

11-1-2020

Family's health: Opportunities for non-collocated intergenerational families collaboration on healthy living

Jomara Sandbulte

Chun-Hua Tsai

John Millar Carroll

Follow this and additional works at: <https://digitalcommons.unomaha.edu/isqafacpub>

Please take our feedback survey at: https://unomaha.az1.qualtrics.com/jfe/form/SV_8cchtFmpDyGfBLE

Family's health: Opportunities for non-located intergenerational families collaboration on healthy living

Jomara Sandbulte ^{*,a}, Chun-Hua Tsai ^b, John M. Carroll ^b

^a Swenson College of Science and Engineering, University of Minnesota - Duluth, Duluth, MN 55812, USA

^b College of Information Sciences and Technology, The Pennsylvania State University, University Park, PA 16802, USA

* Corresponding author.

<https://doi.org/10.1016/j.ijhcs.2020.102559>

Keywords:

Health, Family, Family health, Intergenerational, Healthy living, Family collaboration, Distance

A B S T R A C T

When a family is engaged in healthy living practices together, it enhances the quality of life for all individuals. However, when members in families are separated over distance, the everyday encouragement and support may shift and obstacles arise within the family. In this study, we investigate non-located family members' practices of healthy living, their perspectives on their family's healthy living activities, and what obstacles exist regarding collaboration on their family health. We conducted an interview study with 26 independently living participants representing "elderly parents" and "adult children" in a family dynamic. We present members' practices and strategies for sustainable healthy living activities. We also explore members' creative use of technology for health promotion and describe existing obstacles that prevent families to effectively collaborate in healthy living. Based on our findings, we suggest design implications to support family members living apart on their efforts to cultivate health within their families.

1. Introduction

Promotion of family health is an important process that goes beyond care provision. It empowers individuals to increase control over, and to improve their health (Hubley and Copeman, 2018). This process involves a combination of components, including: health education, the environment in which people live, and health policies (Fertman and Allensworth, 2016; Hubley and Copeman, 2018). To help individuals make better use of these components and make informed decisions about their health, many health promotion programs have been developed, including ones that promote collaboration among all individuals involved in care provision (Patient and Care, 2019) and others that engage families in building a familial culture of health and well-being (Johnson, 2019).

Supporting family health initiatives has garnered attention in the HCI research community (Colineau and Paris, 2012; Lukoff et al., 2018; Schaeffbauer et al., 2015). Although some researchers have linked family influence with individuals' dissatisfaction with their bodies (Kluck, 2010) and family problematic communication styles with eating disorders (Steinberg and Phares, 2001), still other researchers have examined the importance of involving families – especially ones that live together in the same home – in the promotion of a healthy lifestyle, particularly when trying to help individuals adopt positive health behaviors (Edelman et al., 2017; Fertman and Allensworth, 2016; Gillman et al., 2000). For example, Lukoff et al. (2018)'s study showed that colocated family members value both tangible and informational support on health promotion where members take action to help others such as by cooking healthy meals and giving advice. However, these kinds of support can be affected by different factors, including geographical distance. It is common to see the health care supporters living apart, e.g., the young adults who leave their parents' house or the siblings who have their own family. The "leaving home" family members may provide or receive health support remotely (Seiffe-Krenke, 2006), which may cause the everyday encouragement and support to change compared to when members lived together. Moreover, obstacles may arise within the family, for example, with an aging parent health decline. Given that, some researchers

have turned their focus from examining collocated to *non-collocated* family members and the unique obstacles they face when it comes to collaborating on health promotion, i.e., challenges on staying up-to-date on each other's activities and health status when living apart (Binda et al., 2018b; Nurgalieva et al., 2019).

In this paper, we were interested in the implications of aging for families and health collaboration-related issues that may arise. We frame family health as each family member is supporting, improving, and maintaining health both personally and for the whole family (Fertman and Allensworth, 2016; Hubley and Copeman, 2018). Based on the literature, we consider health practices as a form of *collective practices* composed by healthy eating, physical activities/exercises, and mental care as a way to maintain a healthy lifestyle (Hubley and Copeman, 2018). In our study, we focus on non-collocated family members – specifically individuals filling the roles of “elderly parents” and “adult children” in their respective families – to identify opportunities that can be used to promote health collaboration within families even when the family members are living apart. To be more specific, we sought to answer the following research questions: **(RQ1a)** What factors have motivated non-collocated family members to engage in healthy behaviors? **(RQ1b)** How do non-collocated family members maintain their personal healthy behaviors and cultivate their family's healthy living practices? **(RQ2a)** What are common obstacles that non-collocated family members encounter in cultivating their family healthy practices together? **(RQ2b)** How might technology design help non-collocated family members deal with those obstacles?

To answer these questions, we conducted in-depth semi-structured interviews with 26 participants filling the roles of “elderly parents” and “adult children” in a family dynamic. We contribute to research on family health informatics (Pina et al., 2017) by expanding the understanding of non-collocated family members' current practices, needs, and challenges to collaborate on healthy living activities. We discuss how to strengthen family members' engagement on healthy living practices, and leverage some existing strategies that influence their behaviors. In addition, we present factors related

to lack of interest, consistency, and understanding as obstacles that affect family collaboration on healthy living. Thus, we recommend design directions for family-centered health technologies to help non-located families overcome and thrive in their efforts to cultivate healthy living within their families.

In summary, our work intends to investigate non-located family members' – specifically elderly parents and adult children – current practices of healthy living, to gain insights into existing obstacles that prevents family members to collaborate on healthy lifestyles within their family, and to identify design opportunities for family-centered health technologies.

2. Related work

We first focus on literature related to family health and situate our research relative to prior work. Then, we highlight previous work in technologies for supporting family healthy living as well as technologies for supporting non-located families.

2.1. Theoretical framing of family health

Previous researchers have reinforced the importance of family collaboration on health because, for many people, a family can be a source of encouragement at times of necessity, such as during a chronic disease treatment (Pina et al., 2017; Sun, 2016). Studies have examined the needs and challenges of family members living together on supporting individuals with their health conditions, for example, family members helping other members to manage diabetes (Eschler et al., 2015; Kaziunas et al., 2017; Toscos et al., 2012) and caring for a depressed family member (Yamashita et al., 2013). Others have investigated the challenges faced by individuals with a chronic condition on sharing health information with distributed family members (Pang et al., 2013; Wu et al., 2008). The results of this prior work show that engaging the entire family on managing a health condition may have great benefits such as reducing feelings of anxiety (Toscos et al., 2012) and providing family's peace of mind (Kaziunas et al., 2017). Researchers have further explored the

issues of family support in managing health conditions, i.e., to engage family members in behavioral changes for a healthy lifestyle. For example, Colineau et al. (2009) investigated the requirements for a collaborative family weight management site to promote lifestyle changes by engaging family members to support one another in weight management. And Saksono and Parker (2017) examined families' reflections on physical activity to help members gain insights and improve their behaviors.

Although family support in healthy living may evoke negative feelings in some individuals (i.e., family interference, criticism) (Veinot et al., 2011) and influence individuals' dissatisfaction with their bodies (Kluck, 2010), still others may experience a positive influence from family and present the desire to help with the family's common good which opens an opportunity for promoting healthy living within families (Hubley and Copeman, 2018). In this paper, we adopt family collaboration on health by considering family members' practices of health promotion, or put simply, members' practicing healthy living and encouraging others in healthy ways. Thus, we consider family health as each family member seeking to support, improve, and maintain health both individually and for the entire family (Fertman and Allensworth, 2016; Hubley and Copeman, 2018). In addition, we consider health as a form of *collective practices* composed by healthy eating, physical activities/exercises, and mental care as a way to maintain a healthy lifestyle, instead of considering one single aspect of healthy living such as eating habits (Lukoff et al., 2018; Panicker et al., 2020; Schaefbauer et al., 2015).

2.2. *Technologies to support a healthy family lifestyle*

Prior work in HCI has sought to address many hardships that different families face when trying to promote healthy living among members. For example, diet and nutrition is an important aspect of healthy living (Hubley and Copeman, 2018), which has motivated works such as Grimes et al. (2009) and Panicker et al. (2020) to explore this domain as a way to support family household' eating habits (Grimes et al., 2009) and to investigate family

practices around communication of eating habits when living apart (Panicker et al., 2020). In addition, Lukoff et al. (2018) developed “TableChat” to investigate family support on healthy eating habits. Lastly, the study of Schaefbauer et al. (2015) examined the use of a sociotechnical mobile app called “Snack Buddy” as a way to promote healthy snacking and encourage healthy eating behaviors within the family. All these studies presented important findings suggesting that individuals’ value supportive actions taken by their family members to help them on healthy living (Lukoff et al., 2018) and that they appreciate receiving feedback and suggestions on how to improve their eating behaviors (Schaefbauer et al., 2015).

In the context of physical activity, Saksono et al. (2018, 2019) investigated how wearable trackers can encourage physical activity and evoke members’ reflection on their behaviors, and developed a family fitness app called “StoryWell” to promote family physical activity (Saksono et al., 2020), especially low-socioeconomic status (SES) family households to identify opportunities to be active. Also, some researchers have proposed interactive artifacts (Knaving and Woźniak, 2016) and games (Saksono et al., 2015; Stanley et al., 2010) that aimed to facilitate families’ discussion and reflection on exercise such as walking and running. When developing tools to support family sharing of health information, researchers have designed online family portals (Colineau and Paris, 2011a; 2011b; 2012) and social networks (Baghaei et al., 2009; Kimani et al., 2010) to motivate families to adopt and discuss about healthy lifestyles and inspire family members to collaborate with one another in order to achieve positive health outcomes. Collectively, these studies showed the potential for technological interventions for health promotion and urged for further design of social features to support users engagement.

