seeing an open cabinet is now a reminder of her daughter.

seeing the other person in the same space. She suggested an idea for cutting a sofa in half and placing it up against a display wall showing the other home in order to make it appear as a continuous sofa, showing her mom sitting next to her while co-watching.

In the design sessions, some participants proposed methods of sharing co-watching and outdoor experiences together. Examples of this included: glasses that allow users to stream video of their outdoor adventures to the remote person (Figure 3), virtual reality (VR) experiences where parents and children can embark on shared adventures, and a wall-sized display in homes of parents and children acting as a “window” between the two walls, allowing the pair to see one another while watching movies.

Other sight-based experiences of togetherness were based on seeing traces of the other person after the children moved out. For the parents, this included things like the emerging adults’ left-behind belongings, artwork, and left-behind pets. In many homes, the emerging adults’ bedrooms were left the way they used to be, and thus their rooms acted as reminders for their parents. Other traces of emerging adults were based on their habits. For example, P1 explained that her daughter used to leave cabinet doors ajar, and thus seeing an open cabinet was a reminder of her daughter (Figure 4). Emerging adults felt a sense of connection through traces of their parents as well, though in a slightly different way. They felt connected when seeing souvenirs they had taken from home, or gifts they received from their parents. For example, EA4 had taken her old family dining chairs with her to her new apartment, and those chairs acted as a reminder of home (Figure 4).

Although the sense of sight was powerful in connecting people, it also came with some drawbacks. For example, many expressed relief about having more control over their spaces after moving apart, and, therefore, thought that seeing those same traces in the home could potentially reduce their control again. EA11 explained,

“I think I’m a more tidy person than my family. So I feel like I have more control over my space than when I was living with them. So I’m able to keep the house looking like generally cleaner than maybe they would’ve.”-EA11

Sharing always-on videos also created concerns around privacy,



Figure 5: Participant ideas from the design sessions for connecting through the sense of smell: (left) a device that can replicate and spray smells to re-immers the user into the memory, proposed by P16, and (right) sharing ambient smells by placing a nose-like smell sensor (with clothespin clips to close the sensor) on the wall, with a flower-shaped diffuser in the opposite home, proposed by EA3. Sketches redrawn for clarity.

including concerns with sharing private activities or messy spaces. P13 explained,

"I don't want to be seeing his life all the time, I think he has his own life, he needs his space and his privacy, so I don't want to be invasive."-P13

4.4.3 Smell. The pairs described feeling connected to one another through ambient "smellscapes" when they lived together. "Smellscapes" are a combination of smells that comprise the overall smell of a space [53]. Smells that especially created a general sense of connection between parents and emerging adults included smells of specific foods, personal products (e.g. perfume, shampoo, etc), and for the emerging adults, the smell of their parents' home. Other smells that were tied with specific memories included holiday-related smells and the smell of candle smoke (reminiscent of birthdays). Ambient smells were described as creating a sense of connection in co-located homes, and these passive feelings of connection sometimes led to active interactions. P6 recalled,

"The smell of baking cookies and brownies late at night would lead me downstairs knowing that our daughter was up and baking and I would find her in the kitchen to spend a few minutes chatting and tasting the goodies she had made."-P6

Many participants explained that this passive-to-active feeling of connection continued over distance. For example, P6 said,

"When I smell brownies or cookies baking I think of her and sometimes call her to say hello."-P6

EA9 and P9 attempted to work around the inability to share smells over distance by making a habit of describing smells over video calls, such as describing environmental smells like freshly cut grass and the smells of the beach.

