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RESEARCH

Mediated Human-Food Interaction for Remote Presence in Adult Family Relationships: A Social Practice Theory Approach

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Abstract. Family members have emotional, social, and cultural ties to food that keep them connected even when they no longer live together. Adult children leaving their parental households but checking in to see what is for dinner, sharing food photos, or seeking guidance on nostalgic family recipes are examples of staying connected through food. Human-Food Interaction (HFI) is a growing domain for food-tech innovation, and in this study, we investigate the potential of mediated HFI for closeness and social presence. We conducted interviews, photo diary studies, and co-design sessions with 16 participants to elicit family members' sharing preferences and speculative ideas about mediated HFI. Using Social Practices Theory (SPT), we examined not only how family members envisioned technology mediation but also why they chose specific food practices to be mediated and what those practices/interactions added to their relationship. Our findings aligned with the SPT model proposed by Shove and colleagues (*The Dynamics of Social Practice: Everyday Life and how it Changes* 2012) and describe how family members attached sentiment to their food interactions (Meaning), envisioned different tools and technologies to craft connected food experiences (Material), and demonstrated awareness and knowledge about each other's food interests and availability (Competence). We reflect on the intertwined relationships between these elements, highlight the nuances of family food practices and their mediation, and ultimately propose design implications by integrating literature from HFI and Social Presence.

1. Introduction

Adult family members, separated from one another by geographical distance, rely on technology to facilitate food-related communication (Ames et al. 2010; Cao et al. 2010; Le Moignan et al. 2017). Food holds special meaning to families and is a topic that instigates the need for support (Panicker et al. 2020; Sandbulte et al. 2021), triggers nostalgia (Locher et al. 2005), and acts as a means to hold on to one's culture and identity (Altarriba Bertran et al. 2020; Moisio et al. 2004). Technology in this context can play both a positive and negative role. On the positive side, technology through text, audio, and video communication enables the reassemblage of collocated practices to tech-mediated ones (Davis et al. 2014;

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Epp et al. 2014) - allowing family members to share recipes or photos of their food creations on social media, and make video calls during important events. On the negative side, mediated food practices can start to feel less organic and become diluted, less frequent, and/or abandoned (Epp et al. 2014).

The increasingly busy lifestyles of today's generation (Keinan et al. 2019; Vilaro et al. 2018), and restricted travel due to the Covid-19 pandemic (Ceccaldi et al. 2021; Heshmat and Neustaedter 2021) are examples of how challenging it can be for families to maintain social connections over food. This motivated us to examine food-related interactions in remote families from a social presence lens. While previous literature on social presence has focused on the qualities of the medium that facilitate communication, more recent research has started looking at contextual and relationship-based dimensions of presence (Nowak and Biocca 2003). Several studies focused on family communication (Follmer et al. 2010; Mickus and Luz 2002; Roche et al. 2022) have also identified that presence and emotional connectedness can enrich relationships.

Connecting through technology-mediated food experiences is not new to HCI and CSCW, with many of these works falling under the domain of Human-Food Interaction (HFI) (Dolejšová et al. 2020), a growing area of food-tech innovation. Prior systems, such as the Telematic Dinner Party (Barden et al. 2012), NetPot (Foley-Fisher et al. 2010), the Living Cookbook (Terrenghi et al. 2007), and KIZUNA (Nawahdah and Inoue 2013), have focused on facilitating the rituals of cooking, eating, and celebrating remotely. Many HFI researchers and designers have also begun experimenting with emerging multisensory technologies (Deng et al. 2022, 2021)(e.g., 3D food printing, robotics, computational gastronomy) in contexts that go beyond eating - for example, health behavior nudges (De Vries et al. 2020) and flavor-triggered memory recalls (Gayler et al. 2022c, b).This sets the stage for our research, which explores new potentials for family connection through mediated food interactions. To that end, through a series of interviews, photo diaries, and co-design sessions, we ask the following research questions:

1. How do adult family members envision social presence through technology-mediated food experiences with their distant family?
2. What food practices or experiences do family members wish to mediate through technology, and what can researchers and designers learn from their choices about their motivations and values?
3. How can researchers and designers apply these learnings to guide the design of HFI technologies that are contextually meaningful for long-distance family connections?

As our findings emerged, we used Social Practice Theory (SPT) as an analytical tool to organize them. SPT was a good fit because, in addition to technology mediation, we were also deeply interested in the emotional aspects of social presence, how families selected certain food practices to be mediated, and how these could integrate into their remote relationships. Through SPT, we were able to the-

oretically deconstruct *the practice* of mediated food interactions into the elements of Meaning, Material, and Competence, as defined by (Shove et al. 2012). While discussing our findings along the three elements, we emphasize their reciprocal linkage, and weave in literature from HFI and Social Presence theories to consolidate and propose design implications.

The contributions of our work are that: (1) we shed light on the complexity and nuances of food practices when adapted to mediated contexts, (2) we present a range of design ideas for HFI that are grounded in the practice of connecting with family through food, and (3) for theorists and designers, we offer a light reflection on using a practice theory approach in family settings.

2. Background

Our work draws from previous research in family studies, long-distance communication, and Human-Food Interaction, as well as theories of social presence and social practices. In this section, we discuss the background literature that shapes our research questions and motivates our inquiry.

2.1. Food Experiences and Their Significance to Families

Apart from being essential for survival and well-being, food carries immense social, cultural, and emotional value (Lupton 1998, 1994; Charles and Kerr 1988). These values are acquired during childhood from routines such as family mealtimes (Ames et al. 2010) and are carried inherently as children become adults and become responsible for their eating practices. Family food values are also a product of individual family members' past experiences with food, geographic context, religious beliefs, ethnic heritage, and lifestyle choices (e.g., vegetarianism, choosing local over mass-produced food) (Gillespie and Johnson-Askew 2009). All of these values contribute to a sense of collective identity (Moisio et al. 2004; Tibère 2016), which keeps family members connected even as relationship dependencies change and as children become adults (Vassallo et al. 2009). An example of how family members hold on to their past food-related identity can be seen in studies that investigated the notion of "comfort foods" (Locher et al. 2005). People tend to consume foods that are intimately linked to their past (most often childhood) when they are sad or homesick. This is due to nostalgia and wanting to regain a sense of their former identity. Nostalgia and embodied memories are not only connected to food items but also to food practices. Cooking and baking in the kitchen can be a form of therapy for those who have had positive familial memories associated with such practices (Hastings 2021; Locher et al. 2005). It should also be acknowledged that there could be negative food related associations within a family. Negative parental commentary around mealtimes (e.g., fat-shaming) influences disordered eating and problems with body image (Lydecker et al. 2018; Webb et al. 2018). Family interactions around food have an enormous impact on an individual's identity. As a

design space, there is an opportunity to augment the positive impacts, be mindful of the negative impacts, and build meaningful connections around food.

When thinking about food and families, it is also important to consider the impact of change on individuals' relationships with each other, with food, and how food is talked about. Our prior study on healthy eating communication between intergenerational family members shows how meanings and patterns learned while collocated undergo changes and act as a trigger to express care (Panicker et al. 2020). Sandbulte et al.'s work on "turning points" also points to how significant life events or disruptions act as a catalyst for increased information sharing and behavior change (Sandbulte et al. 2019). For example, receiving a medical diagnosis could involve an individual altering their diet, their family member trying to support them, and both parties having increased conversations about health in general. A common theme in studies focusing on food interactions in non-collocated contexts is the potential tensions due to life events and change (Panicker et al. 2020; Sandbulte et al. 2019). Technological mediation needs opportune moments, proper context, and room for negotiation when working with family dynamics and food.

In this research, we seek to leverage food's symbolic ties to familial relationships and construct emotionally rewarding experiences when using technologies. We are motivated to understand the multi-faceted values that already exist in families and food experiences, how these values are challenged due to change, and how family members envision new interactions around food that strengthen their connection.

2.2. Long-Distance Family Communication and HFI Advancements

Families have been communicating about food using phone calls (Ballagas et al. 2009; Cao et al. 2010; Heshmat and Neustaedter 2021), social media (De Choudhury et al. 2016; Le Moignan et al. 2017; Muñoz et al. 2013), and video conferencing (Ames et al. 2010; Judge and Neustaedter 2010; Neustaedter and Greenberg 2012) for a long time. This involves scenarios like conversing about home-cooked meals and restaurants (Panicker et al. 2020) and sharing health behavior (Binda et al. 2018; Poretski et al. 2021). Ever since the COVID-19 pandemic, people have had to restrict their physical interactions with others, which has resulted in more instances of digital commensality (the act of eating together) (Ceccaldi et al. 2021; Heshmat and Neustaedter 2021). More and more people invite family members to have meals together on video (Ceccaldi et al. 2021; Heshmat and Neustaedter 2021) or take part in creative endeavors around food, such as Airbnb's "online experiences" (Cenni and Vásquez 2021). In Section 2.1, we discussed how family members' associations with food-related activities, such as baking and cooking, are often considered therapeutic due to early memories attached to them. Through supporting food related activities and experiences, technology has the potential of bridging distances and bringing comforting feelings of togetherness (Easterbrook-Smith 2021). A pandemic is only one example of disruption and geographic sep-

aration. Designing to bring closeness under such a context has many long-term implications for families.

A challenge that is frequently noted in literature on designing for food interactions is the multi-sensory nature of food (Velasco et al. 2021). Food has sensory, emotional, communicative, performative, and temporal qualities (Gayler et al. 2022a) that make it difficult to have a "complete" experience in long-distance contexts. As described in the examples below, this did not stop or restrict people from relying on commercially available digital communication technology to fulfill their need for connection. Despite the prevalence of smart home technologies like voice assistants and robots, the use and adoption of interactive and experiential technologies for food interactions and social connection have not come into effect. Recent calls for advancing Human-Food Interaction research have also highlighted the opportunity to channel the cultural and sensorial rich aspects of food experiences through modalities beyond just the digital form (Dolejšová et al. 2020).

Human-Food Interaction (HFI), a rapidly advancing field in HCI and CSCW research, is defined as "the interconnection between the self and food" (Deng et al. 2021; Dolejšová et al. 2020; Khot and Mueller 2019). "The self," as discussed in 2.1, tends to draw their food values from familial interactions. Therefore, there is much overlap in research between family studies and designing to augment individual interactions with and around food. Family mealtime is an example of a ritual that is pertinent to the study of inter-mixing remote communication, tangible elements, interactivity, and play. For example, The Telematic Dinner Party features a remote copresence dinner to engage in a meal despite geographical distance (Barden et al. 2012).

NetPot studies a remote Chinese hotpot experience through teleconferencing and projecting the remote diner's actions into one half of the pot (Foley-Fisher et al. 2010). Similarly, HFI and family studies have both applied the concept of playfulness in food interactions. Altarriba Bertran et al.'s speculative play during mealtime features PlaceMap, a tablecloth that highlights food rituals from various countries to the diners (Altarriba Bertran et al. 2021). TableTalk transforms family members' personal devices into a shared communal display for engagement during mealtime (Ferdous et al. 2016). Alhasan et. al put forward the notion of "performative eating", where eating is made playful through digital props such as models of food and backgrounds to impersonate characters or imagine events (Alhasan et al. 2022). This range of projects highlights the value of combining family rituals, such as mealtime and interactivity, through playfulness to create enrichment and social connection.

