Haru in the Kitchen: Investigating Family Members' Perceptions Toward a Social Robot Mediator of Food Experiences

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Abstract

When families live together, they often share meals, and food plays a central part in their everyday routines and rituals. When this changes and families are separated by distance, they may transition these practices to technology-mediated ones. Social robots have shown effectiveness in facilitating human-to-human interactions in various communication contexts. In this study, we explore the possibility of distant families interacting through a social robot mediator in the kitchen. We conducted 9 scenario-based interviews using the Haru social robot as a probe. Our findings highlight opportunities for food-related mediation and participants' hesitations and concerns. We discuss how future research can address these issues, particularly in terms of how a social robot can be positioned in the family and food space, how the robot can be customized for the family's values, and how the robot can serve as a mediator during opportune contexts (e.g., playfulness) and moments (e.g., culturally synchronous practices).

CCS Concepts

• **Human-centered computing → Collaborative and Social Computing**; *Empirical studies in collaborative and social computing*.

Keywords

remote families; social robots; food; human-food interaction; kitchens; domestic technology; research-through-design

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1 Introduction

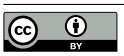
Food is an emotionally, socially, and culturally rich centerpiece to many everyday routines and meaningful rituals in family life. Prior research has shown that routines and rituals support a family's sense of identity, security, and togetherness [24, 72]. When this is disrupted by a change such as moving away from the family home [64, 70], mediating or appropriating some of these acts through technology can be beneficial in reinforcing ties to the family and maintaining connection. Prior studies at the intersection of computer-mediated communication (CMC) and human-food interaction (HFI), have used food as a central theme to produce novel prototypes, such as (but not limited to), a long-distance hot pot experience [26], an apron that can send and receive kitchen sounds [16], and a telepresence robot that enables one to shop for groceries with a love one [82]. Our work is inspired by such prototypes, and also how people used food as a medium for communication during the COVID-19 social isolation period– for example by engaging with loved ones through virtual cooking classes [14], sharing sourdough baking journeys [22], and having meals over Zoom [13].

Social robots have been known for their ability to engage family members in various specialized contexts like supporting aging in place [54], facilitating intergenerational communication [55], and scaffolding learning in children [3]. Our approach focused on exploring a distinct yet specialized context – that of mediating food-related routines or rituals ("food experiences") across distances. Xu et. al. make the argument that incorporating robots into a family's routine or ritual carries potential for a robot's long-term adoption, which is a known challenge for robot use in families [81]. Although our work did not focus on robot adoption, we contribute to an understanding of what food experiences a robot could support, how that support might look, and what reservations or hesitations family members might have about a social robot mediating communication in their space. Our research questions are as follows:

- How or in what contexts do family members envision a social robot mediating food experiences with their distant family?
- What design considerations or hesitations did family members have toward a social robot being part of their kitchen space? What can we learn from this to inform future kitchen robot design?

To answer them, we worked with 9 participants who reported that they had a strong interest or habit of food-related communication with geographically distant family members. First, we captured current ways in which they appropriated food-related rituals and routines through technology, then we introduced them to the social robot, Haru, and had them talk through a series of scenario-based cards on how they might use Haru to augment their food rituals and routines.

Our findings aligned with prior work on the kitchen as a space that is rich with values relating to how various objects are to be positioned or placed, expectations on conduct or social behavior, and cultural meaning [7]. Family members had doubts and hesitations towards a robot's ability to fit into their unique kitchen layouts and spatial arrangements. They liked the idea of sharing with family



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members and intelligent support from the robot, but had value conflicts when it came to connecting their spaces. Furthermore, we discuss the moments where family members felt the most affinity towards connecting with distant family when it came to food. We discuss implications for how to introduce robots into the kitchen under such contexts, how to mediate different family value systems, and how spontaneous and joyful moments are an underexplored context for social mediation.

2 Background

The research questions of this work are informed by prior literature on routines and rituals centered around food, human-robot interaction (HRI) explorations in family and mediated communication contexts, and the significance of the kitchen as a site for social interactions. Taken together, our work focuses on how family members appropriate food rituals and routines for long distance communication, and the potential for a social robot to mediate those interactions.

2.1 Intimacy through food routines and rituals in family life

Food—whether it's the emotions it evokes, its cultural significance, the way it's prepared, or its impact on the body—lies at the heart of many family routines and rituals. Routines in family contexts are organizational tasks or actions (e.g., household chores and assigning roles), while rituals are practices that carry symbolic meaning (e.g., preparing a special dish for recurring cultural celebrations)[80]. Prior research [24, 72] has shown that maintaining rituals and routines is beneficial for supporting a group's sense of identity and togetherness. This theme has been prevalent in many studies on long-distance computer-mediated communication (CMC) and human-food interaction (HFI), particularly in the context of sustaining remote intergenerational and family connections. For example, several studies have explored the ritual of cooking as a means to support connection and kinship, using mechanisms such as the exchange of kitchen sounds [16], recreating culturally significant or meaningful dishes with precision[51], and reading recipes together with loved ones [68]. The concept of commensality, or the social aspects of eating together [73], has been examined in various studies that combine different modalities—such as video projection, sensing, virtual reality, and other technologies—to create interactive environments where distant parties can share a meal [6, 13, 26, 35]. The idea of playfulness and entertainment has been studied as a way to introduce humor, ease tensions, and foster collective actions, such as using games at the family dinner table to learn more about culture and tradition [4].Additionally, the maintenance of rituals and routines during periods of change or after a life transition has been studied as a coping mechanism and a way to build resilience in families [34]. One study on mobile intimacy found that family members use technology to adapt and re-stage rituals, such as collaboratively creating a digital greeting for a loved one's birthday after they had moved away [10]. With food-centric rituals specifically, previous studies report that families use technologies like video chat and social media to seek support and guidance during emotional moments such as experiencing homesickness [43] or dealing with an illness [64]. Essentially, as a medium or context for communication, food—and the rituals and routines associated with it—carries multifaceted qualities that technology can mediate to support togetherness. The focus of our work is to investigate the potential use of a social robot in mediating such food experiences, specifically, what expectations family members have regarding the robot's capabilities, and how they envision the remote appropriation of rituals or routines around food. In the next section, we discuss prior research on robots in domestic and family contexts, and our rationale for considering a social robot for its mediating capabilities.