Similarly to the sense of sound, the smells of home were missed by the emerging adults once they moved out of parents' homes. For example, EA3 attempted to replicate the smell of home by baking a family recipe that their mom used to bake, and found that this brought back comforting memories of home. In the design sessions

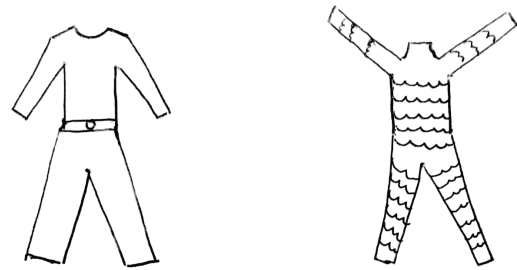


Figure 6: Participant ideas for touch-sharing suits from the design sessions, including one proposed by P1 (left) and one proposed by EA13 (right). Sketches redrawn for clarity.

and in-home activities, both parents and emerging adults expressed an interest in sharing smellscapes. P8 described a hypothetical scenario,

"We could say 'it smells so fresh in the air outdoors here' from a far-away place and have the other experience that."-P8

In fact, the sense of smell was one of the senses that participants engaged with most in the design sessions. This was because of the power and vividness of "smell memories" that participants had that connected them with past events that they shared together. In an emerging adult design session, EA3 shared an idea for sharing ambient smells by placing a nose-like smell sensor on the wall, and having a diffuser in the opposite home (Figure 5). In a parent design session, P16 shared an idea for a device that can replicate and spray smells to re-immers the user into the memory (Figure 5).

In the final pair interviews, some downsides of smell sharing were discussed. The first potential issue was the sharing of harsh or bad smells, such as the smell of burning food. While some pairs thought that this could create some playful interactions between them, others emphasized that the device should filter these smells or should only be turned on temporarily to share "good" smells. Additionally, some participants were concerned with the mixing of the remote smells with the smells of their own home, and distinguishing between them - some were concerned that the mixing of smells would be confusing, especially without having context for what is creating the smells on the other side. EA13 explained that this could result in feeling less grounded in his physical space,

"I like to be grounded where I am and it will be weird smelling other places when I'm at home."-EA13

4.4.4 Touch. Parents and emerging adults both felt that they missed comforting touches. Emerging adults described feeling like they needed comforting touches from their parents when dealing with negative emotions, and parents noted feeling a sense of closeness and conveying love and security through hugs and other comforting touches. Touch also created a sense of connection through caring acts. When co-located in the same home, this was sometimes direct, like doing one another's hair, or indirect, like folding their clothes

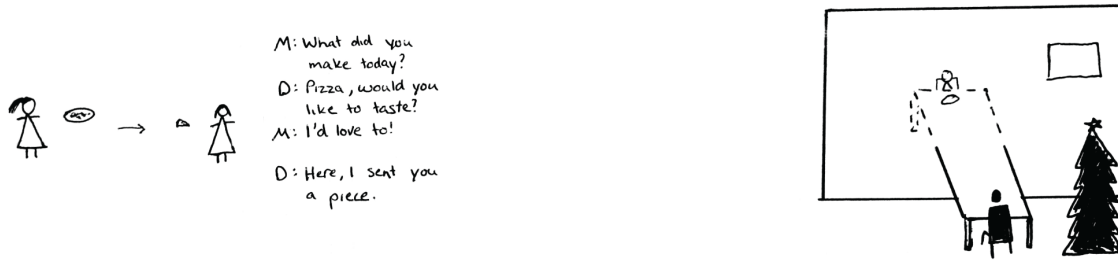


Figure 7: Participant ideas for connecting through the sense of taste: (left) a live food teleportation device proposed by P1 in an in-home activity, and (right) a table-top display creating the ambiance of a shared meal in both homes, proposed by EA16 in a design session. Sketches redrawn for clarity.

for them. This was one of the forms of connection that both sides found most challenging to lose. They attempted to re-create the feeling of closeness through “touch-by-proxy”: touching left-behind items, gifts, and souvenirs. P9 explained,

“Touch has been the hardest thing to get over since our daughter left home. We did send some familiar items with her overseas, like a blanket and pillow with the dog’s picture that she could hug and feel like she’s at home. And occasionally, one of us has curled up on her bed just for a pseudo hug.”-P9

Another form of touch-by-proxy was through the creation of physical gifts for one another, such as knitting a sweater for them.