Current developments in Human-Food Interaction have shown how the convergence of food and technologies, such as robotics (Cobley and Boyle 2020; Suvie 2015; Yang et al. 2018), virtual reality (Nordbo et al. 2015), food printing (Altarriba Bertran et al. 2020; Wei et al. 2014), computational gastronomy (Cordeiro et al. 2015; Rettie 2003), and smart sensors (Barden et al. 2012; Cobley and Boyle 2020; Nawahdah and Inoue 2013), have the potential to push the boundaries of food

experiences. We are motivated to examine what such possibilities mean for family members and remote communication, and how those learnings can contribute to the future design of technology-mediated food experiences. We seek to investigate what food moments, rituals, and practices family members value and how they envision technology to support shared food experiences remotely.

2.3. Conceptualizing Technology-Mediated Social Presence

Within communication research, the notion of presence is defined as "a psychological state in which virtual objects are experienced as actual objects in either sensory or nonsensory ways." (Lee 2004). Presence has been categorized into various types by different theorists, a commonly used distinction being physical, social, and self-presence (Biocca and Harms 2002). Most relevant to our work and CSCW research is the idea of social presence, which points to how humans experience the representation of other humans through technology mediation (Lee 2004; Lowenthal and Snelson 2017). Because other humans are not present in this communication experience, it is up to technology (in most cases) to simulate representations through richness, intimacy, relatedness, or other forms of influence. The quality or effectiveness of mediation also has a high influence on the level of social presence experienced by the individual. The Social Presence Theory, first coined by Short et al. in 1976 also posits that social presence was a "quality of the medium itself" (Parker et al. 1976).

Modern research has introduced other dimensions of social presence that include contextual and individual properties (Oh et al. 2018). These dimensions could include the level of agency experienced, psychological perceptions of proximity, nature of mediated tasks (e.g., accepting care vs. receiving care), and combinations of personality and identity cues (Oh et al. 2018). Gooch et al. focus on emotion in personal relationships and how emotion is a key contributor to connectedness (Gooch and Watts 2015). For example, a phone call with a loved one could induce a stronger sense of connection and presence compared to a video call with a colleague. Gooch and colleagues also argued that communication design should be more holistic and consider the types of relationships (familial, romantic, or social) it supports and enables (Gooch and Watts 2015).

Within family studies, especially in long-distance contexts, social presence is often used interchangeably or presented in conjunction with the concepts of "connectedness", "closeness", "relatedness", "familiarity" and "intimacy." For instance, FamilySong, a domestic media space, promotes casual intimacy through synchronized music listening (Tibau et al. 2019). The wearable prototypes, WARMTH and BREADTH, focus on bringing physical or bodily closeness through the embodiment of negative feelings like loneliness (Beuthel et al. 2021). Mobile Flipper, a lightweight photo-sharing system, supports life event sharing to enhance social presence (Counts and Fellheimer 2004). KinVoices, an Alexa-based voice user interface, builds on the principle of familiarity to support communications through

a voice similar to a loved one (Chan et al. 2021). These systems, along with commonly adopted video-based interaction technologies (Ames et al. 2010; Furukawa and Driessnack 2012; McClure and Barr 2017; Follmer et al. 2010; Raffle et al. 2010; Roche et al. 2022; Strouse et al. 2021), provide examples of various ways that technologies can support long-distance families to connect and promote intimacy. As food activities are often perceived as multi sensory experiences, technology mediating presence through food experience may require an understanding of these experiences across modalities and interaction mechanisms. Prior work on social presence has shown the potential of crafting connected presence through a continuous network of mediated technologies (Kahlow et al. 2020). In this research, we build on these understandings to explore potential design implications that enrich and translate family food experiences across distances.

We adopt Lombard and Ditton's conceptualization of social presence while discussing how family members perceive connection with each other through food interactions. Lombard and Ditton identified six conceptualizations of presence: (1) social richness (feeling "warmth" and "intimacy" through a medium), (2) realism (perceptual and social feeling that the experience is true-to-life), (3) transportation (feelings of "you are there," "it is here," and/or "we are together"), (4) immersion (feeling submerged in a mediated environment), (5) social actor within the medium (losing awareness of the artificial or mediated interactions within a medium), and (6) medium as a social actor (losing awareness of the artificial or mediated nature of the medium itself) (Lombard and Ditton 1997; Lombard et al. 2006).

Through our analysis, we found connections between emergent themes and three of Lombard and Ditton's conceptualizations of presence. Social richness emphasizes the medium and its qualities, especially how "sociable, warm, sensitive, personal or intimate" the medium can be when used to interact with others. It also focuses on how accurate or true-to-life the representation can be and how the "social, symbolic, and nonverbal cues" of humans are relayed. For a very long time, video and communication technologies have strived to reach a high level of clarity and "immediacy" (Argyle and Dean 1965) to enhance intimacy. In the space of HFI, there is a potential to explore ways to incorporate meaning, sensory cues, and symbolism to generate intimacy and warmth. The conceptualization of transportation has connections to telepresence coined by Minsky (Minsky 1980) and defined as the sensation of "being there" at a remote site (a virtual or mediated environment in this case) (Nowak and Biocca 2003; Nowak 2001). Also pertinent to our analysis, and a concept commonly studied with telepresence is the idea of copresence. Copresence, first defined by Goffman (Schneider and Goffman 1964), is experienced when people can actively perceive others and vice versa (Nowak and Biocca 2003). Copresence is different from telepresence in that it is a mutual sense and renders each other "accessible, available, and subject to one another" (Schneider and Goffman 1964).

Lastly, in combination with the conceptualization, immersion, prior family systems have attempted to engage the communicators through means of activity in a

shared space (Mogharrab and Neustaedter 2020; Pan et al. 2015; Rukangu et al. 2020; Heshmat and Neustaedter 2021). Connecting with our analysis and interpretations, these conceptualizations provide examples of how technology as a medium could potentially enhance social presence (Kahlow et al. 2020).

2.4. Technology-Mediated Food Experiences Through Social Practices Theory

In our study, participants co-designed and speculated on what technology-mediated food experiences would look like for them and their relationships with distant family members. A key aspect of our findings, alongside social presence, was the social context of technology support and mediation-specifically, the motivations, circumstances, and values behind why family members chose certain food experiences to be mediated. This motivated us to introduce another theoretical lens, that of Social Practice Theory (SPT), to better understand and articulate the ways in which family members benefit from mediated food interactions.

According to Practice Theory, a practice is a "routinized type of behaviour which consists of several elements, interconnected to one (an)other" (Reckwitz 2002; Castelo et al. 2021). Reckwitz suggests that social practice is formed by the interdependencies between the "elements" of bodily activities, mental activities, materials, background knowledge, know-how, states of emotion, and motivational knowledge (Reckwitz 2002). This was simplified further by Shove and colleagues, who proposed a three-element model consisting of Meaning, Competence, and Material (Shove et al. 2012). Meaning refers to symbolic meanings, social norms, and collective associations; Competence refers to skill and know-how; and Material refers to tools, technologies, or the stuff from which objects are made (Shove et al. 2012; Frost et al. 2020). We used these three elements to categorize and interpret our findings, specifically highlighting how family members adapted or envisioned adapting food practices for long-distance communication.

One of the notable advantages of a practice theory approach, especially with respect to the introduction or speculation of new technologies or media, is that it emphasizes the nuances, depth, and subtleties of how people engage with technology (Christensen and Røpke 2010; Feldman and Orlikowski 2011). This perspective reduces the risk of an overly technology-centric interpretation of people's needs. Additionally, an important characteristic of social practice is the linkage between the elements and how studying their interwoven relationships can be an indicator of social change (Shove et al. 2012; Castelo et al. 2021). For example, one study used this approach to examine how people's values and meanings around the practice of driving changed when they adopted electric vehicles in Norway (Ryghaug and Toftaker 2014). Another study applied this perspective to investigate Information and Communications Technology (ICT) use in practices such as shopping and social network maintenance, illustrating how ICT transforms these practices (Christensen and Røpke 2010).

Similar to how these studies have used Social Practice Theory as a tool, we adapt it to first articulate how colocated food practices can transform into long-distance mediated interactions. We then combine these interpretations into our design implications, which integrate advancements in HFI, considerations of social presence, and the mediation of social practices.

3. Method

We conducted interviews, photo diary studies, and co-design sessions with 16 participants who had family members they lived away from, and with whom they engaged in communication about food. All study procedures were virtual, and all participants were recruited from the United States. Recruitment was first conducted locally from a midwestern US state and then more broadly through social media. For local recruitment, we used community mailing lists and a volunteer program where individuals had experience participating in family health studies. For social media, we used Reddit to share study information and collect contact details of interested participants. Participants were all over the age of eighteen and geographically distant from their immediate family members. We recruited 16 participants, out of which, seven described having adult children living apart from them, and nine identified as having older parents living apart from them. We were particularly interested in individuals who have adult children or older parents who live apart from them because we hoped to gain more insights into individual food related practices and values after they live apart from family members as autonomous adults for some time. All seven participants who have adult children identified as female with an average age of 66.71 (55-73) years old. Among the nine participants who have older parents, there were four females and five males, with an average age of 26 (23-31) years old. We indicate our older parent participants with a "P" alongside their participant number and adult children with a "C" next to their participant number.

We did not collect information about race and ethnicity, and therefore the findings of this study may not capture or describe diverse cultural influences on family food interactions. However, we note that five participants mentioned cultural influences (Italian, Indian, Chinese, and Vietnamese) stemming from either their own background or from a significant other in addition to traditional American home-style cooking in their interview responses. The majority of our participants (all older parents and four out of nine adult children) were female, which is consistent with the literature on the gendering of roles in domestic activities such as food preparation (Inness 2001; Taillie 2018; Schaeffer 2019). Therefore, our findings may not resonate with the experiences and expectations of individuals with other gender identities. An additional point is that our study configuration is limited to adult parent-child family relationships and does not account for the experiences of

other diverse long distant family structures, especially taken out of the context of Western societies.

Detailed information about participant demographics can be found in Table 1. The study was conducted in three parts (detailed below). All study materials and protocols were approved by the university institutional review board.

3.1. Part One: Pre-study Interviews and Onboarding Sessions

We conducted short, semi-structured interviews as "pre-study interviews" followed by onboarding sessions where we explained study instructions to our participants. These were conducted over the phone and lasted approximately 30 minutes in total. The pre-study interview portion took about 12 - 20 minutes and the onboarding took about 6-7 minutes. Some of the pre-interviews were much shorter in duration because we were able to receive those participants' demographics and basic healthy eating information directly from the recruitment channel. Our goal for conducting the pre-study interviews was to capture participant demographics and other contextual information on living arrangements, communication patterns, and dietary habits. As the impact of the COVID-19 pandemic was still prevalent in the US at the time of the study, we also asked questions related to COVID impact on practices surrounding family communication, eating, cooking, and grocery shopping.

Table 1. Participant Demographic Information.