Although this body of literature has presented valuable design solutions for families to share healthy living information and to collaborate with one another to achieve health goals while living in the same household, few researchers have investigated this topic considering the needs and challenges of non-located families on health, especially elderly parents and adult

children. For instance, Binda et al. (2018b) examined non-located elderly parents and adult children practices on health information sharing and their motivations to curate what health-related information they share which inspired future design work on how to effectively support reciprocal sharing of health information among non-located families members (Binda et al., 2018a). In addition, Nurgalieva et al. (2019) examined factors that influence older adults' decision to share or not share their health and well-being information among those involved in their care, including family members. Finally, Panicker et al. (2020) provided empirical understanding of what, why, and how older parents and adult children share or not share eating and meal preparation experiences and practices. Similarly to aforementioned prior works, this paper focuses on understanding non-located family members (i.e., elderly parents and adult children) practices and challenges in health collaboration. However, we expand this line of investigation by looking beyond families' practices in sharing health information to how family members' healthy behaviors have adjusted as a result of being apart and how this in turn impacts the family's health as a whole.

2.3. Technologies to support non-located families

Many people seeking to improve self-understanding have adopted pervasive tools to foster self-insight and promote positive healthy behaviors. Personal informatics (Epstein et al., 2015) and quantified-self (Choe et al., 2014; Rapp et al., 2017) literature, for example, have explored a diverse range of situations including how individuals collect and make sense of their health data (Choe et al., 2017; Epstein et al., 2016; Tang et al., 2018). The collection of health data is important because it allows individuals to create a holistic view of their health, and it also may improve the communication between patients and doctors (Bussone et al., 2016; Schroeder et al., 2018). As an individual ages, collecting such data can make a significant difference on health care, specially if one decides to age in place. Prior work has shown that 90% of older adults have the intention to age in place (Place, 2019). This fact has motivated researchers to further investigate older adults' needs and experiences

of aging in place (Birnholtz and Jones-Rounds, 2010; White et al., 2015) as well as their motivations to seek and engage in daily activities for health such as leisure activities (Lazar and Nguyen, 2017). However, promotion of health has gone beyond the personal level to involve interpersonal relationships such as *family informatics* (Pina et al., 2017). Research in HCI has studied how to support the complexity of family dynamics and has tried to address many of the existing challenges of connecting families (Neustaedter et al., 2013). One important challenge is: how to support families when members live apart. While family members may be distributed by temporal or spatial distances due to different reasons such as work/educational opportunities or lifestyle preferences (Bouchard, 2014; Seiffe-Krenke, 2006), they still have the desire to stay in touch and maintain awareness of each other's status across distance and time zones (Forghani and Neustaedter, 2014; Kim and Monk, 2010; Mayasari et al., 2016; Santana et al., 2005; Tee et al., 2009; Vutborg et al., 2011). Given that, some researchers have investigated how families use digital technology to stay in touch, for example, Derix and Leong (2018) examined how family values influence members' experiences of digital technology use. This study found that the family values guide members' technology practices such as what members' shared, negotiated and decided to take action. In addition, Li et al. (2020) investigated how fitness trackers could support care among intergenerational families living apart. This study showed that family tracking could enhance health awareness in the family and sharing fitness data could become a channel for family members to express care for one other (Li et al., 2020).

Others have developed systems that aimed to provide better communication channels for individuals who are apart from their loved ones (Chung et al., 2006; Kim et al., 2013; Muñoz et al., 2015). In addition, prior studies have proposed platforms for family members to share their lives and experiences (Inkpen et al., 2013; Pan et al., 2015; Procyk and Neustaedter, 2013), to increase feelings of connectedness and awareness (Cornejo et al., 2013; Judge et al., 2011; 2010; Romero et al., 2007), and to foster a sense of

closeness across generations (Vutborg et al., 2010; Yarosh et al., 2013). All these studies are valuable since they seek to better understand family's practices and experiences with technology use (Derix and Leong, 2018) and to support family members in terms of having sustainable communication with extended family (Tee et al., 2009), facilitating shared lived experiences with remote family members (Inkpen et al., 2013), and increasing family's sense of closeness such as between the family relationship of grand- parents and grandchildren despite the distance (Vutborg et al., 2010), but more work is needed to study different family dynamics such as the family relationship between elderly parents and adult children.

When designing for non-located family members, specifically considering elderly parents and adult children, researchers have considered the unique challenges that this family dynamic poses, including providing care and support remotely (Seiffe-Krenke, 2006). In many families, elderly parents want to stay in their homes as they age. Aging in place allows older adults to remain in a comfortable home environment safely and longer (Wiles et al., 2011). As for the adult children, many assume responsibility for the care of their aging parents such as by assisting with emotional care (Center, 2015; 2018). However, at the same time, elderly parents continue to provide parental assistance as needed, for example, with child care (Center, 2018).

Under such circumstances, researchers have examined how to support family members who take the role as caregivers, including exploring opportunities to support those individuals on negotiation and coordination of their actions of care (Gutierrez et al., 2016) and to balance their caring duties (Gutierrez and Ochoa, 2017). Also, researchers have proposed systems to support family ties through sharing information and stories (Santana et al., 2005) and strengthen family communication when members are away (Cornejo et al., 2015). While these efforts are important since they seek to better support this family dynamic in terms of communication and coordination in informal caregiving, more work is needed to look closely at other aspects of support in this context such as health promotion within non-located families. Our work

aims to expand prior works and investigate current practices and challenges of both elderly parents and adult children in their individual pursuit of a healthy lifestyle as well as aims to help them by identifying design opportunities to promote family engagement on healthy living over distance.

3. **Methods**

To unpack the practices and challenges of non-located family members to collaborate on healthy living, we sought the perspectives of people filling the roles of “elderly parents” and “adult children” in a family dynamic. For the purposes of this work, we consider “elderly parents” as family members in an older generation who shared about their own and their family’s practices on healthy living from their perspective. And we consider “adult children” as the younger generation representing the envisioned recipients of their family health modeling and their current personal practice.

This research was approved by the Institutional Review Board (IRB) before beginning any research activity. This research qualified for Exempt status according to the policies of the institution. Given that, during the study data collection phase, we provided a written consent form for each participant in which presented a summary about the research, including: (1) purpose of research; (2) time involved; (3) assessment of minimal risk; (4) statement regarding benefit to participants; (5) contact for questions about the research; and (6) contact for questions about rights as a research participant. Each participant was encouraged to read the document and ask any questions related to it. In the end, we asked each participant for a verbal consent about one’s decision regarding whether or not to participate in the research.

3.1. Study design and recruitment

We recruited participants from local public spaces by distributing fliers (e.g., public library, local restaurants, university boards) and from our local university by posting recruitment requests at the university

research website. Individuals were eligible to participate if they were young adults (18+ yrs) living *independently and apart* from family members or older adults (60+ yrs) living *independently and apart* from family members. Older adults with no children were eligible to participate in this study if they have other family members (e.g., siblings, nieces/nephews) who live apart. Young adults with divorced or deceased parents were also eligible. Recruitment continued until data saturation was reached, defined as the point at which no new themes emerged during the data analysis.

We conducted semi-structured, one-on-one interviews which allowed us to take a more guided conversational approach. We also collected some demographic information from participants (see Table 1). Each interview lasted approximately 50–60 min. Upon the completion of the interview, participants received financial compensation of USD\$10 cash.

3.2. Data collection and analysis

First, we presented introductory comments with a brief explanation about the study and asked for verbal consent. After getting the consent, the interviewer applied a short demographic survey to gather information such as age, gender, highest education level, and technology use. We designed an interview script with a series of questions to learn more about the study topic, however, additional questions were added accordingly with the conversation flow. (See Semi-structured Interview Script in Appendix A). Some example of questions are: “*What does*

healthy living mean to you?”, “*Can you give an example of a healthy living practice or activity in which you like to engage?*”, “*Do you usually have conversations about these activities within your family? Why or Why not?*”, “*In your opinion, is there any technological solution that could facilitate conversations around*

healthy living to happen within your family?”

We asked all participants to reflect on their experiences in talking about their healthy lifestyle within their family. Although we have examined prior literature to frame family health and to understand practices of healthy living, we decided to not define the terms “family” and “healthy living” to our participants because we wanted to let them speak about their experiences from their point of view (Jones and Ackerman, 2018). We believe that not defining those terms helped our research team to further understand participants’ current experiences as well as learn about their existing obstacles with respect to family collaboration on health despite the open-endedness of the discussion. At the end of each interview, we presented closing comments, thanked the participants for their contribution, and gave the compensation. All interview sessions were audio-recorded and transcribed.

Table 1

Sample demographics classified by identified generation.

	Young Adult	Older Adult
Number (n)	15	11
Median Age (Yrs Old)	25	67
Mean Age (Yrs Old)	28	71
Gender (Male/Female)	M: 4 F: 11	M: 4 F: 7
Race		
White	8	11
Black	1	0
Asian	1	0
Latino	1	0
Other	4	0
Education		
>Bachelor’s Degree	3	4
Bachelor’s Degree or Less	12	7
Technology Device		
Wearable Tracker	8	3
Smartphone	15	4
Desktop Computer	7	7

p	Tablet/Lapto	10	5
---	--------------	----	---

We employed a qualitative, data driven approach, following the guidance from the Grounded Theory Method (GTM) to develop an understanding in this work's topic domain, with an emphasis on discovering new insights (Miller, 2014). Although GTM is typically used with much larger data sets and with the aim of creating theoretical contributions, within the HCI field, GTM has been used to help researchers in making sense of the data and to produce a detailed analysis of the conceptual structure of how the participants described their experiences (Muller and Kogan, 2010).

In our study, GTM was incorporated in our data analysis to produce detailed information about participants' experience. As we gathered data from the interviews, our research team met regularly to become familiar with the data. The lead author converted all data to textual format (e.g., transcribing interview recordings) and conducted open coding of all interview transcripts. Then, the research team worked together to examine the codes and piece them together into themes across interviews to describe similar practices, motivations, and challenges. We organized the open codes into groups and identified the relationship between codes to extract axial codes. After that, the authors met to discuss and refine categories and themes that emerged from axial codes. For example, for the obstacle related to lack of interest, we defined labels in our data such as: "Not being heard; No interest; Seeking alternative strategies; Want feedback; Want collaboration" as open code, then we defined "Wanting meaningful conversations about healthy living but no mutual interest" as an axial code, and finally it emerged the "family members' lack of interest" theme in our findings. To ensure the quality and consistency of our data, we applied peer-debriefing and had discussions on divergent themes until differences were resolved.