In the design sessions, many ideas for connecting through touch were shared. A touch-by-proxy idea shared by EA16 was hugging a teddy bear that had pre-recorded audio messages. Several touch suit ideas were shared as well (Figure 6), including touch suits for sharing comforting touches, touch suits for connecting with pets, and touch suits for sharing haptic experiences together.

Participants had different boundaries and preferences regarding the sense of touch. Three of the participants mentioned that they didn’t enjoy connecting through touch or did not like hugs. This sometimes created a mismatch between the pair’s connection needs, and one pair decided on a lighter form of touch contact that felt more comfortable to both of them than hugs. When discussing a touch suit idea, EA3 and P3, a pair who both mentioned enjoying hugs and cuddles, discussed in their shared interview that despite their comfort with touch, they would require an explicit consent process for sharing comforting touches over future technology.

4.4.5 Taste. For many pairs, shared family routines formed the basis of their daily interactions when living together. These rituals were centered around food - whether through shared dinners, breakfasts, or afternoon tea/coffee. After being separated over distance, several pairs attempted to use technology to replicate this experience, for example by video calling in to share meals. This was found to be especially difficult when a large group was on one side of the video call, as positioning the device so that everyone was visible/audible was a challenge, and did not create the same social dynamics. As such, sharing food over video calls was mainly used for special occasions, such as birthday parties, rather than for

regular meals. For some, even this was infeasible due to large time zone differences. Other pairs found ways to share food by mailing or ordering special dishes for one another, but this did not capture the routine or experience of sitting down for a meal together. In the design sessions, some ideas were generated for sharing mealtimes together over distance. For example, one idea involved a table-top display that made it appear as though the tables in both homes were connected, creating the ambiance of a shared meal (Figure 7).

As the emerging adults had moved out and were living independently for the first time, many of them were cooking for themselves for the first time as well. Because of this, one of the forms of active togetherness the pairs shared was recipe sharing and sharing cooking knowledge. This included sharing and collecting family recipes or cultural recipes, which the emerging adults would then attempt to replicate. The process of sharing recipes and tasting food reminiscent of home caused the emerging adults to feel a sense of connection despite noting that their food often lacked the authenticity of their parents’ cooking. An experience that pairs felt missing after moving apart was cooking together. The time they would spend together while preparing food created an opportunity to share casual conversation, and experimenting with new recipes together created shared experiences. EA9 explained,

“My mom and I frequently cooked together, and as an activity that we enjoyed together, it connected us. She also frequently taught me skills in cooking and it connected her to me by her passing on her knowledge.”-EA9

Some pairs tried to replicate this experience by leaving a video call on while cooking in order to have company in the kitchen, and found this to be a connecting experience - even though only one of them was cooking. While the majority of design session ideas about shared taste involved food teleportation or recipe replication (Figure 7), a few of them focused on this experience of co-cooking. EA11 shared an idea to cook along with his mom through a screen in his kitchen that would show his mom’s cooking actions, which he could then mirror in his own home to copy her.

5 DISCUSSION

Based on these results from the interviews, co-design sessions, and in-home activities, we compiled our results into suggestions for the