ID	Age	Gender	Occupation	Remote Family Members (age)
Older Parents				
P01	71	Female	Retired	Daughter (43)
P02	55	Female	Teacher	Daughters (22, 26)
P03	76	Female	Retired	Daughters (51, 46), son (44), and 4 grandchildren
P04	67	Female	Retired	Son (34) and 2 grandchildren
P05	62	Female	Financial director	Daughters (27, 33, 34), son (29)
P06	63	Female	Store owner	Son (37), stepson (43), stepdaughter (41), aunt (70)
P07	73	Female	Retired	Daughter (35), son (37), daughter-in-law, sister (66)
Adult Children				
C01	31	Male	Researcher	Mother (63), father (61)
C02	23	Female	Graduate student	Mother and father (50-60), sister (29)
C03	24	Female	Dishwasher	Aunt (68)
C04	29	Male	Student intern	Mother and father (58)
C05	27	Male	Product Designer	Mother (56), father (61)
C06	26	Male	Full-time student	Mother (50), sister (20)
C07	25	Male	Operations Manager	Brother (24)
C08	24	Female	Project Manager	Mother (48), father, brother
C09	25	Female	Graduate student	Mother (50s), sister (20s)

This generated responses such as participants having to call their family more, one older adult participant having to switch to delivery services versus in-person grocery shopping, and another having to change their living arrangement and move in with close family temporarily. Overall, since participants in our study already lived apart from their family members, they reported general, instead of covid-specific, sentiments and experiences of family food experience sharing, but we collected this data to have additional context while engaging with our participants. Following up on the pre-interview, the onboarding sessions involved researchers sharing and walking through study instructions, such as journaling expectations, journaling process, common questions, and contact details. Participants were compensated with a $10 Amazon gift card for their time participating in the pre-study interview and onboarding.

3.2. Part Two: Mobile-Based Photo Diary Studies

We asked participants to photo journal any two "food-related experiences" for two weeks including weekends. We emphasized the term food-related experiences because we wanted to leave it openended and capture what was interesting to our participants whilst doing a range of activities related to food, such as its preparation, presentation, consumption, and sharing. We encouraged participants to not limit their entries to just meals. Along with each photo entry, we also asked participants two follow-up questions: (1) Tell us more about this photo, and (2) Would you like to share this photo with your remote family members? If yes, why? If not, why not? The photo diary study was conducted over Google Voice where a member of our research team would send participants two text messages daily (Figure 1). The text messages were personalized with the participant's name and contained a reminder to journal and answer the two questions on photo context and whether or not they would share that photo. Participants were expected to journal a minimum of two entries a day. Our participants fulfilled this requirement for the most part, except for a few instances (less than three) of participants forgetting and one instance of a participant suffering a personal loss and not being able to journal.

Our goal with the photo diary study was to motivate participants to reflect on their food and eating habits as well as their interactions with distant family members when it comes to food. We chose food photos because they are relatively easy to take and provide extensive contextual information to support reflection (Cordeiro et al. 2015). We also wanted these photographs and textual responses to serve as probes or artifacts that could be used to elicit design ideas in the co-design session later. Photo diaries carried the limitation that participants may not think beyond photo sharing and other digital communication mechanisms when thinking about food experience sharing in the co-design sessions. This was a consideration that influenced how we designed our "What if" card sketching activity, where we included a mix of prompts that encouraged participants to reflect on their food behavior and family

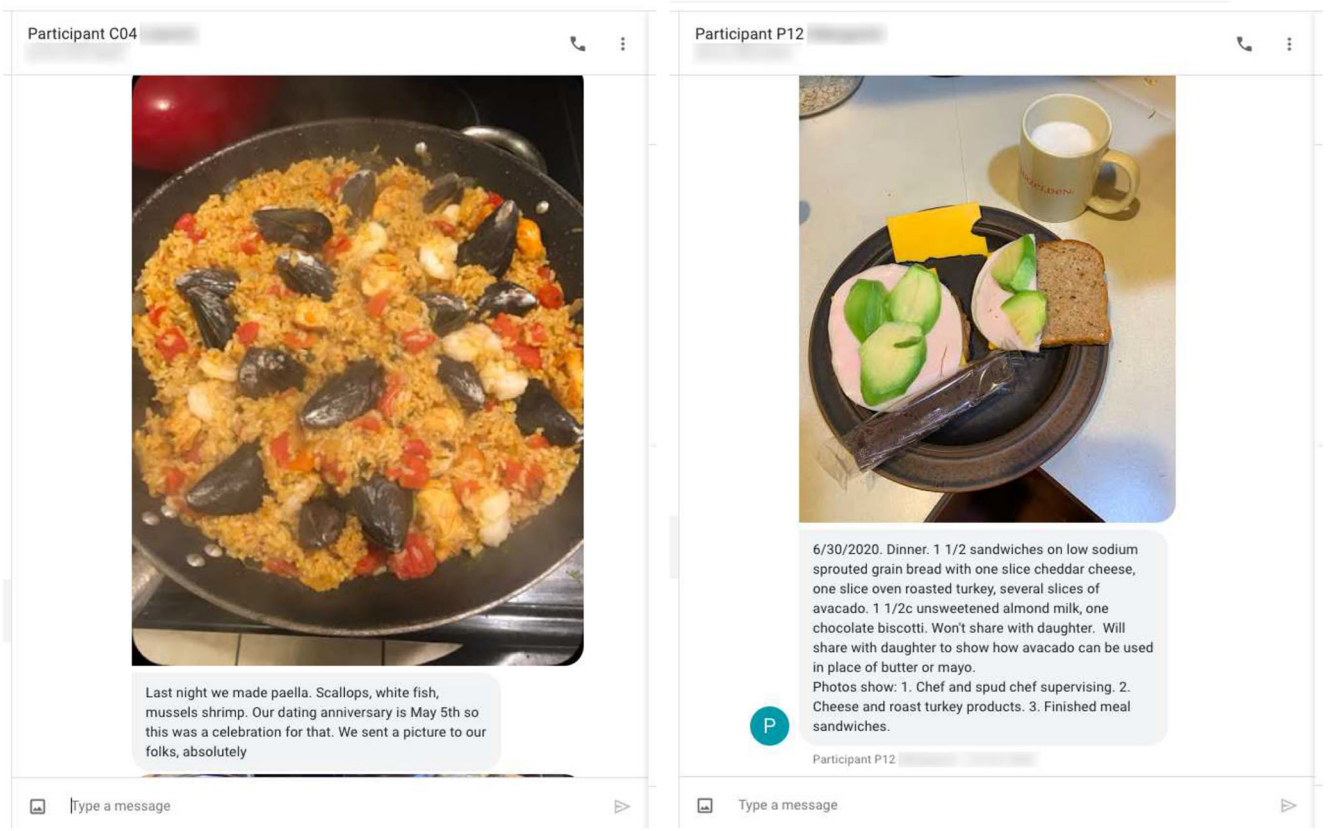

Figure 1. Example photo diary entries sent in by participants on Google Voice.

relationships but also not feel constrained by traditional technology limitations and modalities.

3.3. Part Three: 1-1 Virtual Co-Design Sessions

After two weeks of photo journaling, participants were invited back for a 2-hour design workshop conducted virtually over Miro[1], an online collaborative workspace. Zoom[2], the video conferencing tool, was used to run and record the co-design sessions. Since part two and three of the study were interlinked, participants were compensated with a $40 Amazon gift card for participation in both.

The co-design session consisted of two parts: (1) a photo sorting activity, and (2) what-if card sketching.

3.3.1. Photo Sorting

Photo Sorting was the first activity we performed with our participants. First, we laid out all the photographs and textual entries participants sent to us during the photo diary studies in a card format on Miro (Figure 2). Then we asked participants to reflect on their information and talk about the journaling experience (e.g., what surprised them or what was interesting). We also took this opportunity to ask clarifying questions and other follow-up questions. Finally, we asked participants to sort their data into two piles: What participants were most likely and least likely to share with remote family members. Participants were encouraged to think out loud as they performed the sorting. This activity allowed participants to reflect on their journal data (including the photos and text responses) and elaborate on the context and consideration of their sharing decisions with their remote family members. This reflection also allowed participants to re-examine their thoughts about sharing and identify the tensions behind their decisions. It also shed light on values about foods, eating behaviors in participant families, and the type of conversations participants had with family members. This part of the workshop took 30 minutes to an hour.

3.3.2. What-If Card Sketching

We then had participants do a "What-If Card" activity. In this activity, participants were given six prompts with exploratory, "What-If," questions surrounding food and eating habits. For instance, one of the questions was "What if you had a magic machine to cook with your remote family member?" Participants were then asked to sketch out designs for what these different scenarios could look like (Figure 3). They were reminded to be as imaginative as possible in their designs and to feel free to design with no technological or physical limitations. Participants were asked to explain their sketches and answer a few follow-up questions regarding their ideas.

[1] https://miro.com/

[2] https://www.zoom.com/

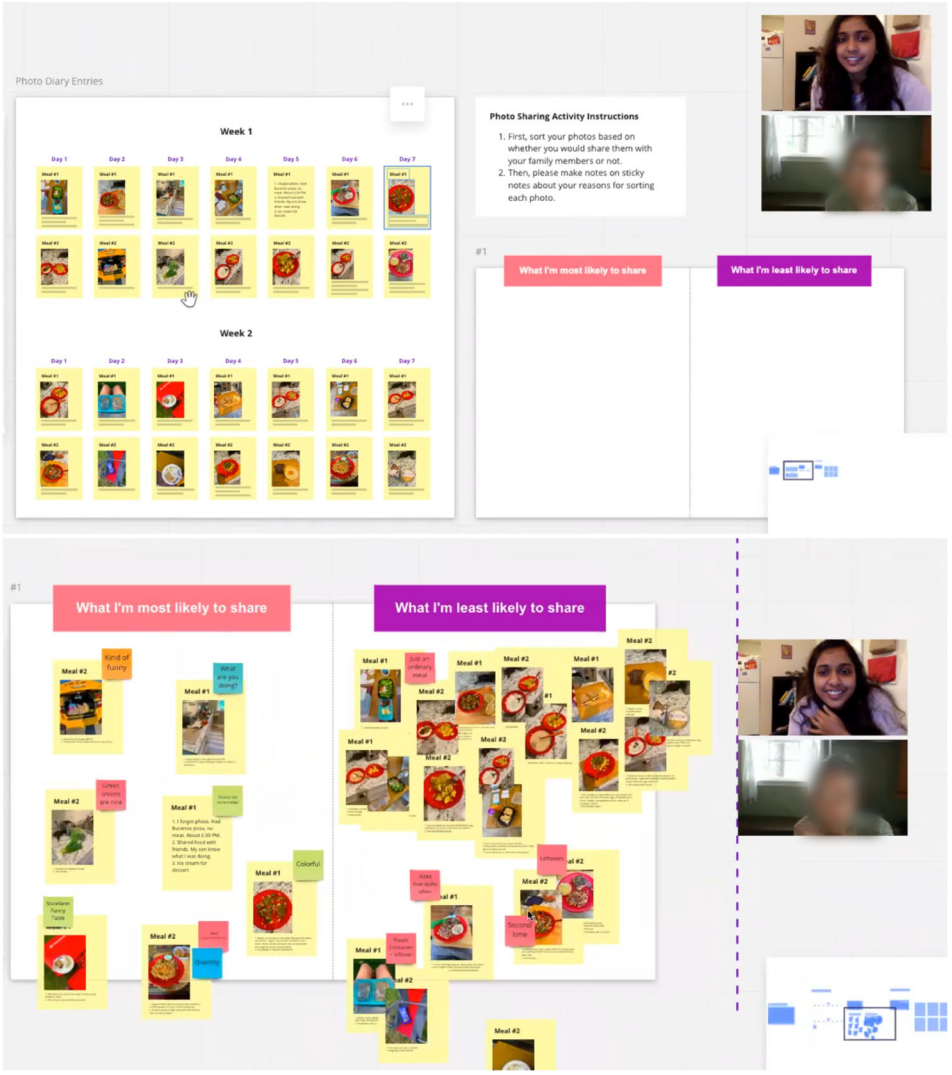

Figure 2. Before and after images of a participant sorting their photo diary images on Miro.