3.3. Participants overview

A total of 26 people participated in our study representing "elderly parents" and "adult children" generations in their respective families. We interviewed 11 older adults (7 females and 4 males) as representatives of the

“elderly parents” generation. The median age of older adults was 67 years old ($IQR=15$). All older adult participants self-identified as White-American. Most older adult participants in this group self-reported their highest level of education as bachelor’s degree or less ($n=7$) or doctoral degree ($n=4$). The older adult participants had different living arrangements, including assisted living community or independent housing. Two participants in this interview group had step- children and two participants had no children but they had other living family members (e.g., nieces and nephews, siblings).

We also interviewed 15 younger adults (11 females and 4 males) as representatives of the “adult children” generation. The median age range of young adults was 25 years old ($IQR=8$). Most young adult participants self-identified as White-American ($n=8$), one self-identified as Latino, one self-identified as Asian-American, and one self-identified as African-American. Most young participants in this group self-reported their highest level of education as bachelor’s degree or less ($n=12$) or some doctoral degree ($n=3$). One participant from this group had a deceased parent, and one participant’s parents were divorced.

None of the participants came from the same family. All participants lived in a small college town in the Eastern United States. In terms of geographic distance from immediate and extended family, both young and older adult participants presented different variations, ranging from living across towns, living across the country (e.g., California, Georgia [U.S. state]), to across countries (e.g., France, India). In terms of technology use, participants self-reported their personal technology devices which help them in healthy living practices (e.g., iWatch and pedometers) and family communication over distance (e.g., smartphone). Most of the participants in both groups (*22 out of 26 participants*) were actively engaged in healthy living practices. Much of their perspective was about their experience on living a healthy lifestyle and ways to cultivate it individually and collaboratively within their family.

All of our participants indicated their view of healthy living by balancing different factors of diet and nutrition, physical activity, and mental health

practices. As for the participants' concept of "family", most participants (*23 out of 26 participants*) considered it as the traditional "nuclear" family that includes parents and children. However, for one young adult participant who had a deceased parent and two older adult participants with no children, their concept of family went beyond the traditional family unit to include cousins, nephews/nieces, siblings, and aunts/uncles.

4. Results

In this section, we describe the major themes and factors under the themes derived from our qualitative analysis. Our analysis shows non-collocated family members' motivation to pursue healthy living practices, which include: family's model of healthy living, social reflection, and health concerns. Then, we present individuals' strategies to sustain good health, including: combining different healthy activities and family support. We also present examples of technology use to support healthy living within families. Finally, we shed light on existing obstacles that prevent family members to fully collaborate on healthy living, including lack of interest, consistency, and understanding.

We refer to our participants using the following scheme: a letter prefix to indicate the generation (P for "elderly parents" and C for "adult children") followed by the participant number.

4.1. Understanding family members practices around health

During our interviews, participants were prompted to reflect on their current healthy living practices and on what have motivated them to pursue healthy living behaviors.

We learned that some families had a model of healthy living which influenced members' current personal healthy practices. Our data revealed that most of our young participants (*8 out of 15*) affirmed to have been *raised* learning about healthy living habits. And most of our older participants (*7 out of 11*) affirmed to have *passed down* healthy practices within their families. From the older participants' perspective, having a model of healthy behaviors was

important to lead the younger members on following good practices of healthy living. For instance, participant P6 mentioned that she raised her daughters to engage in healthy activities and she was very pleased with the fact that both of them have continued to pursue a healthy lifestyle even after moving away:

“Exercise is still our family’s middle name, we’re the third generation YMCA.” (P6)

As for the younger participants’ view, we learned that since leaving home, participants have *refined* their healthy living practices. For example, participant C3 said that having a healthy diet and being healthy was important for her family since an early age. She explained that her parents taught her what to do and how to keep herself healthy. When she went to college, she had the opportunity to learn more information on healthy eating:

“I studied nutrition. So, first, I learned about mainly the science behind it. And if I am interested in like a specific topic or a health benefit, then I usually use the internet or books to learn more.” (C3)

Similarly, participant C12 explained that when he was younger and living together with his family, he was raised receiving encouragement to be active: *“My parents would say, ‘Oh, you need to work out often.’ ”(C12)* When he moved to the USA, he had the opportunity to expand his thinking on healthy living practices:

“I realized that there’s better ways to go about it after seeing what other students do and seeing how other people are living their lifestyle, I kind of like observed that it’s a combination. So, then I figured, ‘Okay, if I eat what I want, I need to control the portion’, and I add the workout that keeps me in a good space.” (C12)

Some participants mentioned that their families did not have a model of healthy living. However, when a family member decided to change his/her behavior, it *reflected* on other members and moved them to start paying more attention or thinking about their health. We observed that the spark for change can come from both sides of the family generation. For example, in participant C14’s case, he was inspired by his dad’s change of lifestyle after visiting a nutritionist: *“So he started changing his diet, and he started to do some small strength exercises. At that time, I wasn’t doing that.” (C14)* Participant C14 said his father would often share information about healthy living which sparked conversations

on health topics within the family. After a time of observation on his father's new behaviors and asserting its benefits for his health, participant C14 then decided to follow his father's steps:

"I thought 'Okay, well, instead of just googling, and reading some random article on Google, let me just talk to somebody'. Because he [dad] did it. It worked for him. Maybe it will work for me." (C14)

For participant P3, the spark came from her son. She mentioned that she fell through her practices but wanted to return to those good habits. Her son, knowing that she loves to dance, decided to give her an intentional Christmas gift:

"My son gave me a book about Dick Van Dyke. If you read his book, he dances every day. He goes to the fitness class every day, he is a good example to follow. So, my son got this book to encourage me." (P3)

Others explained that their decision to adopt healthy living practices were motivated by *health concerns*. For example, participant P1 have faced different health concerns in her family and she has seen family members' health decline. She said this situation has led her to make changes in her own lifestyle: *"You know, I want to just maintain quality of life. Pain free, disease free. Be able to do what you want to do, like travel. So, I do like yoga, I do like stretching, and try to eat healthy."* (P1) Participant P1 affirmed that living a healthy life was the best for her, but also for her spouse and her entire family.

In participant C11's case, she was diagnosed with colitis and had to change her diet: *"So, I get inflammation from specific types of products like red meats and dairy, those are some of my trigger foods."* (C11) After her diagnosis, she figured if she had to give up on those foods, she might as well just go on and join her husband's lifestyle. Her husband has been

following the vegan diet for several years: *"...so it just made sense to go full blown vegan with him [husband]." (C11)*

4.2. *Strategies to achieve sustainable healthy living*

During our interviews, participants also mentioned the importance of

sustaining their individuals' healthy practices in their daily routine to achieve good health outcome. In our analysis, we observed what strategies have helped the participants to maintain their individual healthy living behaviors as well as how family support has influenced their continue engagement in healthy living.

First, according to our participants in both groups (22 out of 26), *combining* different lifestyle practices is a good approach to strengthen healthy living and achieve good health outcomes. For example, participant P5 said that he tries to combine different practices to maintain his health:

"So, my practice of healthy living includes proper diet, exercise. And I do have a number of things that are medically related. So, like, making sure I take my medicine and seeing a doctor regularly and again, just all that kind of stuff. I think that needs to be a combination." (P5)

Similarly, participant C13 said he tries to incorporate different activities in his lifestyle to keep himself healthy:

"I try to play sports, I try to limit junk food. I just try to have a good routine, like sleeping on the right time. So basically I make a good effort to combine all those good things." (C13)

Second, besides combining multiple healthy practices, we observed that family support played an important role to encourage members on sustainable healthy living practices. According to our analysis, we noticed two major factors that characterize how family support has influenced members to sustain their engagement in healthy practices: *accountability* and *incitement to action*.

According to our participants (12 out of 26), keeping each other accountable on their healthy practices was seen as an important factor to help members on getting their activities done, sparking conversations about their progress within the family, and achieving their health goals. For instance, participant P10 said her daughter shares pictures of her exercise routine and uses them to encourage her to do the same: *"...and then she says: 'Have you and dad gotten out to take a walk yet? And if yes, where did you go? How long did you walk?'"* (P10). According to participant P10, her daughter's accountability is

important to help her in regular healthy practices and in achieving her goals.

Participants from both groups (10 out of 26) also mentioned that family members would incite them to action by giving them the necessary push and encouragement when they most needed an incentive to keep going. For example, in participant C1's case, she explained that she goes to the gym to exercise regularly because it has helped her to be physically and mentally healthier. Besides exercising, she also meets with a psychiatrist and a psychologist regularly. But the support from her family has also played an important role to push her to persevere on healthy living practices:

"I remember when there were some rough periods in my life just because of depression, I was not exercising at all. My parents and family would always remind me and say 'Oh, exercise will make you feel better, why don't you go to the gym?' Not literally but they would push me out the door and say 'just go to the gym and come back you are going to feel better.' " (C1)

In short, our data showed that to sustain a healthy lifestyle, participants have determined strategies to motivate themselves to get healthier. In the individual level, they have combined different practices (e.g., eating healthy and exercise) instead of picking out one activity. Going beyond the personal motivation, we learned that finding support in people, such as family was important for participants to keep themselves on track of their health goals. Family members provided accountability and incitement to action when challenges to persevere emerged, for example, as explained by participant C1.

4.3. *Technology use on family's healthy living*

Our data revealed creative ways that non-collocated family members have appropriated technology to mediate family support on healthy living practices, applying it in innovative ways.