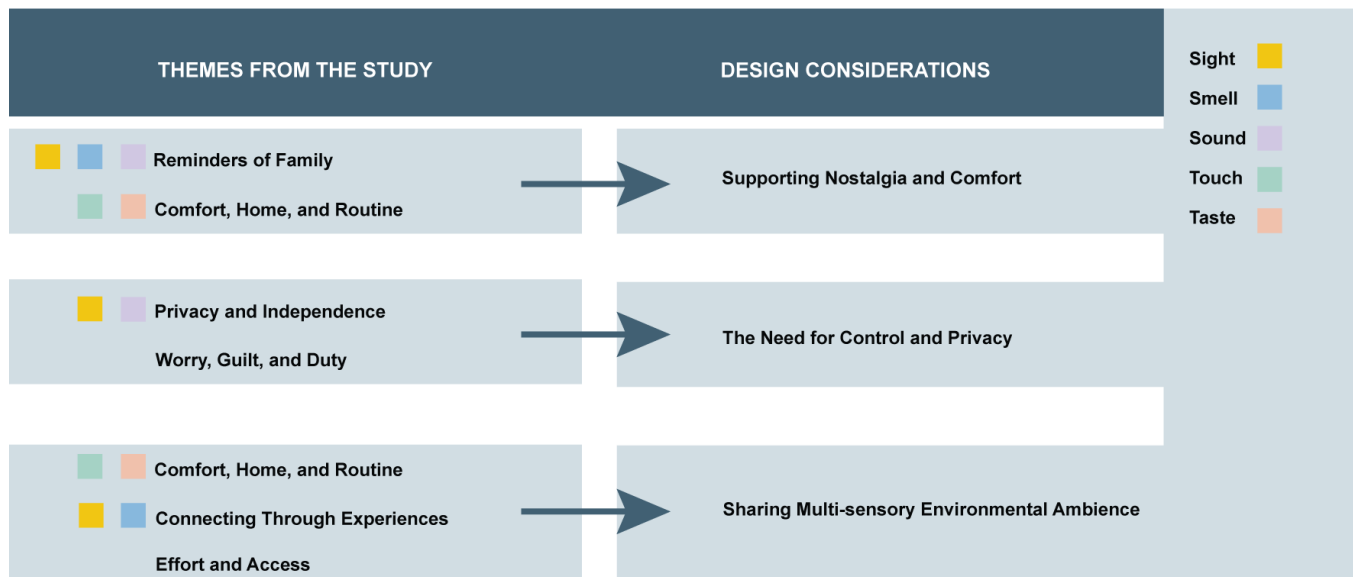


Figure 8: The relationship between the design considerations, the findings of the study, and the senses.

designs of future technology that connects emerging adults with their parents after moving out of their parental home. We aimed to learn about the differences in the connection needs of emerging adults with their parents, as well as understanding how they connect through the senses. Though our results about togetherness through the senses cover a range of interaction types - both passive and active - our goal in collecting this data was to search for a range of design implications that can help this user group, while targeting passive togetherness more specifically. The reason for our focus is that passive togetherness - a key part of co-located togetherness, and poorly supported over distance with current technology - involves sensing the presence of others through environmental cues.

The pairs of emerging adults and their parents currently connect with one another through a mix of texting, phone calls, and video calls. A challenge that many pairs faced was the difficulty of scheduling time to communicate, especially when they had shifting work or school schedules or were living in different time zones. Our work identified several differences in the needs and preferences of emerging adults and parents. A key difference between the emerging adults and their parents was in their different goals for communication. For the emerging adults, connecting with their parents was a way of connecting with the concepts of home, family, and comfort. On the other hand, for parents the goal of connecting with the emerging adults was to check on their wellbeing and to share in the new experiences that the emerging adults were going through. This difference in communication goals has not been well-explored in past research. Additionally, while parents appreciated receiving media content such as articles, photos, or videos from the emerging adults, a recurring sentiment across the emerging adult participants was that they sometimes felt overwhelmed when receiving this content and needed mechanisms for acknowledging or reacting to communication from their parents without a written

response. While past research has shown a link between online information overload and negative wellbeing [3], the differences between emerging adults and their parents in this area have not been explored before. Yet another area where parents and emerging adults had conflicting needs was in their needs for reassurance and autonomy - while parents often felt worried about the wellbeing of their children and needed reassurance about it, the emerging adults valued their autonomy and felt guilty due to their parents' worrying. Past research has shown that parental support of emerging adults' autonomy leads to stronger relationships between them, and higher overall wellbeing in the emerging adults [30].