All participants' "What-If Cards" were then analyzed through memo writing. This activity took 40 minutes to an hour.

3.4. Data Collection and Analysis

The study in its entirety generated three types of data: (1) transcripts of the pre-interview and codesign sessions, (2) photos of participant food experiences with their descriptions, and (3) design sketches made by participants. All transcripts were first anonymized and then manually checked to correct any mistakes. The

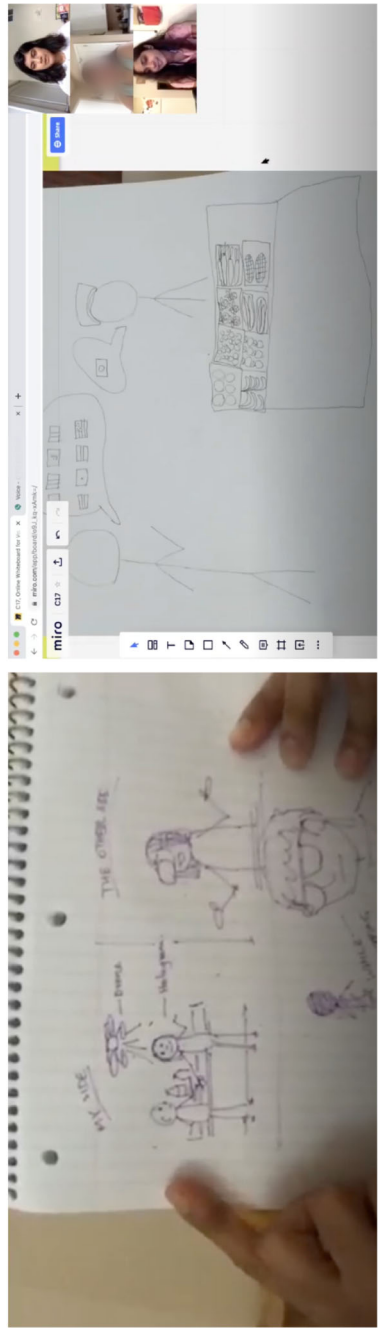

Figure 3. Participants discussing their design ideas.

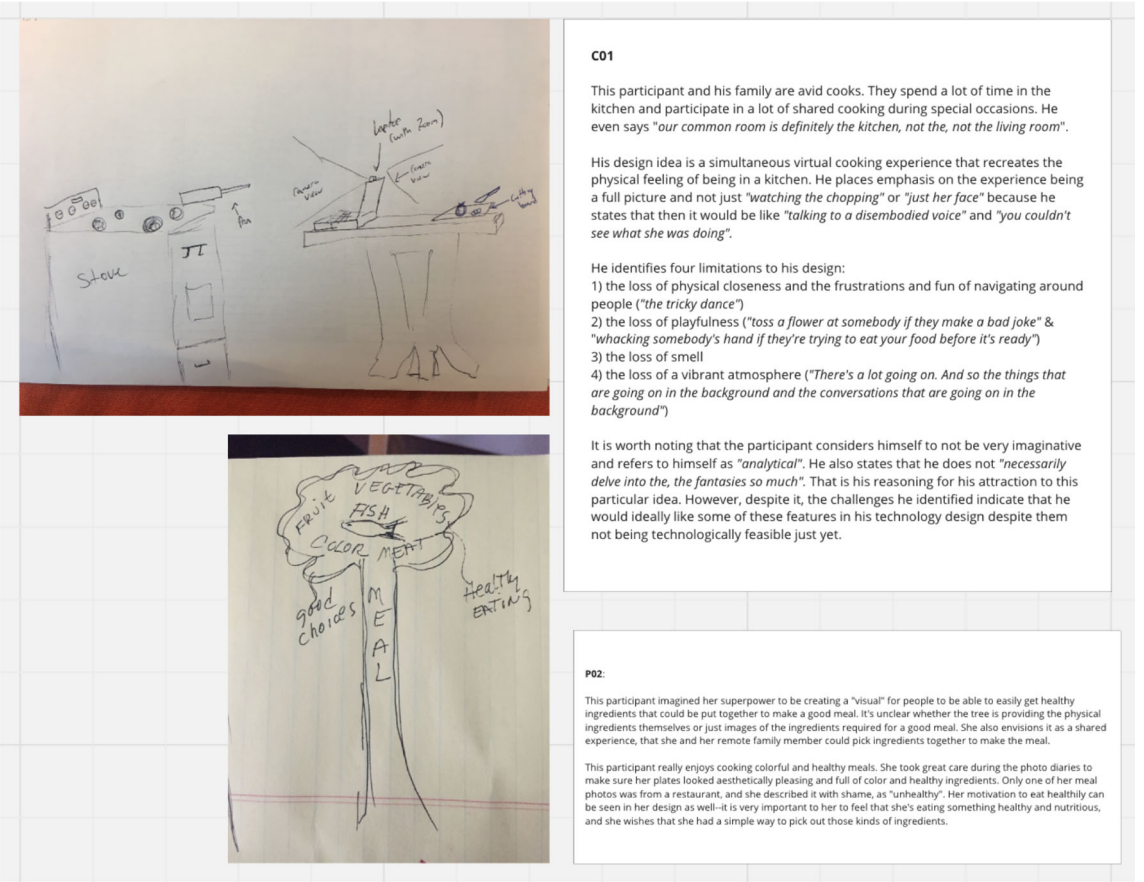

Figure 4. Snapshots of the data analysis process with participant sketches and corresponding reading memos.

transcripts were then uploaded to a qualitative analysis tool, Saturate app[3], for collaborative coding. All researchers first conducted open coding (Braun et al. 2019) on the first four transcripts separately and met to discuss the codes used. The initial set of codes was then put into a codebook for further analysis. This codebook was updated as the analysis progressed. The researchers held weekly discussions to ensure that there was a common understanding and iterated on themes emergent through the analysis process. At the same time, the research team continued to conduct data collection until it reached data saturation - "when new information produces little or no change to the codebook." (P. 65) (Guest et al. 2016). The photo and textual data from the photo diary study were organized into separate documents where the researchers made collaborative notes on data points that required additional clarifying questions during the co-design sessions. Lastly, the design sketches produced from the co-design sessions were uploaded to the collaborative board, Miro, and analyzed through writing reading memos (Charmaz 2014). In these memos, researchers interpreted the sketches and descriptions by connecting features of their proposed design with prior pre-interview and co-design data on their familial structure and sharing practices (Figure 4). Researchers also paid attention to participants' choice of modalities for their designs while analyzing the sketches.

The research team then met to discuss and create high-level abstractions from the themes emerging from the data analysis process. After several rounds of iteration, the emergent research insights were organized into the three-element model of Meaning, Material, and Competence proposed by (Shove et al. 2012), which we found to be an organic fit. For instance, participant descriptions of designs that helped them teleport into their family's space or feel co-present with them demonstrated the use of material such as technology and familiar objects. Additionally, we found SPT to be a useful tool for examining the linkage and relationship between the findings and how they support social presence through food practices in a remote setting. To ground our discussion of these themes, the research team also brought in literature from Social Presence and HFI. The Social Presence literature helped identify connections between the emerging themes in our data and established concepts, such as copresence and telepresence. It also highlighted unique family-specific dynamics, such as instances where agency is challenged. The HFI literature provided valuable insights for ideating potential design directions.

4. Findings

Through our study, participants shared their motivations for food-related communication and sharing with distant family members. They reflected on what they valued in those interactions and what made them feel closer to their family. Additionally,

[3] http://www.saturateapp.com/

they speculated on the context, features, and capabilities of future technologies that could mediate food practices and support social connection.

In this section, we present our findings through the lens of SPT (Reckwitz 2002; Shove et al. 2012), which describes a practice as composed of Meaning, Material, and Competence. Our first set of findings, categorized under Meaning, relates to the shared understandings, symbols, and social norms surrounding food practices. We describe how family members leveraged these meanings as a trigger for connection. The second set of findings, categorized under Material, focuses on the spaces, tools, or technologies participants considered as possible building blocks for mediated experiences. These material elements, and their potential to make participants feel like they are present together in the same food space (eg., transportation), align with Lombard and Ditton's conceptualizations of presence (Lombard and Ditton 1997). Finally, our third set of findings, categorized under Competence, examines the knowledge and understanding family members have of each other's food habits to facilitate engagement, navigate boundaries, and coordinate their activities effectively when translating collocated activities to remote ones.

4.1. Extending Past or Known Family Food Meanings Into Reminiscence, Dialogue, and Scaffolding

Family interactions around food carry meaning. In our study, we observed that implicit or explicit meanings behind actions, such as sharing recipes, upholding traditions, or having a diet-related conversation, were a motivation or prompt for remote family communication. These findings, aligned with Meaning from SPT, highlight the potential of leveraging past or known familial meanings to create connected experiences when distant from one another.

Knowledge sharing While participants in our study were more likely to share pleasant and aesthetic food experiences, frustrations and failures in the kitchen created moments where they sought out family support and guidance. For example, C09 typically did not share pictures of food that were considered "unglamorous" with her mother. However, one day she was having an especially frustrating experience and needed help to scrape food that was stuck to a pan. This immediately made her think about her mother who, according to C09, would know what to do.

> "I think, maybe at the moment, in my frustration, I was like, oh, I need to fix this problem so bad. I need to text my mom and ask what she would do." - C09

It seemed that C09 recognized her mother to be the most knowledgeable person on the topic and someone she could rely on for guidance. Prior literature on family communication talks about how family members can converse using familiar symbols and have a shared understanding of language (Lupton 1994; Panicker et al. 2020; Petrelli and Light 2014). It is possible that C09's mother was the person who would require the least amount of explanation from C09 to understand the

situation at hand and could offer the help and support she needed. This extension of past in-person family interactions and understandings into remote family conversations shows how family communication evolves to support new contexts and interactions.

We also found that family members relied on the synchronous nature of technologies to engage in live support and guidance surrounding food activities. In most cases, participants used communication channels that were most familiar to them, such as audio or video calls. Sometimes they also mixed multiple communication channels to build a more complete experience. In P02's example, she described how her daughter sent her pictures of a recreated version of P02's eggplant dish and sought advice on how to make it less salty.