Several participants from both groups (11 out of 26) mentioned using physical trackers to help them be more active and informed about their activity progress. We noticed that older adults use transitional trackers such as pedometers. For example, two older adults participants (P2 and P5) mentioned

to use pedometers to collect data from their exercise practices: *“...that is just a habit I got into. I like to see how many steps I am taking each day. And how many calories I burned. And It also tells me how long I’ve walked.” (P2)*

However, most of the young adult participants (8 out of 15) mentioned to use popular commercial trackers such as iWatch¹ and Fitbit² to enhance their physical activity experience. Participants mentioned having appropriated some features from the trackers into their family context as a way to collaborate on healthy living. We learned that our participants re-purposed the sharing activity progress feature and the activity competitions feature to use with family members instead of friends or fellow users. For example, participant C11 mentioned sharing her physical activity data with her brother through iWatch. The siblings set weekly contests to encourage one another on their physical activity practices. According to participant C11, when the tracker sends her an alert about her brother’s health data and activity progress, it moves her to action:

“If I get an alert that says he [brother] just completed a workout and burned 500 calories and I’m still 400 calories shorter my goal, it motivates me to want to go and do something. And then he’ll know when I’ve done something and so we kind of just go back and forth and motivate each other.” (C11).

Interestingly, we observed the blending of generations when a younger participant decides to “gift” technological tools to older family members as a way to encourage them in their healthy living practices. For example, participant P9 said she needs to control her weight because of high blood pressure issues. To help track her diet and exercise, she has used different apps in her phone to record her weight and to look up any food calories such as Weight Watchers app

¹ <https://www.apple.com/watch/>.

² <https://www.fitbit.com/home>.

and Noom app. According to participant P9, her older daughter surprised her with a Fitbit as a way to boost her pursuit of healthy living and help her on tracking data of her physical activities:

“I had been using my cell phone to track my steps but you always had to have it with you. But now between my cell phone and the apps on it, and my Fitbit, I can get a pretty good assessment of the bicycling, the walking, and eating.”(P9)

Furthermore, some young participants (4 out of 15) said that they take advantage of social media functions (e.g., Facebook Groups) to create a space for family support and collaboration on health. For instance, participant C5 created a Facebook group with immediate and extended family members. She explained that her goal was to build a culture of healthy living within her family by sharing information related to activities’ progress and health goals, and to promote reciprocal exchange of support messages to encourage one another in their efforts to stay active, especially on difficult days:

“There’s a lot of days that I’m not motivated and then I post ‘Oh, yeah, I had to go and get a cherry vanilla coke. I know it’s horrible’. And then someone message or comment the post and say ‘Tomorrow is another day.’ That’s a nice way to kind of give somebody an energy boost right there.” (C5)

In sum, although some existing technology has not been design specifically for family collaboration on health, still we observed participants repurposing the social features in those devices (e.g., iWatch) to involve family members into their healthy practices instead of friends and fellow users. Furthermore, we noticed participants taking action to engage different family generations in healthy living by gifting technological tools (e.g., FitBit) or using technological functions (e.g., Facebook Groups) to motivate healthy living within their families. Participants seemed to aspire on seeing more family oriented solutions focused on health.

4.4. Obstacles in promoting healthy living within families

The previous section reported some participants’ current practices on healthy living and their strategies to pursue a sustainable healthy lifestyle,

including technology appropriation. As mentioned, we learned that family support is valuable to encourage members on healthy living practices. However, some participants mentioned existing barriers that impact their family collaboration on healthy living.

During the interviews, we asked questions to prompt our participants to share their experiences when members are not involved in the family health project. We identified three main obstacles: *lack of interest*, *consistency*, and *understanding*.

4.4.1. Family members' lack of interest

Participants explained that some family members lack interest on healthy practices which make it difficult to cultivate healthy living together over distance.

According to our data, some members' lack interest in healthy living because they may have different standards and values when it comes to the definition and practice of "health" and "well-being". Those members seemed satisfied with their own thoughts and beliefs, and decide to stick to them which might limit collaborative interactions within the family. For example, participant C7 mentioned that in her family, she and her little sister share the same values and standards in terms of healthy habits since both participant C7 and her sister are interested in learning about food nutrition, have taken nutrition course, and have tried to follow a healthy diet. However, according to participant C7's view, her mother is not on the same page and is not interested in learning about healthy eating because: *"...she has her own ideas. She doesn't base her facts on knowing stuff like nutritional ingredients. My mom has the mindset of not eating a lot to lose weight. She just thinks this is the best way to do it."* (C7)

Given her mother's behavior, participant C7 expressed concerns on her mother's health:

"...I don't think she eats properly in the way she should. And she is borderline diabetic. And I think that she could be doing things better for her health." (C7)

Once, participant C7 tried to help her mother by writing a healthy diet plan and giving it to her, but her response was dismissive: *"She kind of thought it was*

humorous and didn't take it seriously." (C7) After her mother's reaction, participant C7 felt discouraged on trying to help her mother on improving her behaviors: *"...because if she doesn't want to hear it, then what do you really gonna say? I think the people have to want to do it."* (C7) Since this family dynamic has an existing conflict due to differences in their health belief, the strategy of presenting the "right way" of eating healthy was not well-received or effective as participant C7 expected despite of the benefits of the information.

In addition, we observed another reason for members' lack of interest is that some family members are unconcerned about their health thus, they are not actively seeking a healthy lifestyle. For example, in participants C4's case, she and her mother try to motivate each other on healthy living by sharing ideas for healthy recipes. They also share tips about exercise practices and mental care such as sharing information about books on spirituality and personal development. However, according to participant C4, her father does not demonstrate interest in healthy living: *"...he's not doing anything at all [for his health]. He smokes*

like 10 cigarettes a day and he eats pizza."(C4) Participant C4 said she has tried to use alternative ways to have conversations with her dad about his health, but he was indifferent: *"I tell him as joke but he doesn't really want to talk about it. So, we never have a real conversation about that."* (C4) According to participant C4, she is worried about her father's health since it seems that seeking a healthy lifestyle is not appealing to him.

Finally, we observed that some family members lack interest in cultivating healthy living practices because they focus on talking about their ailments. For example, participant P2 explained that in his family, members prefer to focus on their poor health instead of encouraging one another on healthy living practices:

"If we are going to talk about health, it is going to be about their poor health. They talk about their latest operation, or their latest doctor appointment, or the new medication that they are taking. It is not going to be anything uplifting or healthy. They don't really want to talk about healthy living. It is almost like 'I am on 3 medications.' 'Oh, that is nothing, I am on 10 medications.' Or they say: 'I have a bad knee'; 'Oh, I

have two bad knees and a hip', you know, that sort of thing." (P2)

Participant P2 personally prefers to focus on conversations that involves healthy living topics and how to keep good health, but due to his family's attitude, he chooses not to bring the topic up in conversations with them despite being disappointed with some of his family members' behaviors: *"It is depressing. These people are so much younger than me and they are in horrible shape. They do not want to talk about anything uplifting and healthy at all."* (P2)

In summary, participants mentioned to try to involve members who lack interest on conversations around healthy habits and have tried to provide information, such as participant C7's attempt to write a healthy diet plan for her mother. Still, none of their work seemed to be efficient to spark members' interest in healthy living. Family members presented concerns when others are not interested in living a healthy lifestyle.

4.4.2. Family members' lack of consistency

In our analysis, differences in priorities in life was the main reason for members' lack of consistency. Being healthy and having a healthy lifestyle requires a certain level of discipline which includes regular practices. Thus, for some, it is difficult to include those habits in their daily lives despite of the benefits.

According to our participants, it requires a great effort to support other family members in maintaining their healthy living practices consistently when living apart. For instance, according to participant C2, despite engaging in regular conversations and often trying to encourage her parents to be active, it is hard to keep their enthusiasm on being healthy up over distance since healthy living is not their priority. Participant C2 explained why her parents lack consistency in healthy living according to her view: *"My parents, they are not the 'get up and go' type of people. Last summer, I did went over to their house a couple of nights a week and walked with them but they only went because I went over."* (C2) Given her parents' behavior, participant C2 mentioned different at- tempts to help her parents to be more consistent in their healthy activities:

“When I go back to visit, they would walk again. And I have tried to plan mini-vacations for my parents to go with my boyfriend and I every year. Just to kind of get them out. And they do a lot of walking during these trips than they usually do.” (C2)

Similarly, participant C8 explained that her parents are not consistent in engaging on healthy behaviors. According to participant C8, each of her parents have an active job and they use it to justify their lack of physical activity practices: *“So, that is what they justify and say ‘Oh, well, we’re walking during the day [at work]. So, we don’t really have to exercise.’” (C8)* In terms of her parents eating habits, participant C8 described their regular eating practices: *“[Parents] They do a lot of sweets, larger portion sizes, they eat a lot of processed meats like deli meat.” (C8)* In this case, despite participant C8’s efforts in trying to get her parents to eat a little healthier, or try to get them to exercise a little bit more, after having a long day of work, going out for a jog and having no sweets after dinner seemed like the last thing they want to do.

According to participant C8, she and her sisters have tried to hint to their parents to eat healthier and to get them to exercise more often without much response from them:

“The last time I was visiting them at home, we were cooking food. I said: ‘Maybe we should just cook some really great vegetables. Let’s try to do something super healthy and delicious’. And they were like, ‘Hey, we’re so happy. We are eating healthy.’ And then, after I left, they just continued to do all of their unhealthy behaviors.” (C8)

During the interview, participant C8 admitted that her attempts to hint her parents have not worked as she expected.

In summary, we observed that although family members are willing to help and have tried alternative ways to increase engagement in other members who lack consistency in healthy behaviors such as planning visits and cooking healthy meals together while visiting, still participants indicated that their attempts have not been effective in keeping members’ enthusiasm on being healthy up over distance in a way that healthy living is a priority.