Learning from participant experiences and needs, several considerations arise for creating a sense of passive co-presence for emerging adult-parent pairs, which we discuss in the following sections. Figure 8 shows how these considerations are related to the themes emerging from the thematic analysis. For example, row 1 of the figure shows two themes from the results, (1) reminders of family and (2) comfort, home and routine. To support these themes our discussion section explores the design consideration of supporting nostalgia and comfort. The coloured squares illustrate that reminders of family were found in our results to relate to the senses of sight, smell, and sound, while the theme of comfort, home, and routine was related to touch and taste. Similarly, to support the themes of (1) privacy and independence and (2) worry, guilt, and duty, our discussion section explores the design consideration of control and privacy. The themes of (1) comfort, home, and routine, (2) connecting through experience, and (3) effort and access led to the design consideration for sharing multi-sensory environmental ambience.

5.1 The Need For Control and Privacy

The need for privacy has been examined and documented in great depth for connection over distance [1, 9, 37, 42], however HCI research on the privacy needs of this demographic is limited. We highlight it here as a design consideration due to its specific importance within this demographic, and the conflict of needs between the emerging adults and their parents.

Of the 16 emerging adult participants, eight were living with roommates at the time of the study. This introduces an additional reason to emphasize non-invasive design when connecting emerging adults with their parents. In the interviews, participants living with roommates described a change in their use of communal home spaces, and we observed two different forms of change. Some felt that they preferred to spend time in their bedrooms as opposed to the communal spaces of their shared homes, where public or group activities would take place. Others conversely felt more freedom in using the communal spaces of the home, for example to invite others over. In either case, designers could consider avoiding collecting any sensor data in the shared spaces of the emerging adults' homes. In the first case, where the communal spaces of the shared homes are considered to be less private, collecting and sharing data could pose a privacy concern for the roommates. In the second case, collecting and sharing data could pose a privacy concern for the emerging adults who do not want inform their parents of their social activities. In both cases, displaying the parents' data in spaces of the home where roommates may frequent could pose a privacy concern for the parents. Instead, in shared homes designers could constrain their designs to the spaces of the home that are personal to the emerging adult who wants to be connected with their parents. We learned this from the design session discussions as well as the interviews.

Even in cases where the emerging adults lives alone, designers could ensure that their designs do not capture and display information that could be sensitive or private; for example, we found that some emerging adults wanted to maintain privacy about when they were at home or away, when their spaces were untidy, or when they had guests over. Sharing this information is especially likely through the senses of sight or sound. Designs with these senses could avoid capturing/displaying this information without sufficient abstraction, especially if they are designed to be always-on. This was a point of emphasis in many of the designs created by participants and the discussions they shared about the designs.

In the design sessions, emerging adults emphasized a need for privacy when sharing sounds or video streams, and in the post-session interviews parents and emerging adults alike expressed a desire for maintaining control over the visual organization over their living spaces. Additionally, both emerging adults and their parents required an explicit consent process when sharing comforting touches over distance, which we learned in the design sessions and post-session interviews. Though the need for privacy exists when connecting anyone over technology, this relationship type has a unique dynamic that needs to be designed for. As emerging adults navigate the process of building their new independent identities and lifestyles, they have a strong need for privacy and control over their decisions [52]. Alongside this shift towards a greater need for privacy for the emerging adults, we observed (primarily in

the pre-session interviews and design sessions) an increased need for connection in many of the parents, with some parents being very worried about their childrens' wellbeing. This imbalance in connection needs creates an interesting challenge for designers of passive co-presence experiences.

5.2 Sharing Multi-sensory Environmental Ambience

Sharing environmental ambience is an important way to share and display in-the-background information. Parents and emerging adults expressed in the pre-session interviews, design sessions, and post-session interviews that they felt connected through shared soundscapes and shared smells, which created a backdrop of togetherness in a shared home. When sharing meals for example, the ambience of being together while eating created feelings of connection, which was evident in designs generated by parents and emerging adults alike. The desire to share the ambience of home is especially important for this relationship type, as emerging adults highlighted the desire to connect with comfort and home when connecting with their parents. When discussing *ambience*, we refer to the atmosphere that one feels surrounded by. We learned based on the interviews and design session discussions that home ambience was experienced through multiple senses simultaneously, with multiple ambient streams of information combining to create more complex experiences of passive co-presence. We speculate that future designers could replicate this by combining multiple sensory streams over distance. For example, consider the ambience of the home while someone is cooking; this was a commonly described experience that created feelings of connection. Combining multiple streams of information, a hypothetical system (based on elements of several participant designs) could play the ambient sounds of pots and pans in the remote home, along with the smells of cooking and floor projections of footsteps moving around in the kitchen. Together, these sensory stimuli could potentially replicate the experience of passive co-presence. Of course, this type of design would likely be expensive to acquire and integrate into the home since it involves projector displays, speakers, and a variety of sensors. This could impact the actual feasibility of an emerging adult using it.