> "She made the eggplant and sent me a picture of how it looked and how she had put in more salt than she should have or stuff like that. Then I'll walk her through the recipe on the phone." - P02

P02 then communicated with her daughter through audio and shared advice on how to improve the situation. This interest or need to use more than one channel of communication was also consistent with what participants were expressing in our design workshops. While sharing knowledge related to cooking or other food practices, they liked being able to see what was being prepared but also wanted the capability to see their family members and how they engaged with the food. Another reason why participants relied on technology or services for knowledge sharing was that it gave them a medium through which they can share healthy habits or healthy behavior without being perceived as judgmental. To bond and share healthy habits with an adult daughter who lived further away from her, P03 and her daughter subscribed to the same meal kit service and had conversations about what each other would like. This created a way for them to discuss food and recipes.

> "She subscribes to Blue Apron[4] also. So, I think it's helpful sometimes to have somebody that's had that exact meal say this was good or this wasn't good. And that helps her pick. …" - P03

While reflecting, P03 also noted that she did not want to control or overwhelm her daughter with her expectations. Instead, she wanted to gently encourage her to form a habit of cooking. This suggests that knowledge sharing can shift the focus from traditional family dynamic-led behavior, such as mothers advising their children on how to eat, into a more shared partnership around conversations about food.

Tension Resolution Participants in our study often had to talk about changing diets, lifestyles, or living arrangements with their close family. This can be as simple

[4] https://www.blueapron.com/

as a life update, but it can also be a situation where there needs to be a two-way conversation with the goal of mutual understanding. For instance, if a family member has decided to follow a different diet because of their personal values (e.g., vegetarianism), goals (e.g., weight loss), or health concerns (e.g., cholesterol), they end up having to talk about it with other family members so that accommodations can be made when there are events or interactions involving food. Sometimes this can go smoothly, but depending on the nature of the topic, it can also lead to friction or tension. For example, C06 described his mother as an intuitive cook who did not take any health considerations while preparing meals. C06 shared that this was at odds with his personal health goal and whenever he visited his mother, they ended up never agreeing on what to cook or eat. He talked about how, at one point, he made the personal decision to make his own meal so he could monitor his health.

> "The thing with my mom cooking is, she doesn't take any health considerations. She just cooks what she feels like. One time when I told her I'm just gonna make my own meals, she kind of got angry and she's like, Oh, you are rude. You're being selfish." - C06

To accomplish his health goals, C06 was willing to prepare his meals. However, this created tensions at home as his mother was accustomed to being the food preparer, a role that has historically been assigned to women due to long-standing gender norms (Holm et al. 2015). This resulted in him needing to have a conversation with his mother to tell her about his health plans and why it was important to him.

> "I told her... you know I got in touch with a dietitian. This is my plan, it's better for me to do it because I take the time to weigh my food and take in the nutritional facts. So it's better if I do it so I can properly manage and measure my intake, things like that." - C06

This also prompted C06 to reflect on why his mother was uncomfortable with letting someone else handle what she felt was her responsibility. While C06 didn't necessarily agree with her thinking, he demonstrated his awareness of her feelings, and it influenced how he chose to communicate the situation.

> "The only thing I can say is probably what she won't like is just… she still has that mom mentality where she feels like it's her job to cook the food. Sometimes she doesn't like it if it's not her who cooks the food. Let's say, it's not that she doesn't like your food. It's just that it doesn't feel right for her if somebody else makes the meals." - C06

C06's exchange with his mother pointed to the importance of having shared meanings and understanding when having a conversation about health. Like C06, another one of our participants, C05, also talked about difficult conversations that involve taboo topics, such as alcohol consumption (discussed further in Section 4.4). Both these examples highlight that having intentional, albeit diffi-

cult, conversations to reach mutual understanding helps families address tensions around diet and healthy eating habits.

Tradition Keeping Family members often practice and maintain traditions, such as celebrating significant events, having game nights, spending vacations together, and performing various other patterned family interactions (Wolin and Bennett 1984). Prior research views traditions as rituals that play a key role in a family's collective sense of identity (De Backer 2013; Mason and Muir 2013; Petrelli and Light 2014; Wolin and Bennett 1984). In our study, we found that conversations around such traditions were a crucial part of staying connected and conversing about food. For example, P05 talked about her family's practice of having a "Pizza Friday night". When together, this practice served as a motivator for her and her son to find and experiment with different recipes. When apart, this created opportunities for having conversations about pizzas they have made and exchanging pictures and recipes with each other. During the session, P05 also commented that she and her son conversed about food and cooking a lot. This points to how family traditions around food have the potential to evolve with time and create opportunities for intimacy and shared hobbies.

> "We love pizza, we always have Pizza Friday night. But I've been experimenting with different crusts and homemade pizza crusts. And my son is the one that got us started on the homemade crust. We usually talk to him most evenings and we always seem to talk about food. I definitely would have said, Hey, I made a homemade pizza crust. And he probably would want to know what recipe I use. And then, you know, I just would have to tell them what I put on it." - P05

In the case of C04, he talked about his family's tradition of doing something nice for their mother on Mother's Day. He elaborated that the meaning or the significance of this practice was to recognize all the hard work that their mother did for their family and to present her with a relaxing day for herself.

> "She's generally always been the cook. So, I think especially because Mother's Day is Sunday, we always try and do something nice for her, let her relax all day. She is always running around. She usually does the cooking and traditionally we do the cleaning up. But it's just nice for her to take it easy every once in a while." - C04

Another participant, C08, shared that she would send pictures of fruits to her parents during the photo-sorting portion of the design session. When prompted to elaborate, she reminisced about how her parents would give her fruit while studying and referred to this as their "love language." This act carried meaning for her and triggered her to establish contact with her distant family.

> "I would share the watermelon because my parents... like the love language is giving your kids fruit while they're studying and stuff like that. So that's one that I would share with them." - C08

In these three examples, P05, C04, and C08's families kept traditions or practices that were not vastly different from typical families. However, how they derived meanings from traditions and put in the effort to maintain them through related conversations or new interactions was significant. This suggests that technologies for families should consider existing familial practices and traditions to extend meaningful connecting experiences across distance.

4.2. Material Needs for Mediating Food Practices and Shared Presence

Food spaces such as the kitchen and dining area hold family memory and familiarity. When describing food experiences, our study participants situated them in shared physical environments and wanted technology to amplify the feeling of "being there". These findings, aligned with Material from SPT, highlight how the spatial and sensory aspects of the family's food space (through space, technology, and tools) enhanced the feeling of being present with one's family.

Transportation A common design that participants created, which is an example of telepresence, was a window or portal into each other's kitchens. C04 described this concept and how it would enable him to feel his mother's physical presence in his kitchen:

> "I was imagining a concession stand window, kind of like a window into each other's kitchens. I didn't really know how to show that. Other than her floating, I would just see her floating head on the other side, I guess. It's almost a big TV screen, but it'd be like she's actually there." - C04

C04's design of this "window into each other's kitchens" indicated a wish to have his mother be a part of his environment and for him to be in hers' as well. His design achieved this by having a lifesized visualization of his mother on the wall of his kitchen and allowing his mother to view him in the same way.

Sensory Experience Sharing Another aspect of shared physical environments that participants mentioned was shared sensory experiences, that is, being able to share the same senses, such as smells and tastes, despite being far away from each other. This can be seen in P02's idea of cooking together with her mother, who lived in a different country from her, with the added feature of being able to smell each other's meals:

> "We would share the recipe; we would be smelling it together. The whole, entire experience of cooking together is a complete feeling now because I'm not only able to smell the food that she's cooking, I'm able to see what she's doing. She's able to see what I'm doing." - P02

Similarly, P07 designed a magic machine in the What-If card activity that would produce only the sensory qualities of a meal she chose for her remote family member:

> "I'd be able to see the person that I'm talking with ... And then over to the right, those four things coming out of the side of the box would be the aroma of whatever it was that you were fixing. The texture, the temperature, and the taste." - P07

P07's unique design emphasizes sharing the sensory parts of a meal-its texture, temperature, and taste-over the actual meal itself. This type of sharing brings realism and physicality to what is still a virtual experience.

Agency Control In addition to feeling the presence of family and wanting to experience their shared food space, participants also indicated wanting some level of control or agency in the food experience. For example, C08 imagined being able to be a part of her family's kitchen in the form of a robot:

> "It's like a little robot that you can control, like that Black Mirror episode with Miley Cyrus. But you can have your webcam, in that little red circle where your face would be. And you can control it and walk around the kitchen or the countertops while they're cooking. It's interactive. Instead of it being like a computer screen, you just move around with them." - C08

In this design, C08 did not appear as herself in her family's kitchen but as the body of a robot. She was able to view them and navigate the environment in a way that would be realistic from her perspective, but not for her family, who would interact with her in this robot form. Contrasting to ambient telepresence examples brought up by C04 (Section 4.2, Transportation), C08 wanted to have control and agency as well as be actively "present" in the remote family member's environment.

4.3. Competence in Fostering Engagement, Navigating Boundaries, and Coordinating Time

Activities such as cooking, food-themed games, grocery shopping, gifting, and dining were either already occurring (with participants wanting to expand upon them) or were desired as ways of interactive technology-mediated connection. Essentially, participants demonstrated an awareness of what activities would be meaningful, playful, or delightful for their relationship, aligning with Competence from SPT. An interesting aspect of this category of findings was that participants not only knew or speculated on what activities they wanted to engage in with their family but also highlighted how individualized goals, boundaries, and understandings shaped the construction of such joint activities.

Individual Goal Fulfillment A salient aspect of the shared activity designs our participants proposed were the individual and personal goals that participants carried

into a joint family activity. For instance, C01 described him and his family as cooking enthusiasts who thoroughly enjoyed engaging through food and any related topics. Therefore, his design idea involved using video calls to cook together with his remote family to have a good time:

> "So basically just using Zoom here on a laptop while we're cooking things on the stove and preparing things, cut and chop and, just generally making the recipe over Zoom together at the same time. And what would be interesting and fun maybe whoever is on the other side, be it my brother and my mother, whichever family member, to make the same recipe simultaneously. And then see how they differ based off our personal style of cooking and our personal style of preparation, I think would probably be the most realistic way to approach something like this." - C01

Here, C01 imagined a joint cooking activity to do with his remote family members, in which they cook the same recipe and compare the results. He saw cooking together as a fun activity, almost as a game or competition, to see how each family member's meal turned out differently.

In a different example, participant C05 imagined shopping together as a shared activity with their family member. C05's mother lived in a different country and he wanted her guidance on finding the right ingredients for the traditional meals of his culture.