4.4.3. *Family members' lack of understanding*

As mentioned, we did not define the term “healthy living” to our participants, thus the perception of healthy practices presented in this section is based on participants’ experiences and their point of view. In our analysis, we observed that some participants face obstacles because their family members *do not* comprehend their lifestyle choices and behaviors.

When the lack of understanding was due to a member’s lifestyle choice, participants explained that their family had difficulties to understand their practices because they are different from what the family considers as typical. For example, participant C11 said that both she and her husband follow vegan diet due to health reasons: *“My husband’s family has history of heart disease, diabetes, high blood pressure, and so he wanted to try to combat it on a different angle. And I was actually diagnosed with colitis, and so I get inflammation from specific types of products such as red meats and dairy. So, as vegans, we do not eat any animal byproducts. So, no dairy, no eggs, no honey, nothing that actually comes from an animal.” (C11)*

According to her experience, family gatherings can be difficult because of some of her family’s tradition which may evoke feelings of exclusion:

“Thanksgiving is one of the hardest time simply because they just think of turkey, mashed potatoes, gravy, and stuffing. All of those things tend to be focused around heavy meat or animal products. And so, a lot of times I’ll volunteer to make something and bring our own meals so that people don’t have to worry about making something special because we [my husband and

I] don’t really like to feel ostracize and feel like we’re kind of trying to disrupt what has been the tradition.” (C11)

Participant C11 said she does not want to push her lifestyle on her family but to help them understand it. According to C11, she has shared vegan recipes with her mother as a way to help her grasp what a vegan diet is:

“Like pasta salad, right, you just don’t put the meat in it or you just don’t put a dressing that has some sort of dairy in it. I try to do things that help them understand what vegan means because a lot of people are very confused by it and still

don't understand it.” (C11)

When the lack of understanding was due to a member's behavior, participants mentioned that their family struggles to understand it because their behavior or attitude is different from what the family expects. For instance, participant P9 explained her experience with her younger daughter. According to participant P9, she is surprised over her younger daughter's positive self and body image despite being over- weight. Participant P9 said that, in her mind, being overweight is bad for one's health and her daughter is so young and so heavy which causes her concerns:

“To me, I'm concerned for her health. My daughter weighs more than me, she probably weighs close to 200 pounds. But she said: 'Mom, I'm happy with myself and I'm happy with my body image.' ” (P9)

During the interview, we asked participant P9 to comment on how she feels about her daughter's behavior. Participant P9 said it is hard for her to understand her daughter's way of thinking despite knowing that she is following a healthy lifestyle and seems happy:

“She doesn't seem to be bothered by it [her weight]. And my daughter and her husband do walk. They walk all the time, miles a day. So, I know that they're engaging in healthy lifestyle. But sometimes I wonder how she is just happy with it [the weight].” (P9)

In summary, we observed that the lack of understanding barrier related to a member's lifestyle choice can impact family collaboration in healthy living despite members' efforts in engaging in conversations to inform their family about their decision and to explain their choices as a way to help them understand their different practices. Family members seemed to struggle in turning those points of divergence into opportunities for learning and bringing the family together.

5. Discussion

This study investigated non-collocated families, specifically elderly parents and adult children, to identify opportunities to develop *collective health*

practices, and address and minimize obstacles through technological design. We build on previous work by expanding the view of family health informatics (Pina et al., 2017) to include non-located families' view on health promotion. As follows, we reflect explicitly on how our results address the proposed research questions. Then, we discuss design considerations and opportunities that we identified to support non-located families in their efforts to promote healthy living within their families.

Summary of results

Our results described the major themes and factors under the themes derived from our qualitative analysis related to what motivates non-located families on healthy practices, including: family's model, social reflection, and health concerns. Then, we discuss family members' strategies to strengthen personal and collective health practices. This includes the creative re-purposing of digital tools to promote family health. Finally, we examine factors related to lack of interest, consistency, and understanding as obstacles that affect family collaboration on health and present design implications for family-centered health technologies.

RQ1a: What factors have motivated non-located family members to engage in healthy behaviors?

First, we observed that when an older generation passes down healthy practices and raises the younger generation in a family where healthy living is presented as a model of good behavior, the generation who received the family modeling develops a habit of regular refinement of healthy practices even when living apart from family. Prior works have affirmed that parents play an important role in terms of modeling healthy behavior in their children when living in the same household (Edelman et al., 2017; Grimes et al., 2009). We extend upon prior works by showing that when the model of healthy behaviors is *passed down* or *shaped* into families, healthy living seems to become part of individuals' regular activities. Moreover, individuals demonstrated interest to pursue more information about health and to expand their state of thinking as a way to

complement the knowledge they have received from their family. This finding is interesting because it raises the question as to whether individuals would sustain those practices throughout their life span and even pass down their practices to the next generation. Our findings did not provide a final answer to this question, but they do suggest that, following family modeling of health behavior, individuals tend to value healthy activities and experiences persistently. We suggest future work to investigate the long-term affects of family modeling of health behavior within the context of different families, including non-located ones.

Second, we learned that a family member's decision to change may reflect on other members and move them to consider adopting healthy living. Our findings showed that the spark for action can work both ways, from the older to younger generation and vice-versa. When examining family reflections on health data, Saksono et al. (2019) considered how trackers could help caregivers and children towards action in terms of physical activity. Their findings presented reflection themes tailored by individuals' readiness to change, such as family who have considered being active but not yet regularly active, thus requiring supportive friends and family to take action. We complement prior literature to include how non-located family members' attitudes may reflect on others and help them towards action in terms of healthy living. For example, a member who has decided to be active (e.g., go to a nutritionist visit), thus starting to share information about healthy practices within his/her family, may lead others to think about health. We recommend that future work could further investigate reflections themes towards action within different family dynamics and propose interventions that go beyond physical activity to include other healthy practices such as healthy eating and mental care.

Finally, health concerns were considered as a factor to motivate individuals on healthy behaviors. We learned that family history of chronic conditions or an illness diagnosis can contribute to their decision to change their practices. Previous studies have developed family health history tools to increase awareness within families (Cohn et al., 2010) and to help them to learn

about risks for conditions that may run in their families (Portrait, 2019). Our findings suggest that besides learning about the risk of potentially having a condition, family members are interested in engaging in behaviors for prevention which may reduce the possibility of developing a chronic condition. Based on that, we recommend future work to consider developing systems for family members that would not only present risk factors for health condition but also would include information on healthy practices that family members may participate in for prevention.

RQ1b: How do non-located family members maintain their personal healthy behaviors and cultivate their family's healthy living practices?

We learned that family members perform numerous activities to manage their personal health, which combines different lifestyle practices. We observed that most of the practices mentioned were individual- level and related to eating habits and physical activities. Many studies have investigated and proposed design solutions to address the needs of individuals who want to maintain sustainable healthy practices such as physical activity (Altmeyer et al., 2018; Chen et al., 2015) and healthy eating (Barbarin et al., 2018; Chung et al., 2019). This health information from an individual can be presented as a holistic view to cultivating the family's healthy living practices (Barbarin et al., 2018). Our finding supports prior work that shows sustainable healthy practices are strengthened by people's understanding of their behavior as a whole and continued motivation (Barbarin et al., 2018).

Furthermore, we learned that family support plays an important role to help non-located family members on managing their healthy behaviors. For instance, participants mentioned that family members keep them accountable for their healthy practices and encourage them to get their activities done. Also, participants mentioned that family members incite them to action, especially when they need a push to persist in healthy practices. It is interesting to see that the non-located family member benefited from each other. We observed that the family support was passed down to the young adults as well as turned over back to the elderly parents. These findings are in accordance with previous

studies which affirmed the importance of family support on health promotion (Eschler et al., 2015; Fertman and Allensworth, 2016; Hubley and Copeman, 2018). We contribute to prior works by showing how non-located family members' attitudes have influenced other members in their practices and decision to act when living apart. As for future investigations, we refer back to the idea of developing systems that the non-located family members could receive encouragement or attention through comments or visual metaphors (e.g., applauds, achievement badge). This design idea represents in practice the contribution of our findings on effective family support in health and has the potential to enhance family interactions.

Going beyond the individual management of healthy living, our findings demonstrated creative approaches that family members have used to cultivate healthy behaviors within their family. We observed that family members repurposed existing technologies which were meant to have individual and community functions (e.g., peers users) to apply them in the family context as a way to collaboratively cultivate health together. For example, participants who own commercial trackers (e.g., iWatch) have appropriated some features from the trackers to use them within their family. We saw the example of siblings collaborating on health practices by setting weekly contests and health goals to encourage one another on healthy living. We also observed family members "gifting" technological tools to other member as an encouragement and a gesture of support and care on his/her healthy practices. Finally, we observed that people have appropriated social media to create family groups with the goal of supporting each other on health. We presented the example of a participant who uses Facebook Group to promote reciprocal sharing of health information within her family as a way to keep each other encouraged on healthy practices, especially on discouraging days. As mentioned, previous investigations and design solutions have focused on improving personal health goals and to uncover effective ways to encourage individual's practices of healthy living (Altmeyer et al., 2018; Barbarin et al., 2018; Chen et al., 2015). In terms of family health informatics, prior studies have proposed the use of social network

for families to motivate family discussion on health topics (Baghaei et al., 2009; Kimani et al., 2010). In addition, prior work has examined the use of wearable devices to share health data among family members as a way to increase the family awareness of a health condition (Kaziunas et al., 2017).