Combining multiple senses to create an experience of co-presence can create an amalgamation of the individual challenges of each sense, and can additionally create new challenges. The senses of sight and sound both have the capacity to communicate information about the details of activities and people in the homes. When combined together, the challenge with privacy between the homes is more pronounced; if the sensory information is not sufficiently abstracted, the two streams of information clarify and provide context for one another, making it even more likely that private information will be received in the other home. For the senses of smell and touch on the other hand, having the additional context and clarification from the other senses can actually be beneficial, as they can provide insight into the origin of the scent or tactile signal.

How can multiple sensory streams be combined to create a shared ambience while respecting the conflicting connection needs of emerging adults and their parents? Combining multiple sensory streams does not necessarily mean that they need to be captured at

the same time or location, thus revealing unintended information. We can use musical mashups as a metaphor to think about these sensory combinations: just as a music producer combines elements from different sources to create a track with layered elements from multiple songs to create a cohesive piece of music, designers can mix senses from different sources to create a cohesive experience of ambience. This can be a solution to cases where the multiple streams of information clarify each other to the point of reducing privacy. While valuable, a challenge with this type of design would be the integration of multiple sensors throughout the living space of the parents and emerging adults, recording information throughout their day. It could be especially challenging to diversify the streams of information in the homes of emerging adults who have roommates, where sensors in public spaces should be avoided.

In HCI research, there is currently a limited understanding of how multi-sensory shared ambience can create feelings of connection when co-located or over distance. Though research on *ambient* displays and sensors certainly exists, this body of research is not typically concerned with creating a shared *ambience*. Research in ambient and calm technology engages with concepts of awareness; ambient technology engages with the periphery of users' awareness [24], and calm technology changes between the center and periphery of users' awareness [61]. These concepts are important to consider when creating an ambience, as remaining primarily ambient (in the periphery of users' awareness) is fundamental. However, a key difference between ambient technology and technology for creating ambience is the complexity of the sensory experiences. The ambience of a space is experienced through multiple senses simultaneously, such that the sensory experiences *define* the space.

Another key point about this proposed design consideration is that the purpose of designing such technology for creating an ambience would be to *connect* people over distance. Existing ambient multi-sensory designs [18, 28] are meant to evoke specific emotions or experiences - such as the experience of being in nature - rather than connecting people over distance through a shared ambience. Based on the findings of our study, we propose that designers consider shared home ambiances as a way to connect emerging adults and their parents over distance. One way to do this would be to ambiently display personally meaningful signals that the emerging adults and their parents associate with one another, such as those described in the two following design considerations.

5.3 Supporting Nostalgia and Comfort

The third design consideration we propose is supporting nostalgia and comfort. We learned from the interviews and participant designs that when co-located, parents and emerging adults appreciated sensing familiar and routine actions taking place in the periphery of their attention. When distance-separated, the desire to share these passive streams of information arose mainly from the hope of reconnecting with the nostalgia and comfort of home, especially for the emerging adults. In the interviews and design session discussions, they discussed the roles of smell memories and sound memories in triggering a feeling of connection with their parents. The primary value of connecting through the sense of touch for emerging adult-parent pairs was providing and receiving comfort. We discuss nostalgia and comfort together because

the two experiences were closely linked in our study findings, and are shown to be linked in past research as well. Nostalgia is an emotion that carries elements of social connection, loneliness, and happiness, and is most often a positive emotion [62]. Past research has shown that experiences of nostalgia can cause physiological comfort [65], as well as psychological comfort by counteracting loneliness [64]. Future designers could use memories and reminders of togetherness to passively recreate feelings of connection and co-presence.