> "One of my challenges is having the ingredients in the first place. So what if I had these glasses while shopping that could see what I was seeing and we were continuously on a call so that they [remote family members] can point me to the right ingredients to make whatever I need to so that I can actually get the right ingredients and not fuck up on that side. Especially with Indian cuisine, there are so many different spices. There are so many different lentils … and I can't identify them by the names, like those names in the Indian stores might not necessarily be the same names that are sold in India. So, I would want them to see what I'm seeing so that they can actually tell me that it's the right one or not." - C05

Here, C05's activity choice was driven by utilitarian motivations. This was an activity that he wanted to participate in with his remote family member to get something done, not consciously to want to connect or socialize. Similar to C05, Participant P05 also brought up shopping as a shared activity. However, P05's reason for choosing this activity was to influence her daughter to eat healthier:

> "So that [referring to the sketch] is my daughter and me. We're at the farmer's market because I'm always trying to get her to eat healthier. If I took her [to the market] and we talked about ... because she likes to do food prep on Sunday, I do too. We could talk about … you could buy that melon, cut it up, you'd have it all week, or you could cook this corn and then you know, it would be all ready for you. You wouldn't have to eat junk food; you can have a healthy

> meal. I would think it would be more like a shopping trip, where we're talking about what we're going to plan for the week and how [to] incorporate the fresh, healthy foods into that." - P05

While C05 wanted to shop with his mother to accomplish a task, P05's reason for shopping together was to help her daughter with her eating habits. She wanted to bring her daughter to what she saw as a healthy environment-a farmer's market-and encourage her to improve her diet. This is another example of a participant wanting to share in an activity with their remote family member but with the underlying motivation to change that member's habits.

P05 went on to explain that participating in a farmer's market trip with her daughter was a more non-confrontational way to address her eating habits:

> "Well, I think it's really hard to talk to an adult child. And say, you know, you're eating really poorly. But I know if she would eat better, she'd feel better and have more energy. So, you know, sometimes being non-confrontational about it and more, you know, let's do this together and see, what do you think would be a better way to handle it?" - P05

P05's idea showed how a shared activity can be useful beyond the stated purpose of that activity. Shopping together at the farmer's market was not just about shopping, but also about guidance and conflict avoidance. All these participants wanted to engage in activities with their remote family members-cooking and shopping together-but their reasons were completely different. C01 wanted to connect and have fun, C05 wanted to accomplish the task of ingredient shopping, and P05 sought to influence her daughter's eating habits. These examples show an opportunity for technologies for remote families to support a variety of shared activities and fulfill their individualized goals of interacting with each other.

Playful Engagement Participants in our study often introduced an element of playfulness when describing shared food activities. In C01's example above (Section 4.3, Individual Goal Fulfillment), he wanted to engage in a remote cooking scenario that involved comparing and contrasting the outcome. Other participants, such as P04 also had similar thoughts:

> "Does [son and his partner] do it this way? And then you could look at the finished product and see how theirs looks as opposed to mine. Or did they like I have bright red dinnerware, so I would serve my dinner on a bright red plate. And maybe they would serve theirs on a white plate or… You'd see a difference in the personalities that would come out in the way that the actual meal turned out." - P04

P04 elaborated that preparing the same meal remotely might have common processes and ingredients, but it can still look different or be presented differently owing to individual personalities. P04 found amusement and joy at the possibility

of catching such nuances. Another participant P05 liked the idea of having themed food challenges:

> "I was thinking it would be really fun to have like a food challenge. But around the theme, you know, might be like, healthy Mexican, or, you know, haul from the farmers market. Or it could be healthy desserts and everybody has to come up with a recipe and tell what's in it, share the recipe, and share what it looks like" - P05

P05 saw incorporating a theme as a fun way to engage everyone and take part in the shared activity. She also intermixed some of her values such as going to the farmer's market and getting fresh produce into the shared activity as a way to incorporate more healthy eating into her family's diet.

This was a pattern seen in P03 as well:

> "And then the players are around the periphery, and they consist of the California family and If the small figure of the top right, which is the child eats the carrot, he gets fortnight[5] bucks and assigns the number two. And if the mother, my daughter, eats celery and throws her crackers and cheese away, she gets a ranking of a number one." - P03

Here, P03 came up with a remote game idea where substituting the family's meal choices for healthy options would earn their family members points as a reward.

In C01, P04, P05, and P03's examples, they saw opportunities for incorporating playfulness for different reasons such as fun and imparting healthy habits. While there is an opportunity for technology to include playful or gamified aspects of food and food practices, care also has to be taken to ensure or check that family members have compatible goals on the topic.

Timing Expectations and Understanding A trend that was observed in the designs created by our participants was that a majority of them were synchronous in nature. For example, P05's remote shopping and themed cooking ideas required both parties to be present. The same was the case for C05, who suggested remote shopping together through linking together a telepresence drone and smart glasses. C09's design idea was to have a holographic presence of their family member in their kitchen but with a limited agency. P07's design was cooking together nostalgic meals from their shared childhood summers over FaceTime. While there was no one reason given or shared by participants on why synchronous sharing was what they defaulted to, it is possible that they were mimicking or drawing their ideas from existing communication technologies and how they function.

Despite expecting synchronous presence and communication, participants also demonstrated awareness of their family's schedule, communication styles, and time zone differences:

[5] https://www.fortnite.com/

> "But he's a very restless high energy kid, easily distracted. So, she's got a lot on her plate. But I can see why you might not want to do chocolate babka" - P03

Here, P03 talked about how her daughter probably did not have the time to make a laborious pastry (chocolate babka) due to her being a parent and shared her opinion on how that was completely within reason.

Another participant, C05 talked about his communication dynamic with his mother:

> "I generally call my mom. But that's only because like, otherwise she just assumes that I'm busy. That's all. Because like, you know, she doesn't know when I'll have the time to talk. So she leaves it up to me to call her" - C05

C05 stated that his mother left it upon him to initiate conversations. He elaborated further and added that the reason for this setup was due to his busy schedule and his mother being unsure of his availability.

P02, who had family overseas, talked about how a core part of her family (her parents and another extended family) was not able to participate in a lot of her milestones. In fact, P02's design sketch was an "incomplete dining table" because a part of her family was not present at her birthday party (Figure 5). These examples highlight how family members seem to implicitly desire or want to feel connected to their distant family through participation in activities that make them feel like they're still a part of each other's everyday life. However, the challenge here is more of a practical one, where family members have to work past schedules, time zone differences, and communication expectations to freely interact and engage with one another.

4.4. Tensions and Blockers

Participants in our study were not without reservations when it came to the sharing of food-related experiences. We refer to these findings as "tensions and blockers" and they were primarily observed in the photo-sharing portion of the co design session, where participants had to describe what they would or would not share with their remote family. Some of the common reasons for not sharing were the mundaneness of meals, unhealthiness of meals, certain meals or foods being taboo, or meals being "ugly" and not aesthetically pleasing. These findings highlight some of the challenges in mediating food experiences, particularly when it comes to setting boundaries, protecting privacy, and navigating judgments regarding one's food choices or health decisions.

Food and Diet-related Judgment Several participants in our study openly expressed not wanting to share meals that would be viewed as unhealthy with their family members:

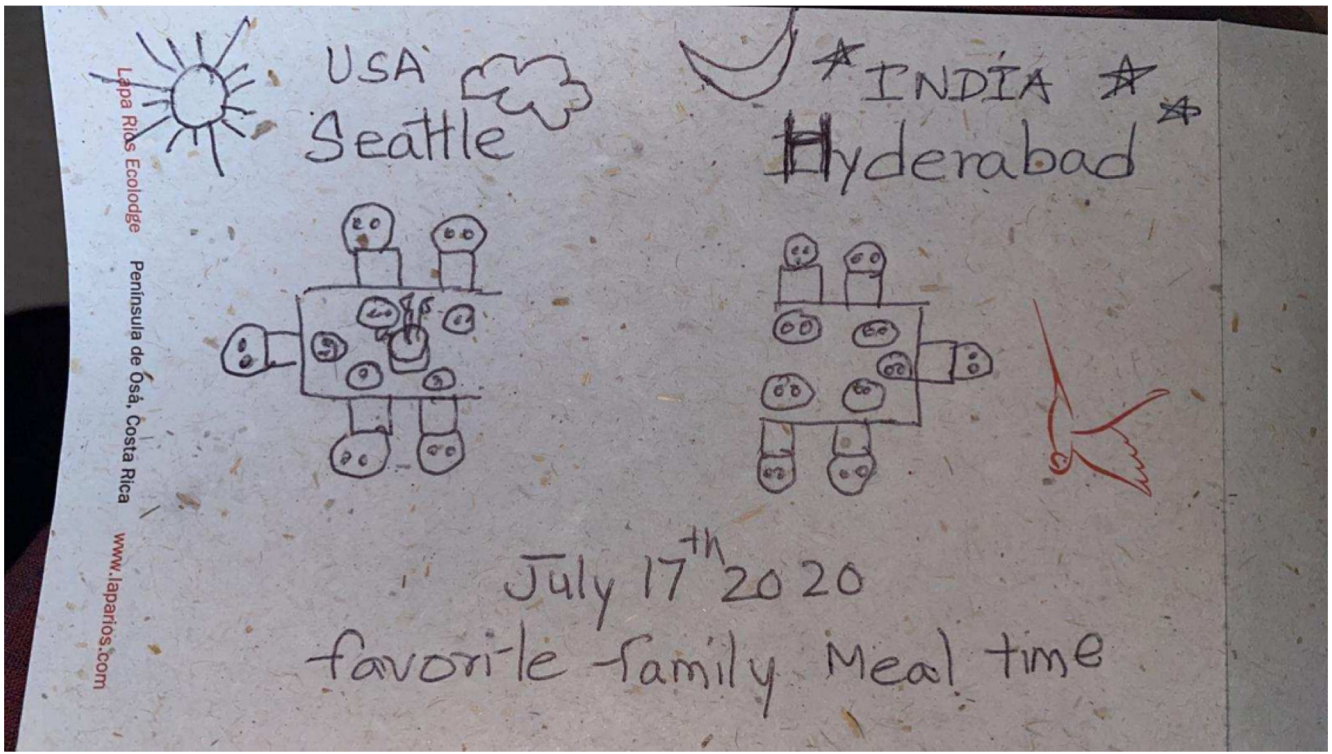

Figure 5. P02's design sketch of an "incomplete dining table". The image shows one-half of her family in the US and the other half in India during a personally significant mealtime experience.

> "I think for [not sharing] the pizza it would probably be because of the unhealthiness mostly to my mom or my dad, and other people." - C02

> "I think almost everything I make is healthy. I pretty much always eat what you saw, what I presented to you is really a good snapshot of the way I eat all the time. Of course, I didn't throw in my Dairy Queen ice cream cone or my malt when I go there." - P01

In C02's case, she did not want to share pictures of the pizza she ate with specific members of her family as she was used to negative comments on unhealthy-seeming food and did not want to experience that judgment. P01's remark was more casual, and when probed, stated that she was fairly confident about eating healthy meals and implied that her preference for not sharing was due to not wanting to present an unhealthy image of herself. These participants felt shame around sharing meals that are viewed as unhealthy, even if they did not eat unhealthily in general. They preferred to leave out mentions of pizza and ice cream to their family members, even if the rest of their meal habits were healthy. This tension around what makes a meal unhealthy and whether it is okay to eat certain food could deter individuals from openly sharing their food experiences with family members.