We, thus, corroborate prior studies that show family members using wearable devices and social media to connect, share, and discuss health information as a way to enrich the family collaboration on health (Baghaei et al., 2009; Kaziunas et al., 2017). We extend upon this previous literature by showing how non-located family members have appropriated existing technology to promote health within their families. Moreover, we emphasize the need to align tracker designs – online portal and health apps more generally – with individuals' desire to include family, not only friends and peer users. We suggest future work to seek techniques that would improve this appropriation by developing design solutions that leverage the family collaboration. Perhaps, one design direction could consider adding a function within a system which allows users to create family groups. And the user would choose which family member he/she wants to share health information with, giving him/her the opportunity to include family in his/her pursuit for health. *RQ2a & RQ2b: What are common obstacles that non-located family members encounter in cultivating their family healthy practices together? And how might technology design help non-located family members deal with those obstacles?*

Based on our results, we identify three common obstacles for non-located families to collaborate on healthy living together. First, we observed that some family members may have *no interest* to partake in the family health project. We were intrigued by this obstacle because we saw examples of families in which a member's decision to change behaviors reflected on others and moved them to think about health. However, when a member is not interested, the echo of others' healthy practices is not effective to move them into action. In fact, some participants reported experiences of family members being dismissive or indifferent when they attempted to involve them in healthy practices or pass down information about healthy living. Moreover, some family

members appear to be more interested in talking about their ailments than healthy living. Since this obstacle suggests that a variety of factors that encourage or discourage family collaboration on healthy living may exist, we recommend to HCI researchers and designers to seek further understanding on what strategies may be more effective under certain conditions. Our work sheds light in some reasons for this obstacle, and based on that, we present one design direction to inform future work on how to deal with this obstacle in the following section.

Second, we observed that some family members may have *no consistency* on their healthy practices which increases the burden on other members who attempt to keep their enthusiasm up. Prior work (Binda et al., 2018b) has discussed the challenges faced by families when members change their roles and how they deal with those challenges, for instance by asking questions in a subtle way. We complement prior work by showing family members' attempts to help members on being consistent in their healthy practices. For example, when living apart, members plan visits and vacations to see family and they use this family time to help members become more enthusiastic about healthy practices by cooking healthy meals or inviting them for walks. However, we learned that some family members' enthusiasm is limited to the time of the visit/vacation. We, then, recommend future work to seek for innovative ways to help family members on turning their priorities so healthy practices will become regular and to maintain their enthusiasm. In the next section, we provide a design example that addresses this challenge.

Finally, we observed that some family members may have *no understanding* on other members' lifestyle choices and behavior or attitude. For example, one participant who follows a vegan diet mentioned that her family struggles to understand her lifestyle choice because it is different from what they perceive as typical. Another participant said she could not grasp her daughter's positive body image attitude because it is different from what she expects. Despite this existing challenge, we see family members trying to help others members to comprehend their behaviors by presenting information to

inform them on their choices and have positive conversations about it.

Christensen et al. (2019) affirmed that “*several individual activities can become a shared experience, when these activities share a common goal in the family.*” Our finding is in line with prior work and complements it by showing how non-collocated

families may face obstacles and turn them into an opportunity to bring families together despite their different practices. Based on our finding, we propose a design idea for future work in family-centered design.

5.1. Design implications

We discuss the design implications based on the participants’ mentioned existing barriers, i.e., family members’ lack of interest, consistency, and understanding, that impact their family collaboration on healthy living.

Motivating the uninterested: We observed the obstacles that family members did not feel the health information was related to them and did not take the health guidelines seriously. For those members who lack of interests in healthy living, it may not be realistic to expect them to proactively adopt a health app and conduct goal-based activities. It is essential to bring supports from the other family members. One way of increasing the relativeness is to provide personalized messages and explanations to empower people to manage their health behaviors in ways that better fit their lives and values (Blandford, 2019). For instance, to use family history information as a tool to promote a healthy lifestyle (Claassen et al., 2010) as well as a holistic view of healthy practices (Barbarin et al., 2018). Such a system should proactively push the personalized messages and explanations that can increase the health awareness to the whole family members, e.g., to show the same personified recommendation to all family members and encourage them to discuss or communities the health information. We believe make information transparent is the best way to hold people *accountable*, which can be contributed to their healthy lifestyles and decisions.

In terms of *motivate* family members in engaging in health practices, we

find opportunities to *persuade* those members through the lens of reflective personalization, i.e., understand the deeper user preference and set up personal health suggestions for them (Lee et al., 2015) and provide technological intervention to change the users' behavior (Cremonesi et al., 2012). The system could adopt the goal-setting theory in the family context (Colineau and Paris, 2011b), which encourages the family members to work towards a specific, collective health goal influenced by how much the family as a whole contributed. The essential design is, the family member (e.g., young adults) can set up a goal or challenge to other family members (e.g., older parents). It is like a son "gifted" a health tracker to his father. Family support through the challenge can bring mutual attention to healthy lifestyles which can further change people's behavior in a positive way.

Supporting sustainable practices: We observed the barrier for those who are irregular in their practices of healthy living. The family members would be able to provide health support when they are co-located, e.g., stay at home with his/her parents. However, when they are in a remote distance, health practice is not sustainable. We find an opportunity to promote sustainable practices through the lens of health recommendation systems (HRS), which have been used to promote positive health-related lifestyle changes (Cheung et al., 2019). HRS is one of the typical solutions to improve the users' awareness, understanding, and behavior regarding their health and general well-being. HRS advanced the tradition recommender system in the concepts of transparency, persuasion, empowerment, and trust (Schäfer et al., 2017). For example, HRS can be used to nudge people toward healthier habits that lead to better lifestyles (Thaler and Sunstein, 2009). Radha et al. (2016) proposed an HRS to provide feasibility-tailored recommendations by matching the difficulty of the advice with the ability of the user. The goal is to maximizing motivation that leads the users to a better lifestyle. Another example, Elswiler and Harvey (2015) proposed the use of food recommender tools to help individuals planning their healthy diet.

The design implication of supporting consistent health practices is to empower the non-located family members and let them collaborate on healthy activities, instead of proactive behavior intervention like a traditional health education program. A successful context-based HRS should be able to provide a personalized recommendation that tailors the nudge types to the user behavior based on the users' current context (Schafer et al., 2017), e.g., location, weather, health history, mood, etc. We believe the family members can play a support role in incorporating the system. For example, the system can provide a context-dependent recommendation to remind the young adults to mention the dietary restriction in the conversation with his/her parents. The system can suggest having a certain cuisine so the parents and children can collaborate on cooking dinner remotely, etc.

Nurturing Shared Experiences: To explore this opportunity on cultivating shared experiences on family health, we build upon prior works that affirmed that families desire to communicate often and share information (Binda et al., 2018b; Judge et al., 2011; Pan et al., 2015). The goal is to increase mutual communication so the family members can better understand each other's needs and support one another according to family members' different stages of life. For example, Pan et al. (2015) developed "The Family Board" to support families on message sharing. Inspired by this previous work, we propose a design idea that allows members to share information, more specifically health information that would introduce knowledge to their family about their current healthy lifestyle practices, decisions, and difficulties.

This system would work as a center of information for the entire family. Members would be encouraged to mutually share any media with a reliable source of information on healthy practices. For example, if a member wants to inform his/her family on a vegan diet, this person can share an article about a plant-based diet and its benefits. Then, family members who read the article would be educated on this topic and encouraged to leave a comment or feedback (e.g., like, heart). Based on the user-generated content, the system

would be able to learn intrinsic user feedback and make other members aware more about their family, e.g., the new information that never appears in their daily conversation, e.g, dietary hobby or daily activities. In summary, this system would facilitate family sharing or lifestyle-related information, and aid the introduction of atypical topics into the family in a subtle way. It would be interesting to see how a tool can facilitate the “flipping” that the dependent can provide vital support for the parents.

In summary, we present several design ideas for addressing the identified barriers in our findings. We argue a successful family health- promoting system should not be a solitary endeavor or solely individual interests. Instead, these systems require essential partnerships to participant in the *family-centered design* cycle such as people living with different locations, health conditions and beliefs, and their family members (Johnson et al., 2008). Our findings indicate that simply pre- sent the correct health information or persuade the family members to follow the instructions (suggestions) would not work. The family-centered design needs to further account and support the different goals, needs, emotions, motivations, beliefs, and prior knowledge of family members (Pina et al., 2017), which bring challenges and opportunities in coordinating multiple stakeholders toward collective health.

6. Limitations

In this study, we tried our best to recruit participants from different families to understand the reasons and meanings behind some family experiences. However, our sample size ($n=26$) and a group of participants might not be representative of the general population of non-located families, as the majority of them were female, white, self- reported as being relatively healthy, highly educated, and experienced in using technologies. Our sample complies with the nature of this research and its focus on identifying underlying ideas about the topic (Braun and Clarke, 2013). We are aware that a more diverse sample including participants with lower socioeconomic status and more ethnic variation would be needed to represent the general population of non-

collocated families. Also, we acknowledge that our recruitment material (e.g., fliers) may have caused priming effects of the participants' recruitment. In addition, our participants self-reported their perspectives on their families practices which may not represent the other members' viewpoints (Creswell and Inquiry, 2007). Finally, we focus on non-collocated family members, specifically elderly parents and adult children but we acknowledge the need for future investigation to consider other types of family dynamics (e.g., couples living together).

7. Conclusion

Even though families are considered a source of encouragement and support in one's different life events, many factors can come across the family's provision of support and prevent members from fully experiencing the benefits of family endorsement such as geographical distance. In this study, we proposed a research investigation focusing on non- collocated family members, specifically independently living participants representing the "elderly parents" and "adult children" in their respective families. We aimed to identify people's practices of personal healthy living and innovative approaches to cultivate health together. In addition, we sought to understand existing obstacles regarding collaboration on family health. We learned that the family's model of healthy living, family reflection towards action, and health concerns move individuals to adopt healthy practices. We observed that family members have used technological tools to fill the need of family collaboration in health. We identified three common obstacles that prevent families to effectively collaborate in healthy living: lack of interest, consistency, and understanding. Based on our findings, we contribute with design implications for future family-centered health technologies that aim to support family members on their efforts to cultivate health within their families when living apart.