2.2 Prior explorations of social robots in family contexts

Social home robots have been studied for their ability to engage and assist family members living together. These robots can potentially take on various roles, such as performing household tasks, providing entertainment, offering educational support, and serving as companions [17, 49, 57]. If they are well-received, they carry the potential of becoming part of the household [12]. Social robots in families have also found application in specialized contexts like aging in place, social support, homecare, intergenerational communication and children's learning. One example is of a study that explored the use of a conversational social robot in offering support when witnessing disruptive eating behaviors in people living with dementia [5]. Other examples, with children, explored the use of social robots in cultivating their emotions through conversation [52], and also in keeping children engaged during educational or therapy activities [36]. Despite their potential, in both general and specialized contexts, the adoption and successful integration of social robots into domestic spaces has remained limited [20, 81]. A recent study posited that long-term adoption of a robot into the family space can be made possible by integrating robots into existing or new family routines and rituals [11]. Building on the significance of food in family routines and rituals (as discussed in the previous section), we explore the idea of food serving as a specialized context for social robots to interact with and facilitate conversation among family members.

Robots have been used to support practical tasks in the kitchen, provide social assistance during eating, and enable telepresence for doing activities like shopping. For example, in aging-in-place scenarios, robots were used to assist older adults with tasks such as chopping or peeling vegetables [45]. Task support can also involve the robot working together with the human to perform collaborative work – for example, following the user's movements and providing next steps of the recipe [18] or assisting the user with suggestions on how to aesthetically plate the food [46]. Robots have also been used to converse with children and encourage their eating [69] or provide companionship and entertainment for people dining alone [44, 58]. Finally, telepresence robots have been explored in long-distance communication studies to have agency in the other's space [82], or simply "hang out" as the other is cooking or eating [83].

Food-related routines or rituals involve various different forms of engagement-some more practical, some more social or emotional. Studies on mediated robot communication have emphasized their effectiveness in facilitating task collaboration, participation, and

conversation with multiple parties [2]. This suggests the possibility that a social robot can play the dual role of being a communication device and mediating food interactions. A study on people's preferences for having a social robot support remote communication during COVID-19 revealed favorable outcomes, and participants expressed that they desired companionship doing shared activities [39]. The pandemic isolation period was also a time when people started dabbling with new ways of interacting through food. For instance, there were reports of people making trending recipes [22] to share on social media, having meals over zoom [13], and participating in virtual food experiences such as Airbnb's "online experiences"[14]. Motivated by these prior interaction designs and findings, we seek to investigate reactions to the idea of a social robot mediating food-related routines or rituals, understand any reservations family members might have, and aim to gather design insights. In the next section, we provide context on the value of a kitchen, particularly in family contexts, and considerations to be mindful of while considering technology's placement in the kitchen.

2.3 The social significance of the kitchen and technology placement

The kitchen is a not just a space for cooking, but also for social moments and relationship support. Even mundane activities in the kitchen like food preparation or washing dishes are a time for bonding in families when they share daily updates with one another, listen to stories, and get to know each other more [62]. While various studies have tried to capitalize on the social richness of this space, the kitchen is still an atypical space for communication technologies [61]. This is not to say the kitchen does not feature technologies at all, but rather that the technologies present are more like appliances, serving some limited assistive function [61]. A few studies have tried to develop social technologies in the kitchen, such as the Sociable Kitchen [56], where a digital screen is embedded on a kitchen island with visual representations of food, and used to facilitate reactions and conversation from people. Another is Terrenghi et al.'s Living Cookbook [77], which was designed to be present in the kitchen similar to an appliance, but empowers people to record, annotate, and play back their cooking moments, thus serving as a "family photo album". In fact, Terrenghi argues for the kitchen to be considered a socio-technical space that has the potential to go beyond usability and functionality, and towards novel ways of honoring family practices like preserving cultural roots, developing contextualized learning, and setting the stage for cross-generational sharing [76]. In Bell and Kaye's Kitchen Manifesto [7], they suggest that technologies draw from the rich cultural history of the kitchen; namely the experiences that take place there that are valued, the way objects are used, cultural context that informs the dynamic, people's lived experiences, and rituals of domesticity. In our work, although we are interested in the possibility of a social robot mediator, we also build upon these prior insights on the kitchen as a place of meaning-making [63] and intimacy for the family. We make our best efforts to ensure that our approach supports and enhances the social experiences within the kitchen, with a focus on extending these connections to remote family members, rather than just introducing more technology into the kitchen space.

3 Methods

In this research, we conducted 9 scenario-based interviews to investigate how family members envision a social robot mediating food experiences with their distant family members.

Recruitment. We sought to recruit individuals who had either a strong interest or a habit of sharing *"food experiences"* (open ended) with their distant family members. We included a few sample prompts (for e.g, do you share food-related TikToks, do you share recipes etc.) but invited participants to share what they did or talked about with their family member with regards to food. We recruited our participants mostly through social media (Twitter and Reddit), and shared our recruitment material to both our close networks and also to publicly accessible food-related subreddits (for eg., r/CookbookLovers). We also put up flyers on our university campus and our university's classifieds website. Out of the nine participants we included in the study, six were recruited via social media and three through local university flyers. Recruitment posts and flyers linked to a screener survey that collected participant demographics, their self-reported familiarity with daily-use and robotics technologies, and context on their food communication with their family (see Table 1). To the best of our ability, we screened and chose participants who were diverse and had a passion for the topic as evidenced by their qualitative responses. All study procedures were approved by Indiana University's institutional review board.

Participants. We originally recruited and interviewed a total of 10 participants, but chose not to include the data of one participant as they gave inconsistent responses consistent with [66], and it was later discovered that they had sent in images that were publicly available, and not images of their food spaces. They were still compensated for their time. Out of the 9 participants, 5 were women and 4 were men. We only recruited participants 18 and above, with the youngest age being 21 and the oldest age being 47 (avg age is 28.4). We did not collect racial information. In terms of cultural influences on food habits, participants referenced American, Jewish, Indian, Italian, and East Asian influences. All participants were located in the US, however 4 of them reported that the family they communicate with regarding food is located in a different country. Table 1 shows an overview of participant demographics and summaries of how they reported their current technology-mediated food rituals and routines.

Setting, Duration, and Compensation. All interviews were conducted online, through Zoom and facilitated over Miro [1]. Each interview was between 44 and 69 minutes long, with an average duration of 53.1 minutes. We collected a total of 478 minutes of interview data for qualitative analysis. All interviews were anonymized and then transcribed through otter.ai[2]. Participants were compensated with a $15 Amazon Gift card for their time.