Missing or Misrepresented Context A different tension that came up in our study was the possibility of communication technologies missing context and misrepresenting a situation. This was observed in the case of C05, where he, similar to participants in section 4.4.1, did not want to share meals that would portray the image of an unhealthy lifestyle to his remote family members. The difference in this scenario, when compared to the earlier tension of being judged, is C05's lack of trust or skepticism of technology and how sharing wasn't worth risking a delicate or difficult situation with his family:

> "This thing of having two coffees, just on the surface itself, looks unhealthy. You associate it with someone who just sits and drinks coffee all day in front of a laptop. But it's actually not like that. Like, this is just coffee for me, although it's two cups. It's actually not the same kind of coffee that I might get at a cafe. If I went to a café, I would just get one coffee, it has a thickness and richness to it. Whereas this is actually quite watery. So, if I've just drunk one cup, I don't feel like I've drunk anything at all. It's not about being highly caffeinated." - C05

In this example, C05 did not want to share that he was drinking two cups of coffee in one sitting with his remote family members because they would not understand the nuances of why he was drinking it. His family members lacked the context surrounding the food experience and would be concerned about his unhealthy lifestyle. This is a tension that could impact shared environments between remote family members and create conflict. That is, if food experiences were conveyed as a shared environment to a remote family member without context or explanations

from the sharing family member themselves, there is a possibility for misunderstandings if the situation is interpreted incorrectly or in an undesirable way.

Boundary Setting The need for boundaries, privacy, and control was another pattern shown in our participant responses. This was first seen in the case of C06 (section 4.1.2) whose mother was initially imposing her intuitive way of cooking on C06 and not letting him cook or make meal decisions for himself. Another example is the case of C05, who shared that his family did not drink alcohol, and alcohol was not an openly discussed topic in his household:

> "With alcohol intake, as far as everyone is concerned, my family does not drink alcohol. Neither does my extended family. So alcohol intake is not really something that's openly discussed in my family. I started drinking in college and the second year that I was drinking, I told my mom. I was drinking and I already knew that my brother was drinking alcohol. He hadn't told our mom. But I still told her and since then, she's just come to accept it and as long as it's in moderation, it's fine. But it's still not something that we openly discuss." - C05

This story shows that in C05's family, alcohol was a taboo subject. A shared experience between them that accidentally showed a bottle of alcohol or a drink in the background could pose a real problem for him. This example also reveals how not every family is comfortable with openly sharing everything, and that boundaries and taboos exist. These various tensions mentioned by participants can make it challenging to create truly shared experiences between remote family members. Participants' concerns about judgment and shame around the unhealthiness of foods are important privacy considerations. Furthermore, not all families practice open and unrestricted communication. Therefore, technology that attempts to construct these moments of connection between remote family members must be designed with these tensions in mind.

5. Discussion

Our research themes, through the lens of SPT, illustrate how family members extend or envision extending prior food practices into technology-mediated ones. Through the constructs (or "elements") of Meaning, Material, and Competence, our findings highlight what aspects of food practices and family members' relationships with each other (through these practices) support social presence.

This discussion section is organized as follows: first, we reflect on our practice-oriented approach and contributions (5.1). Next, we discuss the design implications of our empirical findings, drawing on recent literature from HFI and incorporating theory from Social Presence (5.2, 5.3, 5.4). Finally, we address the limitations of our inquiry (5.5).

5.1. A Social Practice Approach to Mediated Food Practices and Remote Social Presence

Our study was motivated by how family members attribute social presence to food-related interactions in remote or long-distance contexts. We adapted SPT as a theoretical frame because it places emphasis on the context of technology use over a solution-based approach. Other works in HCI have also adopted practice theory, such as (Wakkary et al. 2013)'s work on DIY (do-it-yourself) practices among green enthusiasts and (Klapperich et al. 2019)'s work on wellbeing-driven design with "positive practitioners" of coffee brewing. Their works further support the benefits of a practice-based approach - essentially that, SPT broadens the perspective and design space for designers by shifting the focus from individual behaviors (which can lead to single-use products or solutions) to a view that practices are interlinked, dynamic, and evolving, thus offering more opportunities for innovation and transformation (Kuijer et al. 2013).

According to SPT, practices are socially shared entities, thus making it a particularly good fit for families with multiple viewpoints. This was evident in our study, where even with good intentions and a shared desire to connect, family members sometimes held differing views on health or their roles within the relationship, leading to tensions. This is the main contribution of our work, where we highlight the nuances of the social context in which mediated food interactions can occur, along with the interpersonal dynamics and negotiations between family members concerning their food practices and sharing.

In applying SPT, we used Shove et al. 's model (see Figure 6), which suggests that "social practices consist of elements that are integrated when practices are enacted." These practices "emerge, persist, and disappear" as the links holding them together are made or broken (Shove et al. 2012). This implies that an interdependence exists between the elements, and that a practice cannot exist without it. Our findings supported this idea: for example, the meaning behind a food prac-

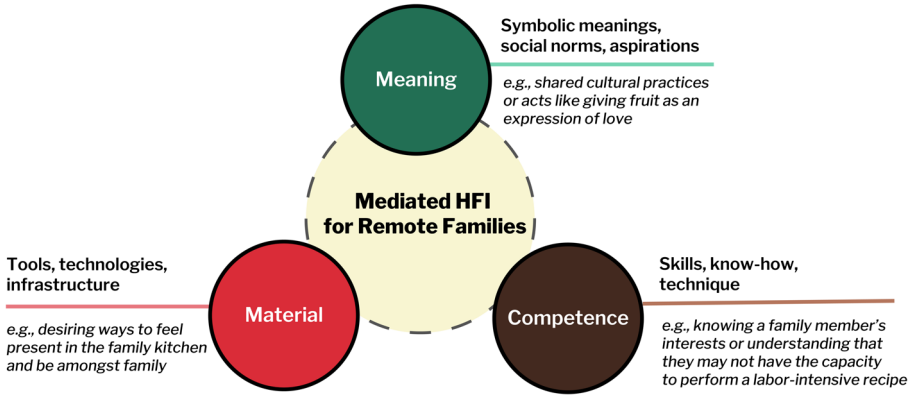

Figure 6. Illustrating how we adapted (Shove et al. 2012)'s model for Mediated HFI.

tice (e.g., nostalgia) alone did not make it a practice; it needed a material (e.g., immersive technology) to actually be realized. In the subsequent sections where we discuss the design implications for mediated HFI (5.2, 5.3, 5.4), we recognize that there is inherent interplay between Meaning, Material, and Competence, and clarify that they are organized distinctly not because of their independence but to emphasize the aspect that family members prioritized or valued most in specific practices and how it connected to their relationships.

A limitation of our approach, which we acknowledge, is that we used SPT as a form of analysis and did not extend our findings to include new elements. For example, gender roles and their influence on family members' relationship dynamics (particularly food and cooking) emerged as a subtle theme, and other studies too have pointed at how practice theories could benefit from integrating close relationships in the study of how practices change (Bartiaux and Reátegui Salmón 2014). Therefore, a future direction for research could be investigating the impact of family roles on practices and how these roles might influence the design of mediated food practices.

5.2. Designing for Meaningful Food Interactions: Everyday Practices, Rituals, and Transitions

Food carries symbolic meaning among family members (Panicker et al. 2020), and in long-distance contexts, food interactions are the culmination of childhood memories (Lupton 1994), former collocated food practices (De Backer 2013), and collective rituals (Petrelli and Light 2014; Wolin and Bennett 1984). From our analysis, we observed that the importance of meaning is relevant for design in three significant phases of adult family life: (1) everyday activities (e.g., seeking guidance during cooking), (2) rituals (e.g., keeping traditions and special events), and (3) transitions (e.g., changes in diet).

1. Facilitating everyday scaffolding of food practices Having everyday food challenges manifested a need for guidance from their distant families in the case of C09, P02, and P03 (see section 4.1.1 for detail). The act of parents providing support to help a child perform food-related tasks can be referred to as "scaffolding" or guided participation (Wood et al. 1976). Although referred to here as an act, scaffolding typically involves many steps of guidance built on parental instincts and understanding of the child's skill levels (Obradovíc et al. 2016; Vandermaas-Peeler et al. 2002). Parent-young child scaffolding has been studied extensively in the psychology literature (Wijayaratne et al. 2021) but is relatively underexplored in adult familial relationships. This may be due to the natural decline of scaffolding needs or asks as children grow older (Vandermaas-Peeler et al. 2002). However, our empirical findings show that food was a trigger for scaffolding and learning. While phone calls and various apps currently facilitate food, diet, and cooking support (Cao et al. 2010), many participants desired immersive, highly sensorial forms of

communication where they could experience the presence of their family, follow their guidance cues with the food at hand, and perform next steps with appropriate reinforcement. This desire for more visual and sensorial communication is in line with prior social presence literature which states that media better suited to reproduce rich social information (e.g., face-to-face video vs. text communication) is perceived as having a higher social presence (Oh et al. 2018). To empower family members in the scaffolding process of food experiences, there is a potential for technologies to leverage the experiential qualities of food - i.e., through taste, smell, and touch (cite HFI here). For example, the toolkit developed by Luo and colleagues (Luo et al. 2023) and the Meta Oculus Quest virtual reality game "Lost Recipes" (Games 2022) both support people to recreate or perfect cultural recipes through sensors and VR technology respectively. Future technologies could make such experiences collaborative and include features based on an understanding of family meaning and behaviors. This could look like teaching or learning culturally relevant recipes with access to a range of modalities. Even though such an experience might not be comparable to real-life experience, the richness and the sentiment behind it can assist people in discovering or rediscovering meaning, identity, and connection with each other (Moisio et al. 2004).

2. Uplifting celebratory rituals and the sentiment behind food As per Wolin and Benett, ritual life "reinforces the family identity and gives all members a shared and necessary sense of belonging" (Wolin and Bennett 1984). Unsurprisingly, rituals were a predominant theme in participants' social interactions around food and included celebrations, traditions, and patterned interactions like going to the farmers market on Sundays. Food, in our study, was not just an important artifact in the context of rituals (Petrelli and Light 2014) but also fundamental in influencing sentimental and emotional family interactions, such as gift-giving, bonding, and reflection. Here, there are several opportunities for technology mediation with a celebratory (Grimes and Harper 2008) and cultural (Altarriba Bertran et al. 2020) focus. For example, meal kit services have been gaining traction as a way to reduce the burden of planning and involve family members in meal preparation (Fraser et al. 2022). In our study, one participant (P03) brought up multiple times how using the same service as her daughter instigated conversations and bonding between them. Future meal-kit service design can build on the understanding of family rituals and explore interactions beyond meal delivery. For example, IYASHI Recipe (Yonezawa et al. 2021) detects sentiments from recipe data and uses it to recommend healing recipes to the provider and recipient. Technology like IYASHI Recipe could further support family members to use food as a love language (e.g., through the preparation of comfort food together or gift giving of food with familial meaning) and express care towards each other.

3. Supporting transitions in food habits or values Transitions are inevitable in family life. Findings from our study indicate that changes, especially those pertaining to value shifts or dietary choice transitions often required re-negotiations and

formations of new shared meanings. However, participants thought these negotiations were stressful and created tension, such as in the case of C06 (4.1) and C05 (4.4). Prior research has pointed out how tension may be mitigated through reflection (Grimes et al. 2009), goal sharing (Lukoff et al. 2018), and respectful disconnection (Hwang et al. 2018). One potential design direction is for technology to serve as a mediator and employ these known tension-mitigating strategies. For example, "social agents" (Skalski and Tamborini 2007), intelligent systems that behave socially, such as FoodChatAR (Weber et al. 2021), can enable users to interact with anthropomorphic food and gain knowledge on its origins and sourcing. Taking inspiration from FoodChatAR, a virtual agent or avatar suggesting healthy food could take the heat off the family member's back and come off as less imposing or judgmental. However, such technology-based mediators could appear less authentic in family conversations.