Credit authorship contribution statement

Jomara Sandbulte: Conceptualization, Methodology, Investigation, Formal

analysis, Data curation, Writing - original draft, Writing - review & editing. **Chun-Hua Tsai:** Formal analysis, Data curation, Writing - review & editing. **John M. Carroll:** Resources, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank the anonymous reviewers for their thoughtful feedback on earlier versions of the paper. We also would like to thank the family participants for making this study possible. This material is based upon work supported by the National Science Foundation (NSF) Smart and Connected Health Award No. 1502176. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

Appendix A. Semi-structured interview script

A1. Introduction

Hello and thank you for joining me today. I am conducting a study to understand more about the practices and challenges of non-located family members to collaborate on healthy living. From this interview study, I aim to learn about your current practices of healthy living, to gain insights into existing obstacles that prevents family members to collaborate on healthy lifestyles within their family, and to identify opportunities to promote family collaboration on healthy living over distance.

Here is a written consent form in which present a summary about this research. Please, take your time reading it. I will be happy to answer any questions you may have. [Wait]

Consent: Do you agree to participate in this study? [Wait for answer]

Would it be ok to record this conversation? I will also take notes during the session.

Just to confirm, it's okay that I audio-record our conversation? [Wait for response]

You may refuse to answer any questions if you feel uncomfortable.

You may leave the meeting at any time.

A2. Interview questions

(Note: Questions may slightly change during the session.)

1. What does healthy living mean to you?
2. Can you give an example of a healthy living practice or activity in which you like to engage?
3. What other types of healthy living activities would you like to do more of?
 - What, if anything, would make you feel encouraged to engage in these activities more often?
4. What does family mean to you?
5. Please, think about your experience in talking about your healthy lifestyle within your family.
6. Do you usually have conversations about these activities within your family? Why or Why not?
 - If yes, how do those conversations come up? Please, share an example if you can.
 - If not, why do those conversations not come up?
 - In your opinion, is there anything that could facilitate this conversation to happen within your family?
7. In your opinion, is there any technological solution that could facilitate conversations around healthy living to happen within your family?

- If yes, which one? Please give me an example and explain how this technology may facilitate these conversations to happen.
- If not, please explain why not according to your view. Do you have any suggestion on how future technologies could be developed to facilitate conversations about healthy living within your family?

Is there anything else you'd like to tell me that I have not already covered?

Thanks!

References

- Altmeyer, M., Lessel, P., Hosseini, S., Krueger, A., 2018. SilverCycling: evaluating persuasive strategies to promote physical activity among older adults. Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems. ACM, New York, NY, USA, pp. 45–50. <https://doi.org/10.1145/3197391.3205410>.
- Baghaei, N., Freyne, J., Kimani, S., Smith, G., Berkovsky, S., Bhandari, D., Colineau, N., Paris, C., 2009. SOFA: An online social network for engaging and motivating families to adopt a healthy lifestyle. Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7. ACM, New York, NY, USA, pp. 269–272. <https://doi.org/10.1145/1738826.1738871>.
- Barbarin, A.M., Saslow, L.R., Ackerman, M.S., Veinot, T.C., 2018. Toward health information technology that supports overweight/obese women in addressing emotion- and stress-related eating. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 321:1–321:14. <https://doi.org/10.1145/3173574.3173895>.
- Binda, J., Georgieva, E., Yang, Y., Gui, F., Beck, J., Carroll, J.M., 2018. PhamilyHealth: a photo sharing system for intergenerational family collaboration on health.

- Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing. ACM, New York, NY, USA, pp. 337–340. [https://doi.org/ 10.1145/3272973.3274091](https://doi.org/10.1145/3272973.3274091).
- Binda, J., Yuan, C.W., Cope, N., Park, H., Choe, E.K., Carroll, J.M., 2018. Supporting effective sharing of health information among intergenerational family members. Proceedings of the 12th EAI International Conference on Pervasive Computing Technologies for Healthcare. ACM, New York, NY, USA, pp. 148–157. <https://doi.org/10.1145/3240925.3240936>.
- Birnholtz, J., Jones-Rounds, M., 2010. Independence and interaction: understanding seniors' privacy and awareness needs for aging in place. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 143–152. <https://doi.org/10.1145/1753326.1753349>.
- Blandford, A., 2019. HCI for health and wellbeing: challenges and opportunities. Int. J. Hum.-Comput. Stud.
- Bouchard, G., 2014. How do parents react when their children leave home? An integrative review. J. Adult Dev. 21 (2), 69–79. <https://doi.org/10.1007/s10804-013-9180-8>.
- Braun, V., Clarke, V., 2013. Successful Qualitative Research: A Practical Guide for Beginners. Sage.
- Bussone, A., Stumpf, S., Buchanan, G., 2016. It feels like i'm managing myself: Hiv+ people tracking their personal health information. Proceedings of the 9th Nordic Conference on Human-Computer Interaction. ACM, New York, NY, USA, pp. 55: 1–55:10. <https://doi.org/10.1145/2971485.2971542>.
- Center, P. R., 2015. Pew research center - 5 facts about family caregivers. <http://www.pewresearch.org/fact-tank/2015/11/18/5-facts-about-family-caregivers/>.
- Center, P. R., 2018. Pew research center - adult caregiving often seen as very meaningful by those who do it. <https://pewrsr.ch/2IUeU8>.

"[Online; accessed 08-November- 2008]".

- Chen, S., Lan, Y.-C., Zheng, Y.-R., Huang, H., Chang, W.-D., Yeh, S.-C., Huang, M.-C., 2015. Usability of a low-cost wearable health device for physical activity and sleep duration in healthy adults. Proceedings of the 2015 Workshop on Pervasive Wireless Healthcare. ACM, New York, NY, USA, pp. 35–38. <https://doi.org/10.1145/2757290.2757298>.
- Cheung, K.L., Durusu, D., Sui, X., de Vries, H., 2019. How recommender systems could support and enhance computer-tailored digital health programs: a scoping review. Digit. Health 5. <https://doi.org/10.1177/2055207618824727>.
- Choe, E.K., Lee, B., Zhu, H., Riche, N.H., Baur, D., 2017. Understanding self-reflection: how people reflect on personal data through visual data exploration. Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare. ACM, New York, NY, USA, pp. 173–182. <https://doi.org/10.1145/3154862.3154881>.
- Choe, E.K., Lee, N.B., Lee, B., Pratt, W., Kientz, J.A., 2014. Understanding quantified-selfers' practices in collecting and exploring personal data. Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 1143–1152. <https://doi.org/10.1145/2556288.2557372>.
- Christensen, P.K., Skovgaard, C.Ø., Petersen, M.G., 2019. Together together: combining shared and separate activities in designing technology for family life. Proceedings of the 18th ACM International Conference on Interaction Design and Children. ACM, New York, NY, USA, pp. 374–385. <https://doi.org/10.1145/3311927.3323141>.
- Chung, C.-F., Wang, Q., Schroeder, J., Cole, A., Zia, J., Fogarty, J., Munson, S.A., 2019. Identifying and planning for individualized change: patient-provider collaboration using lightweight food diaries in healthy eating and irritable bowel syndrome. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol. 3 (1), 7:1–7:27. <https://doi.org/10.1145/3314394>.

- Chung, H., Lee, C.-H.J., Selker, T., 2006. Lover's cups: drinking interfaces as new communication channels. CHI '06 Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 375–380. [https://doi.org/ 10.1145/1125451.1125532](https://doi.org/10.1145/1125451.1125532).
- Claassen, L., Henneman, L., Janssens, A.C.J., Wijdenes-Pijl, M., Qureshi, N., Walter, F.M., Yoon, P.W., Timmermans, D.R., 2010. Using family history information to promote healthy lifestyles and prevent diseases; a discussion of the evidence. BMC Public Health 10 (1), 248.
- Cohn, W., Ropka, M., Pelletier, S., Barrett, J., Kinzie, M., Harrison, M., Liu, Z., Miesfeldt, S., Tucker, A., Worrall, B., et al., 2010. Health heritage©, a web-based tool for the collection and assessment of family health history: initial user experience and analytic validity. Public Health Genomics 13 (7-8), 477–491.
- Colineau, N., Paris, C., 2011. Family vs. individual profiles in a health portal: strengths and weaknesses. Proceedings of the 25th BCS Conference on Human-Computer Interaction. British Computer Society, pp. 321–330.
- Colineau, N., Paris, C., 2011. Motivating reflection about health within the family: the use of goal setting and tailored feedback. User Model. User-Adapted Interact. 21 (4–5), 341–376. <https://doi.org/10.1007/s11257-010-9089-x>.
- Colineau, N., Paris, C., 2012. A portal to promote healthy living within families. In: Szomszor, M., Kostkova, P. (Eds.), Electronic Healthcare. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 259–266.
- Colineau, N., Paris, C., Marendy, P., Bhandari, D., Shu, Y., 2009. Supporting family engagement in weight management. CHI '09 Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 3991–3996. [https://doi.org/ 10.1145/1520340.1520606](https://doi.org/10.1145/1520340.1520606).
- Cornejo, R., Tentori, M., Favela, J., 2013. Enriching in-person encounters through social media: a study on family connectedness for the elderly.

Int. J. Hum.-Comput. Stud. 71 (9), 889–899.

Cornejo, R., Weibel, N., Tentori, M., Favela, J., 2015. Promoting active aging with a paper-based SNS application. Proceedings of the 9th International Conference on Pervasive Computing Technologies for Healthcare. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering), ICST, Brussels, Belgium, Belgium, pp. 209–212.<http://dl.acm.org/citation.cfm?id=2826165.2826196>

Cremonesi, P., Garzotto, F., Turrin, R., 2012. Investigating the persuasion potential of recommender systems from a quality perspective: an empirical study. ACM Trans. Interact. Intell. Syst.(TiiS) 2 (2), 1–41.

Creswell, J.W., Inquiry, Q., 2007. Research Design: Choosing Among Five Approaches. Sage, Thousand Oaks, California.

Derix, E.C., Leong, T.W., 2018. Days of our lives: family experiences of digital technology use. Proceedings of the 30th Australian Conference on Computer-Human Interaction, pp. 332–337.