Use of Haru robot as probe. We chose to use the Haru robot, developed by Honda Research Institute, as the social robot probe for the study. Haru was designed by Honda as an experimental social robot for embodied communication research [32]. In the

[1]https://miro.com/
[2]https://otter.ai/

Figure 1: An image of the Haru robot

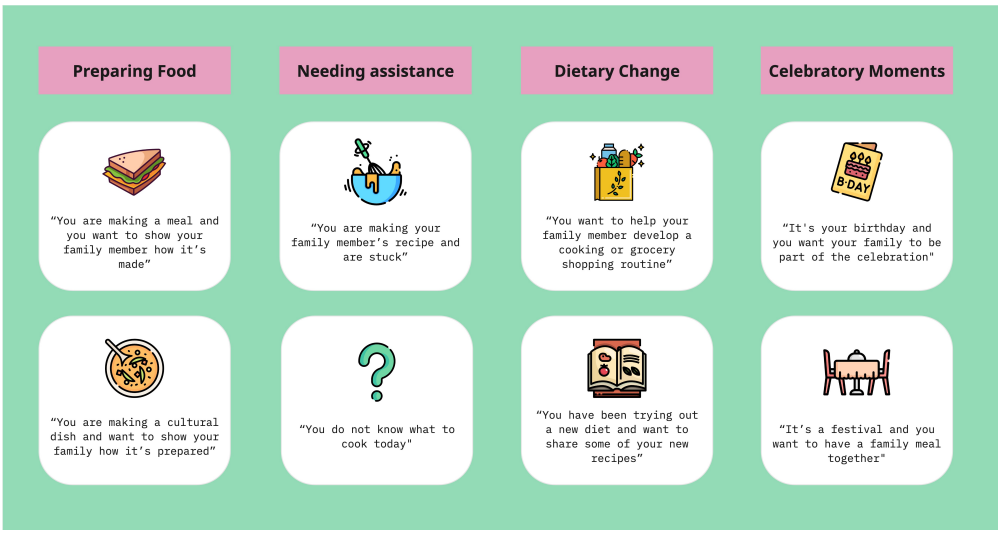

Figure 2: Scenario cards used to elicit participant responses. Icons on the cards ©Freepik.com

past, Haru has been studied in use cases such as affective messaging (sending emojis to Haru to embody and communicate emotion) [33], long-distance gameplay (rock-paper-scissors) [9], remote cross-cultural mediation (supporting children's education across countries) [19, 31], and facilitating behavior change (healthy habits coaching) [38]. We felt Haru was a good fit because Haru's capabilities and previously tested use cases aligned with our study goals of investigating socially rich interactions between distant family members. Additionally, we anticipated that food mediation among distant families might involve elements of telepresence, intelligent communication, and cross-cultural facilitation [65]. These are all areas in which Haru has already been explored, and we felt it would be an appropriate medium to probe how participants envision a wide range of mediation possibilities.

We note and acknowledge that Haru's physical form carries limitations in terms of mobility and lacks arms, which we foresaw could constrain its practical use, especially when participants try to envision scenarios involving cooking or other hands-on activities. However, since our study focused on communication and social interactions within the kitchen, we prioritized Haru's social affordances and capabilities over Haru's physical limitations.

Study Procedures. Prior to the interview, participants were asked to send 5 images of their "food spaces" or places that were meaningful to them in relation to food and family (for e.g, kitchen, dining area). During the interview, participants were first asked background questions on their communication habits around food, and what those communication practices bring to their family relationships. Second, participants were asked to do a *"show and tell"* with the images they brought in, and share how they use those spaces. Third, participants were virtually introduced to the Haru robot through a series of media (a mix of still illustrations[3] and short video snippets[4]) that depicted Haru's functionalities. These illustrations and video snippets featured (1) Haru's social capabilities with humans, (2) Haru engaged in mediating gameplay between distant friends, (3) Haru enabling communication through emoji eyes, (4) Haru video projecting, and (5) Haru behaving as a personal assistant. The video snippets were very short and not more than 10 seconds. Participants were encouraged to treat the media as examples, to think creatively, and go beyond Haru's demonstrated capabilities when interacting with the scenario cards. Finally participants were introduced to 8 scenario-based prompt cards categorized as falling under (1) preparing foods, (2) needing assistance, (3) dietary change and (4) celebratory moments (see fig.2). The prompts displayed on the cards were created based on the themes identified in a prior study on how remote inter-generational families communicate on topics related to food [64]. Participants were then asked to choose

[3]For the illustrations shown to participants, see research by Honda Research Institute: https://spectrum.ieee.org/honda-research-institute-haru-social-robot

[4]The video snippets shown to participants were spliced from: https://www.youtube.com/watch?v=g64vwq9y2lQ

Table 1: Interview Participants N= 9

No	Gender	Age	Occupation	Participants' self-reported food communication with distant family (Summarized)
P01	Woman	47	Admin Assistant	Talks about recipes, restaurants and culinary adventures. Considers themselves *"a family of foodies"*
P02	Woman	25	Graduate Student and Clerical Assistant	Talks with family overseas about how to cook ethnic meals. Also stated that, *""sometimes I will film a reaction of me trying [the prepared meal] as well"*
P03	Woman	23	Development at Nonprofit	Entire family uses the same grocery list and meal plan app (AnyList) and shares recipes with one other that way. Described an incident where she had a virtual birthday party celebration over zoom with her mom. Both mom and her made the same carrot cake (*"Claire Saffitz"* recipe) synchronously during this time.
P04	Man	23	Medical Assistant	Talks with family about what is being prepared and shows each other food and sometimes discusses how it was made.
P05	Woman	32	PhD student and Instructor	Shares recipes over group chat and pictures of fun food items that were prepared. Sometimes shares videos to give assistance and also video calls frequently. Shares recipes and videos on Social Media.
P06	Man	22	PhD Student	Recently moved to the US and is getting acclimated. Frequently talks to family about food (*"What did you have in your meal?"*). Also exchanges pictures of ingredients and food items that are available, expensive or different in the US.
P07	Man	21	Student	Shares recipes, pictures and videos of food. Specified that this is more frequent when home and actively cooking and baking.
P08	Woman	33	PhD Student and Instructor	Described how their family had a *"secret ingredient"* cooking challenge, where each person had to choose a fruit or vegetable and make a meal with that as the theme. This led to frequent communication, recipe swaps and picture sharing.
P09	Man	30	Graduate Student	Talks about food through group messaging apps, typically gets guidance on how to make cultural recipes