5.3. Recreating Family Food Spaces: Visual Realism, Sensory Exchange, and Presence

A family's food space, oftentimes the kitchen, is where a range of food-related social interactions, such as cooking, coffee time, casual chats, and gameplay (as in C01's case), take place. Through co-design and discussion, participants in our study expressed a desire to immerse themselves in these locations and be a part of the interactions that take place there. These material expectations and desires manifested in three key features in technology design: (1) visual realism (e.g., seeing the kitchen immersively or just as in their memory), (2) sensory capabilities (e.g., smelling or tasting the food; hearing sounds from the kitchen), and (3) virtual colocation (e.g., transporting or teleporting to their family's space).

1. Creating realistic representations of food, family, and space Participants expressed that being able to see the visual form of remote family members, the detail of what they were cooking or eating, and the vividness of what artifacts they were using was key to feeling like they were part of the experience. Participant-proposed designs reflected this through life-sized portals and windows in the kitchen. While some current technology exists to simulate such telepresence experiences, many participants reported that they were not readily accessible. For example, high-definition 3D systems, such as Google's Project Starline (Lawrence et al. 2021), have a long-projected development period and (as of writing this paper) are not available for domestic use. Instead, communication technologies (e.g., Zoom Hwang et al.,2018, Meta Portal Mason and Muir,2013) have adopted alternate approaches like placing call participants into a common environment or allowing automatic panning and zooming of the environment to improve presence. While interaction technology has the potential to support such spatial sharing, the contexts and desirability of situating them within family communication require further research. As we discussed in section 5.1.1, family interactions often build on prior

shared experiences and rituals, therefore, collaborative scaffolding and celebratory sharing could be explored as potential use cases. However, care must be taken to avoid oversharing, protect privacy, and maintain boundaries among remote family members (Section 4.4).

2. Enhancing sensory experiences and engagement The majority of the participants wished for more immersive sensory experiences with their remote family when speculating about technology-supported food interactions. When participants were apart from their family members, they missed the sense of smell, the ability to taste, and the little moments with each other, such as whacking somebody's hand when they were trying to eat the food before it was ready (C04). There are many upcoming HFI systems and prototypes that enable olfactory (Brooks and Lopes 2023), gustatory (Narumi et al. 2011), and tactile (Dolejšová et al. 2020) communication. The Metaverse (Covaci et al. 2023) and the Internet of Senses (Panagiotakopoulos et al. 2022) also hold promise in multisensory experiences through various sensors paired with virtual reality. In family contexts, we suggest that these sensory experiences take inspiration from our findings that highlight Meaning (section 5.1.1) and enable the inclusion of context or sentiment to co-create a shared environment. As an illustrative example, such technology can look like a tiny pod that releases the simulated smell of a birthday cake during a call. This could potentially convey the feelings behind wishing someone "happy birthday" even if it may not be as accurate as real life. Sound and music sharing in the kitchen space, such as using kin voices in voice user interfaces (Chan et al. 2021), providing ambient sound exchange (Chai et al. 2017), and encouraging synchronized music listening (Chowdhury et al. 2021; Tibau et al. 2019), can also be built on to support everyday and celebratory family moments.

3. Entering the food space and experiencing family presence Participants expressed the desire to teleport into their family's spaces and have agency in those spaces - for example, C08 wanted to be a robot that can move around in her family kitchen, and P05 wanted to have a farmer's market walk with her daughter. This maps to Lombard and Ditton's conceptualization of presence as transportation ("you are there"' or "we are together")(Lombard and Ditton 1997). Prior research has shown that telepresence robots can facilitate the social aspects of shopping through known idiosyncrasies, personalities, and patterns of their partners as well as physically embody features that can mediate a new and diverse set of interactions (Yang and Neustaedter 2018). Our research expands on this prior work to show the potential for telepresence mediation to combine with a meaningful, familial environment and provide agencies to remote family members to support family interactions. Such technologies could also leverage other physical artifacts in the kitchen, such as a camera system in the fridge to discuss food storage, meal preparation, and planning.

5.4. Participatory Food Activities: Supporting Goals, Agency, and Coordination

The involved and social nature of food keeps it at the center of family relationships. Participants described how they envisioned bonding with their distant families over food - they wanted to cook together, figure out ingredients, do interactive "food challenges" (P05) and so on. From these depictions, we reflect on three key aspects to consider when supporting social dynamics during food activities or interactive moments: (1) Goals (e.g., influencing health and diet), (2) Agency (control in decision-making), and (3) Availability (bidirectional expectations).

1. Balancing shared and individual goals Participants often had implicit or explicit goals behind their desire to engage in long-distance food activities. Most of the time these goals were motivated by wanting to maintain connection or bond (Neustaedter and Greenberg 2012; Nguyen et al. 2022; Heshmat et al. 2017), but there were instances where participants were projecting their own goals (albeit with good intentions) onto their family members. For example, shopping for ingredients together meant guiding what the other eats or sharing values surrounding food and diet. Having a virtual cookout meant a chance to recreate memories and an opportunity to compare, contrast, and share new ways of doing things together. Prior research has indicated that familial practices around food, such as consumption, giving, and caring, have undercurrents of power dynamics, control, and influence (MacDonald et al. 2018; Patzer 2018). In the context of healthy eating, everyone in the family might have different definitions of healthy eating (Cordeiro et al. 2015), and in turn, one family member's well-intentioned support could be perceived as nagging (Lukoff et al. 2018). Within our study, when there was a mismatch in food or diet-related goals, as in the cases of C05 and C06 (sections 4.1.2 and 4.4.3), it led to conflict, unpleasant judgment, and a need to find common ground. This type of goal mismatch is also closely tied to adult's sense of agency (perceived control) and the desire to decide and enact their own food choices (Sobal et al. 2006). Without carefully considering individual and collective food-related goals, designs might compromise individual agency when attempting to craft shared experiences. One way to address goal mismatches and the breach of the agency is to enable technology to collect, negotiate, and advocate for the individual's goals and values to account for family dynamics. For example, a system supporting remote synchronous cooking could encourage turn-taking, enable individual and collective goal-setting, and provide a mechanism to nudge interactions when they stray from goals. In this way, this type of system could also encourage shared decision-making and participation, instead of relying on a single food preparer or decision-maker (such as the mother figure in the family) (Gillespie and Johnson-Askew 2009; Gooch and Watts 2015). Additionally, visual cues or indicators of each participant's contribution (for example, who is speaking and who made more food decisions) could bring more balance to the shared activity experience, similar to the design of the Babble system (Bradner et al. 1999).

2. Managing coordination and time The availability of family members to participate in food activities or interactions was another key consideration for technology support or mediation. Participants in our study generally assumed that everyone would be available at the same time. None of the designs produced by our participants were asynchronous in nature, although they did voice concerns about time zone differences and scheduling. Several studies related to food and dining have taken the asynchronous design approach, such as systems promoting intimacy through recorded dining sounds (Yonezawa et al. 2021) and commensality through time-shifted video playback (Nawahdah and Inoue 2013). One potential design exploration with asynchronous technology is to combine it with food practices that are time or labor-intensive. The time-intensive nature of such practices, such as the preparation of wines, pickles, or Christmas cakes (Petrelli and Light 2014), not only makes them suitable for asynchronous interaction but also imbues these processes with meaning over time. Technologies could help family members collectively participate in these long-duration food preparation processes, allowing them to connect over the shared experience and the anticipation of a final product. Building on the design space of food science projects (e.g., fermenting, brewing) (Kuznetsov et al. 2016) and food gardening (Jochum and Goldberg 2016), technology could support similar food project creations and facilitate a range of shared activities, such as knowledge exchange, photo-taking, and progress comparison, thus enabling family members to connect meaningfully over time.

5.5. Limitations

Our study carries several limitations. Although cultural influences on food were observed through participant responses, the study in its entirety was conducted in the Midwest region of the United States. This means that care must be taken when applying the research themes to other contexts where food culture and family dynamics differ. We also did not explicitly collect racial and ethnicity information, other than participants mentioning their family traditions in their responses during co-design sessions. Further research is needed to unpack the nuances of cultural influences on family-shared food experiences. Finally, the majority of participants in our study, particularly the older adult parent group, identified as female. While this is consistent with the literature on the gendering of domestic tasks (Inness 2001; Taillie 2018; Schaeffer 2019), future research should carefully explore and consider food and cooking roles under broader contexts.

6. Conclusion

In our study, we investigated family members' current and desired ways of interacting with their distant family through food, with an emphasis on social presence and connection. We applied SPT to theoretically organize and make sense of what family members cared about and how technology could fit into their relationships

when designing mediated HFI interactions. We found that our findings aligned with the constituent elements of (Shove et al. 2012)'s model:

- **Meaning:** Family members attached sentiment to their food practices, and this persisted even as it was adapted to a remote context (e.g., giving fruit as an expression of love).
- **Material:** Family members envisioned using tools and technologies to share space, feel present, and recreate familiar objects for a connected remote experience (e.g., virtually walking through the family kitchen).
- **Competence:** Family members had knowledge and understanding of each other's interests and availability (e.g., knowing that a family member may not be able to perform a labor-intensive recipe due to their schedule or other responsibilities).

While analyzing our findings, it was also evident that relationships existed between the three elements. For example, the desire to craft an image of the family's space or to see the family's home-cooked meal is an extension of prior meaning or memory. Similarly, wanting agency or supporting each other to make this happen requires material support. In our discussion, we emphasized the reciprocal relationship between the elements while also bringing in literature from HFI and Social Presence theories to ideate design implications for future technologies that mediate HFI interactions. We also reflected on the benefits and limitations of using SPT in our study context. For instance, a key benefit in a family setting was that focusing on the practice illuminated some of the interpersonal dynamics, tensions, and negotiations that could arise during such interactions (e.g., mismatches in health goals). And a limitation of our approach was that because of our scope and use of SPT as an analytical tool, we did not explore the potential for new elements to emerge-such as how family roles might influence the mediation of food practices.

In sum, through this work, we contribute an empirical and theory-grounded understanding of the food practices that support distant family member's sense of closeness and social presence, as well as design implications for future HFI work.

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Author Contributions

Study procedures and analysis were performed by AP and KB. A first draft was jointly written between AP, KB, and CC. Subsequent revisions of the manuscript

(five iterations) were done by AP with support from CC. All authors read and approved the final manuscript.

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Data Availability

No datasets were generated or analysed during the current study.

Declarations

Competing Interests

The authors declare no competing interests.

Ethical Approval

All aspects of the study, including recruitment materials, research activities, data collection instruments, and study protocol were approved by Indiana University's Institutional Review Board (IRB #2002166895).

Consent to Participate

All participants provided voluntary informed consent, either during the study session or through email, to participate in the research and be recorded.

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