We emphasize the specific relevance of this design consideration to emerging adults and their parents. The experience of moving out of a parental home can be a major lifestyle change for the emerging adults as well as the parents. For some, they are moving to an entirely different part of the world, leaving behind not only their parental home but also their hometown and many aspects of life that they associate with comfort. For the parents as well, this change can be difficult, as they may be used to being directly involved in and responsible for the lives and wellbeing of their children, which is a change that can be challenging to adjust to. These experiences were especially evident in our pre-session interview findings. For these reasons, feelings of nostalgia may be heightened when reminiscing about the past, and the need for comfort may be stronger.

Reminiscence has been well explored in HCI research [12, 43, 56, 63] in the context of supporting individuals in the rediscovery of their past experiences. Some past research has explored reminiscence within families, allowing family members to access shared moments in the past [16, 49] or the memories of other family members [8]. In addition to research about reminiscence, nostalgia has been explored in HCI research. HCI research about nostalgia includes designs that support the exploration and retrieval of familiar information from past time periods [38, 54]. These designs support the *active* retrieval of past memories rather than creating a passive feeling of nostalgia and connection. To elaborate, we refer to Baldassar et al.'s concept of *imagined co-presence*, where passing remembrances of family members create feelings of co-presence [5]. This is not the focus of existing designs in HCI research on reminiscence and nostalgia.

Based on our study findings, we recommend that designers make use of sensory triggers to create these passive feelings of co-presence over distance. For these sensory triggers to provoke reminiscence passively, an element of serendipity and unexpectedness can be beneficial. An expected sensory signal is either a result of an action (which is not passive), or it can fall too far into the background of users' awareness to provoke reminiscence. Being unexpected brings the signal closer to the foreground of attention while additionally allowing it to be passive. Designs can make use of this when displaying sensory streams, perhaps by incorporating these surprises intermittently into the home ambience - especially within the audio and olfactory streams, where we found a notable capability for triggering memories (expressed by participants in the interviews, in-home activities, and design session discussions). A range of memories created feelings of nostalgia and connection for participants - from the memory of the ambient sounds of the home on an ordinary day, to memories of shared activities, to memories of family traditions and holidays. Designs could make use of these in different ways to create different feelings of co-presence over distance.

The emerging adult and parents groups both expressed a pronounced need for reminiscence, nostalgia, and comfort in our study. At the same time, emerging adults expressed a desire to be fully immersed in their independent lives. These two needs could possibly conflict - for example, overly-frequent reminders of the parental home may decrease feelings of independence. Designers could keep this in mind when designing for reminiscence, and potentially arrive at a suitable balance by allowing some level of customization for different emerging adult-parent pairs.

5.3.1 Leveraging Left-Behinds and Souvenirs. Designers can leverage *left-behinds* and *souvenirs* as proxies for togetherness. The emerging adults expressed to us in the interviews and in-home activities that when they left their parental homes, they left behind small objects, handicrafts, pets, and in some cases, fully decorated bedrooms. These left-behinds act as reminders of togetherness for parents, who mentioned in the in-home activities and interviews that they feel connected through the touch, sight, and in some cases even smell of these objects. At the same time, many of the emerging adults explained that they had taken items from home with them when moving out, such as furniture and gifts from their parents. These objects similarly acted as passive reminders of togetherness for the emerging adults. When designing technology for creating passive connections between emerging adults and their parents, designers could consider integrating these left-behind items or souvenirs into designs.