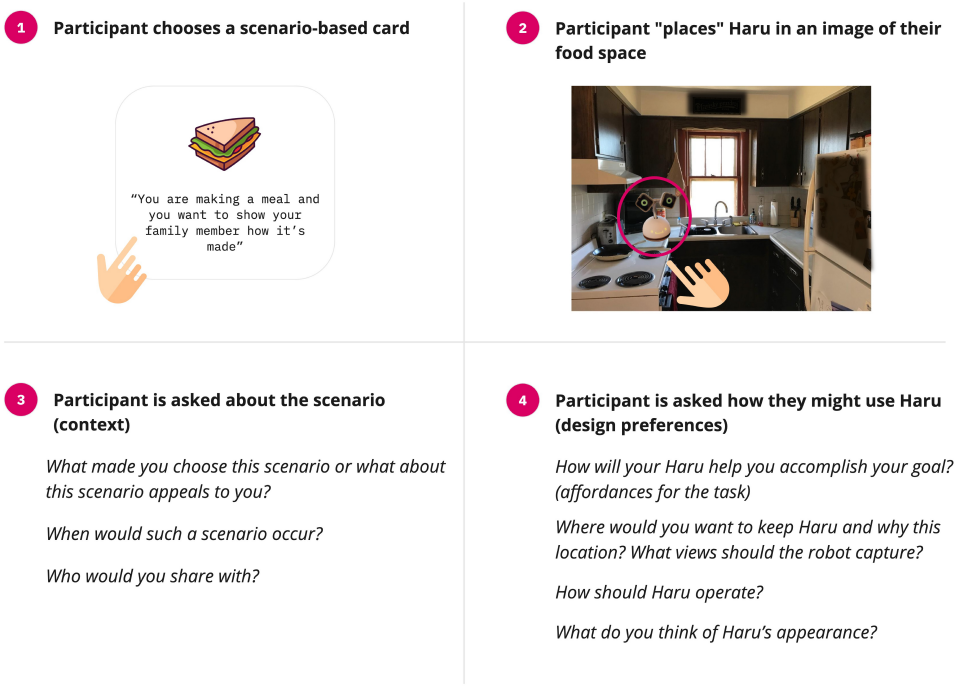

Figure 3: Overview of study procedures with example questions asked to participants. Icons ©Freepik.com

2-3 cards and envision themselves enacting a situation based on the prompt and using Haru. An image of Haru was superimposed on enlarged images of the participant's food space (in a participant-chosen spot) (see fig. 3). This step was done to help participants visualize Haru's presence in their domestic space as they answered questions and engaged in discussion.

Data Analysis. Interview transcriptions, once corrected and anonymized, were uploaded to a textual analysis tool, Saturate App[5]. We adopted an inductive thematic analysis approach [8] to qualitatively code the data and generate overarching themes and design insights. The first author conducted open coding on the first three interviews, then met with other researchers to discuss and refine the initial codes. The remaining interviews were coded by the first author, with clarifications discussed collaboratively throughout the process. Upon completion, the codes were grouped into broader themes such as (but not limited to) mediation contexts, value influence, privacy concerns, spatial considerations for Haru, and participant-envisioned roles for Haru. These themes informed the structure of our findings, detailed in the next section.

4 Findings

We structure our findings according to our research questions. First, we describe the contexts and moments during which family members used or desired technology for mediating their food practices. These findings emerged as participants chose different scenario cards and reflected on how it would apply to their relationships. Second, we report on how family members envisioned Haru in their spaces, concerns or hesitations they had about Haru's presence, as well as possible roles for Haru based on their imagined scenarios.

4.1 Contexts and opportune moments for food-related mediation

While choosing scenarios for social robot support during food experiences, most participants chose scenarios dealing with preparing food, needing assistance, and sharing celebratory experiences. Notably, none of the participants chose supporting dietary changes. When prompted to choose a card, we had encouraged participants to pick the one they related to the most in terms of their daily life or relationship with their family member. So, we speculate that this was an organic coincidence, and that none of the interviewed participants were actively engaged in health- or diet-related changes at the time. We did have one participant (P08) who referenced her mother starting a food challenge aimed at encouraging healthier practices and better weight management for another family member (section 4.1.2), but this was not directly applicable to her.

In this section, we detail how participants connected to the scenarios through their past memories and experiences, and used them to ground contexts and opportune moments where they envision Haru mediating their food interactions.

4.1.1 Life-transitions and changes led to wanting connection. Participants shared how they adjusted to changes and how life transitions served as a trigger for creating commensal experiences, learning familial recipes, or staying connected through small food-related exchanges. For P03, the COVID-19 pandemic and the resulting quarantines were one such life event that led to increased technology-facilitated communication. She described how her family, particularly her mother, started having more food-related interactions with her to alleviate her feelings of isolation.

> *"And then during the pandemic, I didn't go home for a whole year, because I didn't feel safe to travel. But then for like, a whole month, I was living just like alone pretty much in a large house, because all my roommates went home. And I was very sad and lonely. So she [my mom] started, you know, doing stuff like that with me on Zoom. So I'd be less sad and alone, which is, it was fun. And you know, everyone else was also doing stuff on Zoom, like having, you know, like, dinner dates, or like, during activities. So it was kind of fun to do something that you usually do in person, but virtually."* - P3

Other life events, such as moving away to college, were also mentioned by participants. P2 described how she and her sister meal prepped together over the weekend and that was their thing when they were collocated. After her sister moved away, they still maintained a habit of food and recipe sharing to preserve that dynamic.

> *" So my sister after she moved away, she moved away about like, last year or so, before that her and I used to cook together a lot. Specifically, during the weekend, we used to make like pretty much a couple days worth of food, like meal prep and stuff. That was our way of bonding at the end of the week. So I guess that was a dynamic that I had with my sister in terms of food."* - P2

> *" So I feel like food is like a way for us to connect, because I can like text her, a recipe and then she can try it one week, and then she will give me feedback. She'll send me a recipe and whatnot. It's kind of our way of connecting. Because we're not in like one physical place together."* - P2

These accounts highlight how people lean on comforting food rituals and familial support during times of change and even distress.

4.1.2 Fun in the kitchen; inspiration and impromptu moments. Although not part of our scenario cards, a common context for food-related communication and exchange between family members was fun and the impromptu nature of food and food-related practices. For instance, Participant P03 narrated a funny incident where a cat walked over her blueberry desert and left pawprints all over her place. She described how this led to her sharing the incident with her family.

> *"I was living with a cat and I had made this like blueberry crumble and the cat walked across the whole thing. And there was like little paw prints all through the crumble. You can see them like leading off into the hallway. So I took a video of that. So that was cute. Like blueberries all over his paws."* - P03

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

Participant P08 also talked about how an unplanned (not cooking related) video chat turned into poking fun and participating in her sister's cooking experience.

> *"It wasn't intentionally meant as a cooking thing. But I think in one of our zooms, our family zooms my sister had, she was in the middle of making dinner and so she just had her like phone propped up or something like on her countertop. And so we were kind of making comments and like, you're burning the shrimp, you got to flip them."* - P08

Participant P05 when reflecting on her memorable food-related exchanges, described an incident where she took substantial effort to prepare a meal and decided to take an impromptu picture to both show her labor and progress of the dish.

> *"Like, I made something last time, but it took like a while. Like we made, we made the bowl like the meatballs, and then we were gonna fry them. So it's like, we were prepping, I took a photo of like the whole prep line. I sent a photo and it was like, basically where that paper towel roll is like it was all kind of laid out. All across. Yeah. And there weren't as many things near the microwave. So that was all filled with like other prep items and stuff like oh, look, this is in the making"* - P05

Lastly, participant P08 brought up gamified food experiences that were originally geared towards better health but ended up being more of a bonding activity. This wasn't impromptu in the sense it was unplanned, but there was an element of surprise and fun involved for all participants.

> *"And so we got really into, like cooking and, and kind of experimenting more. And so I think my mom kind of wanted to run with that. And then also, she was a little concerned, because honestly, my brother had been putting on weight. And she was like, Well, I want to encourage him to like, eat healthy, but like in a way that's really positive and like community-ish"* - P08

> *"So it was her idea really to have a challenge where every week, one of us would have to choose a secret ingredient. Generally like a vegetable or, or something like that. And then at some point during the week, we would have to incorporate it in some meal that we made, and then take a picture to document it"*- P08

4.1.3 The timing of cultural events led to similar food activities and its planning. Participants highlighted cultural events and shared traditions as an opportune moment for increased communication. This was best explained by P05, who stated that having an upcoming cultural event meant everyone would be doing similar things and there would be more conversation and buzz about everything related to that event.

> *"Everything in a way brings us together, you know. Like, at some time of the year.. we're all kind of making the same things depending on things like, you know, cultural festivities and stuff. And so, 'Oh, look, I made this', 'Oh, I'm planning on making this next week actually', you know, that kind of thing. Or just like, exchanging recipes and stuff where you're like, 'Oh, I think you'll like this."* - P05

This was also emphasized by P06, who explained that during their cultural festivities, everyone plans together, shares special foods that they plan to eat and celebrate at the same time irrespective of time zones.

> *"For cooking normally we have the groups, that means in the group we go okay, I am cooking this one [refers to a dish] and I share it there in the WhatsApp group and say okay, we are making these these things [refers to different dishes] for Diwali. So then they also share that okay, these [refers to dishes] are our things. So that means in the celebration time, mainly in the New Year on April, special timings are there. So the people come together at that time, and we do all the things on time, like everyone at the same time, even though we are in different, different countries"* - P09

Overall, this is indicative of cultural ties being a timed, intentional experience where people may rely on technological support in their food spaces.

4.2 Considerations and challenges for Haru in the food space

While walking through scenarios for social robot support and mediation, participants reflected on various considerations and also challenges that could potentially hinder their acceptance of a social robot as a mediator. In this section, we discuss participants' thoughts on Haru being amidst familial value systems, spatial constraints, and the ways in which Haru can mediate food interactions.

4.2.1 Values and belief systems are key in understanding family member's willingness to have a social robot in the kitchen. Participants in our study had reservations about having a robot in their intimate food space, and in most cases, these feelings were connected to personal beliefs and shared values that they wanted to uphold. For instance, P01, who is very passionate about food and cooking, found cooking a practice that kept her fully engrossed and grounded and did not want to share that time with technology or her other family members.

> *"I feel like my time in the kitchen or my time cooking really is my me-time. It's such a therapeutic experience for me because I am ON all the time... So the energy that I use when I'm in the kitchen for me personally is so one-sided. That I almost want that time by myself"* - P01

> *" I love that edible therapy. And the distraction that it gives me from being in front of my computer because I work so much. The best part about cooking in my household is that my son [and] my husband don't cook."* - P01

Participant P08, who believed in minimalism and not having too much material waste, expressed that she would only be open to a robot if it added significant value to her space and relationships. Furthermore, she elaborated on how she would treasure things more if she made them herself. So her idea of a technology in the

kitchen would reflect those values of using what she has, customized according to her needs and space.

> *"Both my husband and I are generally like, somewhat minimalist. And so I don't think that we would probably be jumping to go get something if it just seems mildly convenient. It has to really be something that we'd use, and we know we would get a lot out of."* - P08

> *"As I've gotten older, I really regret that I have had so much material waste in my life... And also, obviously, all of the issues with climate change have really affected me and my thinking and so I am much more committed than I ever was."* - P08

> *"I do like things that I can make myself. I like all kinds of crafty things. And I think there is a feeling more invested or like proud of something when you've helped make or even feeling more connected to it, that it seems more personal, than something that you would buy? I suppose I'd be more open if it were a modification of something I have... "* - P08

These expressions of values also went beyond the personal level. i.e., Family members also emphasized that using Haru as an experience-sharing device meant that their distant family member's values would also take effect in their space. For example, P06 described his mother's strong sentiments towards a dirty kitchen and how he would have to clean his space prior to a video exchange.

> *"Because if she [mom] sees the kitchen is dirty, I'll be scolded. Because she does not like a dirty kitchen."* - P06

Similarly, participant P09 talked about how he would only choose to use Haru for cooking feedback and guidance and not asynchronous, commensal experiences. According to him, it would not be considered polite, as his family in this case would just be spectators vs. active participants in the experience.