The concept of *proxy co-presence* [5] describes the phenomenon of feeling connected with distance-separated family through interactions with objects such as photographs, gifts, and recipes. We encourage designers to draw on the sensory and passive aspects of this form of connection, which we found were valuable to emerging adults and their parents, and apply this to HCI and technology design. In HCI literature, the idea of *heirlooms* as a form of connection with family has been explored [22, 31, 41, 57]. This body of research primarily explores how heirlooms are archived, curated, and retrieved, as these inform the design of "technology heirlooms" [41, 57]. Technology heirlooms are digital artifacts that can be passed down or inherited by loved ones [41]. This is notably different than what we propose here as a design consideration; heirlooms are objects that are explicitly meaningful, and are specifically passed down or inherited due to their longstanding value within a family. In our study, we found that ordinary objects, with no meaning or value in and of themselves beyond their connection to a parent or emerging adult, could create feelings of connection by being sensed in the periphery of participants' awareness; this is what we suggest can be leveraged in technology design for this demographic.

This can be accomplished in different ways. First, objects can be imbued with display properties. For example, a work of art on the wall, created by a parent or emerging adult, could have a frame that changes in appearance (e.g. lights up) when they are present in the space remotely. Alternatively (or in conjunction), the objects can be used as sensors. For example, a gifted mug could track when it is being used, and the information could be ambiently displayed in the other home in some way. These are hypothetical examples based on aspects of participant designs in the design sessions and in-home activities. In reality, since this type of design involves personally

meaningful items, it could rely on some amount of do-it-yourself (DIY) technological setup, which might be especially challenging for an older demographic of parents.

6 CONCLUSION

Moving out for the first time creates shifts in communication patterns and needs between emerging adults and their parents. Through an HCI and communication-design lens, we investigated the perspectives of parents and emerging adults and worked with them to learn about how we might design to support the experience of connecting over distance. Through a co-design study (including interviews, an in-home activity, and a design session), we worked directly with 16 pairs of emerging adults and their parents. We explored passive connections by studying togetherness through each of the five senses separately. The reason for this is that passive togetherness involves sensing the presence of others, and we were interested in learning how to design for connection through sensing. Based on our findings, we propose that designers of passive co-presence technology for remote parents and emerging adults could consider sharing multi-sensory environmental ambience, supporting nostalgia and comfort, and leveraging left-behinds and souvenirs.

6.1 Limitations and Future Work

Despite the range of participants' cultural backgrounds, we were not able to conclusively observe the influence of culture on emerging adult and parent communication, due to the sample size of 16 pairs of parents and emerging adults. Past research has shown that cultural background affects parent-emerging adult perceptions of connection over technology [27]. Future work could examine the role of culture in connection needs between emerging adults and their parents. This could additionally include pairs where the emerging adults and their parents do not share the same cultural identities, such as first/second generation immigrants. Future research could also study the differing needs between transnational pairs and pairs who live at a distance that allows them to meet in-person regularly.

Additionally, all of the emerging adults in our study were undergraduate or graduate students, and the majority of them had moved out to attend school. It is possible that communication needs could differ for emerging adults who move out to start careers, families, or to gain independence, among other reasons. Future research could explore the differing connection needs between emerging adults who moved away from their parents for reasons besides pursuing post-secondary education.

We also recognize that participants who were likely to sign up for this study were those who had a good enough relationship with one another to sign up as a pair; many emerging adult-parent relationships would certainly not benefit from connecting as we discuss in this work. The ideas we discuss are speculative examples meant to demonstrate helpful aspects of passive connection, and are not proposals for technology to be built. Nonetheless, we note that the ideas we discuss in this work (whether proposed by participants or proposed by us) could potentially be used harmfully, for example for surveillance rather than connection. We speculate that in certain parent-emerging adult relationships there may be a tendency

toward harmful use of these designs, and caution future designers to take this into account. Future research could investigate how technology should be designed to prevent its misuse between emerging adults and their parents, with the understanding that various relationship dynamics may require differing levels of privacy and autonomy. While our approach in this study was informed by speculative design [17] and therefore does not focus on the details of actually creating such technology, we additionally note that if in-home connection technology for passive co-presence were to be implemented and deployed, particular caution would need to be taken in how the data is used and shared with third-parties in order to avoid potential harms to the users.

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