> *"I guess, for the eating things, I don't think it should be shared, because it is not nice. When it comes to cooking things, yes, we can sit there and get feedback, how we have done, whether it is the right or wrong kind of thing. Otherwise, it's not nice to send something. We eat something once we eat it, eat it."* - P09

4.2.2 The Kitchen is a tight, messy space where communication technologies do not typically have a permanent spot. As participants reflected on their existing technology use as well as how they might use Haru, a predominant theme that surfaced was that adding technology and gadgets to the kitchen required much thought and care, especially when technology, such as a robot, was considered fragile. Participants were protective of their kitchen and countertop spaces and mindful of cleanliness and safety.

Participants thought that they often had to adjust or move the technology to capture a range of things such as the food, the people involved, and the changing landscape. P03 illustrated this challenge when she described a time when she had a remote birthday celebration with her mother, where they both made the same cake recipe.

> *"[About making the same cake over zoom] Obviously not as good as in person, especially when making something elaborate. Cuz I didn't really have the counterspace for my laptop with all the other stuff that I was doing. So they kind of got shoved around and I had to put the zoom on my phone because it was smaller and I could like stick it in the windowsill. But you know, she still couldn't see me. And it's also a little harder with my mom because she goes very slow on some parts where I'm not as slow. So I was just kind of sitting around waiting for her to catch up a lot."* - P03

Participants P05 and P06 discussed the difficulty of operating technology in the kitchen where things can get dirty. For P05, the concern was to avoid getting the technology dirty as much as possible, whereas, for P06, the concern was to avoid getting dirt into the food from the technology's surface.

> *"If I'm making something intricate that needs a lot of instructions, I'll probably take my laptop with me. So that I can actually read as I go, as opposed to constantly touching my phone that you know, it's a little harder to unlock with your hands dirty and stuff."* - P05

> *"I do not bring my phone to my kitchen at all. So I am a bit of a germaphobe kind of person. So I don't usually bring things which I often touch in my day to my kitchen, like, no shoes, nothing, no outside clothes. Nothing of that sort. So that's why I never take my phone with me to my kitchen. Because if I hold it and I know I have held it for like throughout the day, then I have to wash my hands."* - P06

Proximity to power outlets was brought up by participants P02 and P07, especially as they speculated where they might place Haru in the kitchen.

> *"And like, obviously, I'm assuming it needs to be connected to the wall. And I just think it's more accessible this way. If I just have it, you know, to my right."* - P02

> *There is an outlet on the island. So probably, if it needs a charging cable, I'd probably just plug it in, sit down"* - P07

P05 highlighted the concern of breakability and maintenance. They stressed that the kitchen has a lot of movement and that a fragile, difficult-to-clean artifact might add to the burden rather than be helpful.

> *"I'm like, how delicate is it? Because things in my kitchen fall around a lot. You know, like if it's sitting there it's gonna fall or get moved or pushed around or whatever. How like waterproof and spill proof is it and stuff? Just in case. How easy is it to clean when it gets sticky, dirty, or anything?"* - P05

4.2.3 Haru's roles in the Kitchen: a camera operator, an unwelcome observer, or an intelligent mediator? As Haru's most conspicuous features were its large expressive eyes and emotive face, the robot's social nature and capabilities were evident to participants. However, despite an awareness of Haru's social capabilities, Haru's utilitarian features were referenced more by participants in the study. Specifically, Haru's screen-like eyes, rotational body, and personal assistant features were mentioned as supporting participant expectations of Haru's role in the kitchen.

Haru being akin to a camera operator was the most common idea put forward by participants. For example, P07 described how Haru could possibly take the awkwardness out of sharing cooking moments by doing the re-positioning and adjusting for him.

> *"Because a couple of times I do remember… I'd have shared a video that was awkward… like my phone's hung up here. And I'm mixing a bowl or something like that. So I guess, that would be helpful in those instances where I'm trying to show her [fiancee], because I do remember a couple of times, I was cooking or baking. And she'd be like, she'd get 20 different snapshots or videos of me doing that. So instead of having to awkwardly hold my phone or trying to show it, I can just show it to the camera as I'm doing."* - P07

Similarly, Participant P01 also wanted to leverage Haru's video and movement capabilities to support recipe sharing between her and her niece. P01 also brought up an interesting suggestion that one of Haru's eyes be a captioning of the conversation, as she only needed one screen; *"And then I would think that it could basically turn its eyeballs into one screen being you and the other screen being like... maybe a script or something of our call"*. Later she indicated that this could be useful as a written copy of the recipe.

> *"Hey, Haru, call [niece] and then turn the camera on. You know, ask Haru to turn the camera on. Oh, hey, [niece], what's going on? Oh are you busy, I was making enchiladas and you asked me to call you the next time I was making them so I could show you, you know what ingredients I used and how I like kind of fill them before I baked them, like the order of the ingredients going into the flour tortilla…"* - P01

> *"So I think that would be, basically, I wanted to give you a viewing platform to have the sequence of the events that are part of my recipe instructions. And then once I put it in the oven, just be like, oh, did you have any other questions? Write this here. I am trying to just show you and explain to you how easy it is to make these."* - P01

Some participants, including P07 and P06, talked about the possibility of Haru coming across as an unwelcome third party observer in their communication with family members. P07 valued seeing his family and felt it would be strange to see the robot's eyes as opposed to his family.

> *"It's definitely interesting. The one thing I would be opposed to is.. I see the little two eyes and the mouth and I'd be seeing the robot's face and not like my fiance, my family's face"* - P07

P05 brought up how Haru's social presence and agency meant there could be unwanted or unexpected interruptions in his family conversation.

> *"When we are talking, like I mean, I'm talking [to] my family, I probably wouldn't want the robot interrupting me in the middle unless I asked something to her about, hey, when I'm explaining something to them, oh, like, for example, I buy vegetables and groceries and I forgot what price it was."* - P05

Haru being interpreted as an unwelcome observer or a third-person intruder was contrasted by participants like P09, who speculated that Haru can be a more intentional and intelligent mediator. P09 described how in a shared cooking experience, Haru could maybe see and interpret that a step is complete and automatically suggest the next one to the family member. P09 also suggested that if there are delays on one side, Haru can notify the family member when to come back online or pay attention again.

> *"If [Haru] can see what we do, then he can view that we have the things [ingredients]. So the first step is done, then he can start the second step automatically by understanding what we do, rather than the Alexa we are currently using."* - P09

> *"Let's say we are going to cut the vegetables and all that. So, it takes some time right, then that means my other parties who are done with this one, they can do whatever they want to do. And automatically this Haru tells them okay, they have done this, they have completed this process. So now they can be given a notification for them to come back online"* - P09

5 Discussion

In this study, we conducted a small-scale exploration on whether a social robot might be an acceptable mediator of intimate food experiences between remote family members. Overall, our findings reveal more hesitations and concerns than perceived benefits, even though participants either already mediated food experiences through technology or expressed a desire to do so. Reflecting on these themes, we discuss how future approaches might address these challenges differently, particularly how a social robot is positioned in the family and food space, how it integrates into family value systems, and how it can serve the role of mediator by aligning with opportune contexts (e.g., playfulness) and moments (e.g, culturally synchronous practices).

5.1 The social robot's positioning: challenges, scaffolding uncertainties, and considering mobility

Family members expressed concerns about Haru's ability to fit into the kitchen, and highlighted spatial challenges (how to make room for the robot), safety challenges (the robot is too close to potential hazards), and maintenance challenges (the robot will get dirty). Some of these concerns stemmed from implicit expectations that family members had regarding robots, for e.g, that they are fragile, or that they are not durable. This is consistent with prior literature on how people's previous exposure to robots in other media (for eg., movies) shape their expectations on the robot's affordances and limitations [37, 60]. Additionally, the unique layout of various kitchens, how different families organize and navigate the spaces [15] make it a disruption to plan for the robot's accommodation and intended role. All of these factors combined made it less than desirable to have a robot entity as part of the kitchen, even in cases where family members could envision the robot as being useful.

Related literature has looked into how to enhance first impressions between the robot and the human. For instance, creative and

aesthetic unboxing experiences were designed to facilitate positive child-robot interactions [48]. Research by Fischer [25], called for better dialogue design and linguistic cues to reduce user uncertainty. Taking inspiration from these explorations, we point designers towards the possibility of scaffolding the family's experience in accommodating the robot in their space and defining its roles. For instance, having a small kitchen shouldn't deter potential users and make them feel the technology was not designed for their space. Instead, we suggest that social robots be designed to work with family members on how to optimize space and positioning. They could also convey anticipated scenarios related to privacy, non-use and care, and provide appropriate guidance or suggestions (for e.g, DIY adjustments, intelligent feedback on safety).

An alternate approach to addressing participants' perceived (and in some cases very real) limitations of the social robot not fitting well in the kitchen is to rethink whether the robot needs to be there at all times or remain stationary. For example, integrating food-related interaction capabilities into robots that already have broader functions in the environment could be fruitful, particularly if they are mobile and do not take up precious counter space in a kitchen. For instance, Amazon's Astro robot [21] is designed to move around the home and support both remote and proximate communication. Based on our participants' feedback, incorporating ways that it can support telepresent food related activities could extend the usefulness of the robot without creating the need to purchase a bespoke technology for these activities alone.

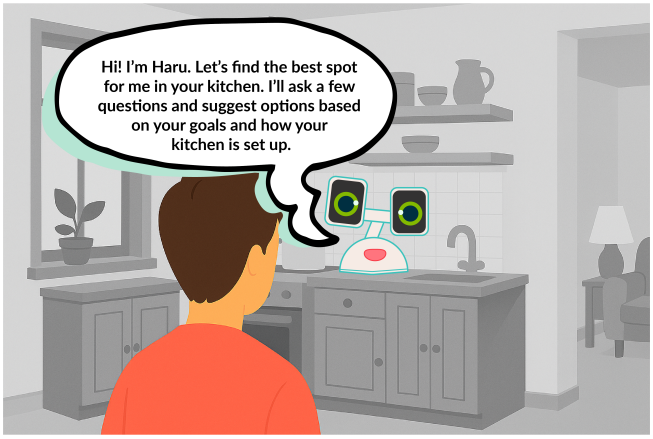

Figure 4: An example illustrated scenario of Haru working with a family member to ease the process of positioning a robot in their space.

5.2 The social robot amidst family values: exploring customizability through value-sensitive design

Family members' personal and shared values toward food practices and technology use were prioritized when considering Haru's presence in the kitchen. This was reflected in several ways during our study: for instance, the need for quiet time while cooking, minimalist values that questioned the robot's value proposition in the kitchen, concerns about privacy and boundary breaches, and doubts about the robot's ability to understand cultural norms or follow cues. These findings underscore that values—particularly how a social robot might comprehend, support (rather than undermine), or respond to them—were important to family members.

One approach that could be considered to lift up such human and family values in future social robot work is Value Sensitive Design (VSD) [28, 47], which prioritizes values throughout the design process. Voida and Mynatt [79], who introduced a methodological adaptation of cultural probes for eliciting values, highlighted how technologies for the family and within the domestic space aren't always driven by productivity or maintenance, but also reflect the family's sense of identity and togetherness [78]. This was seen in our study, where values emerged as a consideration for family members' willingness to have a social robot in their space, played into their feelings towards a communication channel of food practices, and influenced how they felt about shared access. We suggest that future research with Haru or other social robots systematically investigate values by adopting approaches proposed by Schmiedel et al. [71], Friedman et al. [29], and Voida and Mynatt [79] to create a comprehensive catalog of values relevant to family food interactions. Such a catalog could guide designers in developing customizable or "tailorable" social robots [53].

Prior HRI studies have highlighted the benefits of giving users creative freedom with robots. For instance, in one study, users personalized the Roomba robot with stickers to match their home's aesthetics [75], while another discussed how accessories like clothing and jewelry brought out the robot's personality and helped align it with its social role [40]. These examples, although different from values in that they focus on the robot's external appearance, are similar in that they show how personalization can better integrate the robot into the family's space and help users develop a sense of connection with the robot. For social robots mediating food experiences, we suggest expanding the idea of personalization to include customization options for values and cultural norms. These customizations could be pulled from a defined value catalog (through the VSD approaches described above), or, if the social robot is powered by artificial intelligence and LLMs, family members could interact with the robot through dialogue [1] and teach home rules, food values, privacy considerations, and other preferences.

5.3 The social robot as a mediator: opportunities during life events, for playfulness, and in culturally synchronous events

Prior HRI research and robot design in kitchen or domestic spaces have primarily focused on cooking [74], improving the efficiency of food practices [27], commensality [58], and individualized feeding or eating support [5]. In our study we used a social robot to bring out the social elements of family members' food practices and how it supports their long distance relationships. However, beyond media sharing and task support, participants' current creative, playful, and cultural food interactions through technology did not (for the most part) translate into new or unique ways in which a social robot can mediate food experiences.

An approach in social robot design highlighted by Kamino et al.[42], describes how familiar patterns can be integrated into robots

for meaningful adoption and interaction ritual chains. Building on this, we propose that future iterations of social robot support for family members could align with some of the contexts described by participants: (1) re-imagining past food routines disrupted by life events through technology, (2) gamifying food experiences or enabling fun, whimsical interactions, and (3) leveraging culturally synchronous events and practices.

For the first context, when life events or major changes took place, participants described an increase in food-related media sharing or communication as a response. This aligns with related work on how families connect remotely on food or health topics [64, 70]. A possibility here is that if social robots could sense the context of the change and the type of routine disrupted, they might become timely and meaningful facilitators. For example, they could support the transition of a shared collocated meal prep practice into a new remote dynamic or encourage shared remote food activities between family members when sensing isolation. Within robotics, there is also work being done on context-based perception in social and human-centric environments [59], this opens up possibilities for robots to understand context better in dynamic spaces and make situational decisions and actions.

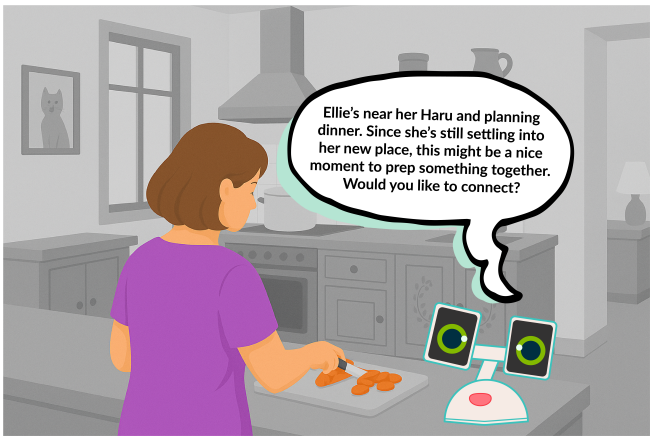

Figure 5: An example illustrated scenario of Haru nudging the family member to communicate with their distant family member after a life transition, and in an effort to transform a routine into a new practice.

In the second context, participants brought up playfulness-driven sharing, which could provide an opportunity for the social personality aspect of the robot to emerge. In HCI research, playfulness is considered a very nuanced concept, often described as a state of mind rather than an action [30]. Lucero and Arrasvuori in their work emphasize that designing for playfulness involves objects or artifacts that elicit playfulness and enjoyment [50]. Social robots could take on the role of such artifacts, intentionally facilitating playfulness through food, such as by mediating food-related games or challenges and prompting the sharing of funny or silly kitchen moments.

Finally, considering the third context of culturally synchronous events (or rituals), participants reported that these often led to similar experiences and common threads of conversation. Past studies

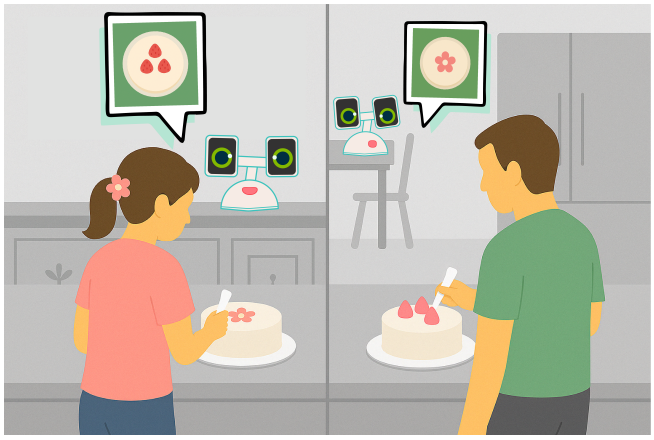

Figure 6: An example illustrated scenario of Haru facilitating playfulness through food, such as food-themed games or challenges.

have deconstructed rituals as consisting of many components or layers [23, 67], including—but not limited to—symbolic foods (e.g., mooncake for Lunar New Year), scripts (e.g., saying grace before eating), and time-shared practices (e.g., fasting during Ramadan). Future research could explore whether a social robot mediating cultural rituals and the meanings they carry for the family could facilitate deeper connections among family members and between family members and robots. Additionally, related work on food within HRI has shown that qualities associated with food, such as bonding through feeding, its influence on mood, its role in celebrating achievements, and its connection to seasonal traditions, can enrich human-robot relationships [41]. Therefore, integrating robots into cultural food rituals with opportunities for long-distance mediation could be a promising or interesting area for further study.

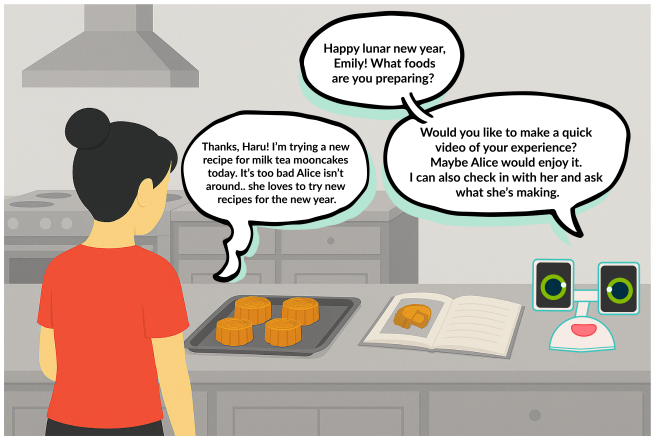

Figure 7: An example illustrated scenario of Haru encouraging communication during culturally synchronous moments.

6 Conclusion

In this study, we were interested in family members' thoughts and feelings toward a social robot potentially mediating food practices or experiences that were meaningful to their relationship. To find answers, we conducted interviews where 9 participants were first asked to send in pictures of their food spaces, then shown some videos of Haru (the social robot we used as a probe), and were asked to select one or two of 8 scenario cards (e.g, "you do not know what to cook today" or "you are making a cultural dish and want to show your family member how it's prepared") to walk over their expectations and hesitations. Our findings were organized into opportune moments for mediation (drawn from participant reflections) and design considerations and challenges for using Haru in this mediation. Overall, we found that participants expressed more hesitations and concerns than perceived benefits. In our discussion, we reflect on how future approaches can address this feedback, especially how the social robot might fit into family food spaces, be customized to work with family values and norms, and mediate experiences aligned with the family's identified or existing patterns and rituals.

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