Edelman, C.L., Mandle, C.L., Kudzma, E.C., 2017. Health Promotion Throughout the Life Span-e-book. Elsevier Health Sciences.

Elsweiler, D., Harvey, M., 2015. Towards automatic meal plan recommendations for balanced nutrition. Proceedings of the 9th ACM Conference on Recommender Systems. ACM, New York, NY, USA, pp. 313–316. <https://doi.org/10.1145/2792838.2799665>.

Epstein, D.A., Caraway, M., Johnston, C., Ping, A., Fogarty, J., Munson, S.A., 2016. Beyond abandonment to next steps: understanding and designing for life after personal informatics tool use. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 1109–1113. <https://doi.org/10.1145/2858036.2858045>.

Epstein, D.A., Ping, A., Fogarty, J., Munson, S.A., 2015. A lived informatics model of personal informatics. Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous

- Computing. ACM, New York, NY, USA, pp. 731–742.
<https://doi.org/10.1145/2750858.2804250>.
- Eschler, J., Kendall, L., O’Leary, K., Vizer, L.M., Lozano, P., McClure, J.B., Pratt, W., Ralston, J.D., 2015. Shared calendars for home health management. Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing. ACM, New York, NY, USA, pp. 1277–1288. <https://doi.org/10.1145/2675133.2675168>.
- Fertman, C.I., Allensworth, D.D., 2016. Health Promotion Programs: From Theory to Practice. John Wiley & Sons.
- Forghani, A., Neustaedter, C., 2014. The routines and needs of grandparents and parents for grandparent-grandchild conversations over distance. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 4177–4186. <https://doi.org/10.1145/2556288.2557255>.
- Gillman, M.W., Rifas-Shiman, S.L., Frazier, A.L., Rockett, H.R., Camargo, C.A., Field, A. E., Berkey, C.S., Colditz, G.A., 2000. Family dinner and diet quality among older children and adolescents. Arch. Fam. Med. 9 (3), 235–240.
- Grimes, A., Tan, D., Morris, D., 2009. Toward technologies that support family reflections on health. Proceedings of the ACM 2009 International Conference on Supporting Group Work. ACM, New York, NY, USA, pp. 311–320. <https://doi.org/10.1145/1531674.1531721>.
- Gutierrez, F.J., Ochoa, S.F., 2017. It takes at least two to tango: understanding the cooperative nature of elderly caregiving in Latin America. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. ACM, New York, NY, USA, pp. 1618–1630. <https://doi.org/10.1145/2998181.2998314>.
- Gutierrez, F.J., Ochoa, S.F., Vassileva, J., 2016. Identifying opportunities to support family caregiving in chile. Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2112–2118.

<https://doi.org/10.1145/2851581.2892386>.

Hubley, J., Copeman, J., 2018. Practical Health Promotion. John Wiley & Sons.

Inkpen, K., Taylor, B., Junuzovic, S., Tang, J., Venolia, G., 2013.

Experiences2Go: sharing kids' activities outside the home with remote family members. Proceedings of the 2013 Conference on Computer Supported Cooperative Work. ACM, New York, NY, USA, pp. 1329–1340. <https://doi.org/10.1145/2441776.2441926>.

Johnson, B., Abraham, M., Conway, J., Simmons, L., Edgman-Levitan, S., Sodomka, P., Ford, D., 2008. Partnering with Patients and Families to Design a Patient-and Family-Centered Health Care System. Institute for Patient-and Family-Centered Care and Institute for Healthcare Improvement.

Johnson, R. W., 2019. Building a culture of health.

<https://www.rwjf.org/en/how-we-work/building-a-culture-of-health.html>. [Online; accessed 06-September-2019].

Jones, J., Ackerman, M.S., 2018. Co-constructing family memory: understanding the intergenerational practices of passing on family stories. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 424:1–424:13. <https://doi.org/10.1145/3173574.3173998>.

Judge, T.K., Neustaedter, C., Harrison, S., Blose, A., 2011. Family portals: connecting families through a multifamily media space. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 1205–1214. <https://doi.org/10.1145/1978942.1979122>.

Judge, T.K., Neustaedter, C., Kurtz, A.F., 2010. The family window: the design and evaluation of a domestic media space. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2361–2370. <https://doi.org/10.1145/1753326.1753682>.

- Kaziunas, E., Ackerman, M.S., Lindtner, S., Lee, J.M., 2017. Caring through data: attending to the social and emotional experiences of health datafication. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. ACM, New York, NY, USA, pp. 2260–2272. <https://doi.org/10.1145/2998181.2998303>.
- Kim, H., Monk, A., 2010. Emotions experienced by families living at a distance. CHI '10 Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2923–2926. <https://doi.org/10.1145/1753846.1753886>.
- Kim, H., Monk, A., Wood, G., Blythe, M., Wallace, J., Olivier, P., 2013. TimelyPresent: connecting families across continents. Int. J. Hum.-Comput. Stud. 71 (10), 1003–1011.
- Kimani, S., Berkovsky, S., Smith, G., Freyne, J., Baghaei, N., Bhandari, D., 2010. Activity awareness in family-based healthy living online social networks. Proceedings of the 15th International Conference on Intelligent User Interfaces. ACM, New York, NY, USA, pp. 337–340. <https://doi.org/10.1145/1719970.1720025>.
- Kluck, A.S., 2010. Family influence on disordered eating: the role of body image dissatisfaction. Body image 7 (1), 8–14.
- Knaving, K., Woźniak, P., 2016. TickTockRun: towards enhancing communication in runner families. Proceedings of the 19th ACM Conference on Computer Supported Cooperative Work and Social Computing Companion. ACM, New York, NY, USA, pp. 309–312. <https://doi.org/10.1145/2818052.2869114>.
- Lazar, A., Nguyen, D.H., 2017. Successful leisure in independent living communities: understanding older adults' motivations to engage in leisure activities. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 7042–7056. <https://doi.org/10.1145/3025453.3025802>.
- Lee, M.K., Kim, J., Forlizzi, J., Kiesler, S., 2015. Personalization revisited: a reflective approach helps people better personalize health services

- and motivates them to increase physical activity. Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing. ACM, pp. 743–754.
- Li, Q., Epstein, D.A., Caldeira, C., Chen, Y., 2020. Supporting caring among intergenerational family members through family fitness tracking. Proceedings of the 14th EAI International Conference on Pervasive Computing Technologies for Healthcare.
- Lukoff, K., Li, T., Zhuang, Y., Lim, B.Y., 2018. TableChat: mobile food journaling to facilitate family support for healthy eating. Proc. ACM Hum.-Comput. Interact. 2 (CSCW), 114:1–114:28.
<https://doi.org/10.1145/3274383>.
- Mayasari, A., Pedell, S., Barnes, C., 2016. “Out of sight, out of mind”, investigating affective intergenerational communication over distance. Proceedings of the 28th Australian Conference on Computer-Human Interaction. ACM, New York, NY, USA, pp. 282–291.
<https://doi.org/10.1145/3010915.3010937>.
- Miller, M., 2014. Curiosity, Creativity, and Surprise as Analytic Tools: Grounded Theory Method. Springer.
- Muller, M.J., Kogan, S., 2010. Grounded theory method in HCI and CSCW. Cambridge: IBM Center for Social Software, pp. 1–46.
- Mun˜oz, D., Cornejo, R., Gutierrez, F.J., Favela, J., Ochoa, S.F., Tentori, M., 2015. A social cloud-based tool to deal with time and media mismatch of intergenerational family communication. Future Gener. Comput. Syst. 53, 140–151.
- Neustaedter, C., Harrison, S., Sellen, A., 2013. Connecting families: an introduction. Connecting Families. Springer, pp. 1–12.
- Nurgalieva, L., Frik, A., Ceschel, F., Egelman, S., Marchese, M., 2019. Information design in an aged care context: views of older adults on information sharing in a care triad. Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare. ACM, New York, NY, USA, pp. 101–110.

<https://doi.org/10.1145/3329189.3329211>.

Pan, R., Forghani, A., Neustaedter, C., Strauss, N., Guindon, A., 2015. The family board: an information sharing system for family members.

Proceedings of the 18th ACM Conference Companion on Computer Supported Cooperative Work & Social Computing. ACM, New York, NY, USA, pp. 207–210. <https://doi.org/10.1145/2685553.2699008>.

Pang, C.E., Neustaedter, C., Riecke, B.E., Oduor, E., Hillman, S., 2013.

Technology preferences and routines for sharing health information during the treatment of a chronic illness. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 1759–1768. <https://doi.org/10.1145/2470654.2466232>.

Panicker, A., Basu, K., Chung, C.-F., 2020. Changing roles and contexts:

Symbolic interactionism in the sharing of food and eating practices between remote, intergenerational family members. Proc. ACM Hum.-Comput. Interact. 4 (CSCW1), 1–19.

for Patient, I., Care, F. C., 2019. Patients and family resource center.

<https://www.ipfcc.org>. [Online; accessed 06-September-2019].

Pina, L.R., Sien, S.-W., Ward, T., Yip, J.C., Munson, S.A., Fogarty, J.,

Kientz, J.A., 2017.

From personal informatics to family informatics: understanding family

practices around health monitoring. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. ACM, New York, NY, USA, pp. 2300–2315.

<https://doi.org/10.1145/2998181.2998362>.

Place, A. I., 2019. Aging in place vs. assisted living.

<https://www.aginginplace.org/aging-in-place-vs-assisted-living/>.

Portrait, M. F. H., 2019. My family health portrait - a tool from the surgeon general. <https://phgkb.cdc.gov/FHH/html/index.html>.

Procyk, J., Neustaedter, C., 2013. GEMS: a location-based game for

- supporting family storytelling. CHI '13 Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 1083–1088. <https://doi.org/10.1145/2468356.2468550>.
- Radha, M., Willemsen, M.C., Boerhof, M., IJsselsteijn, W.A., 2016. Lifestyle recommendations for hypertension through rasch-based feasibility modeling. Proceedings of the 2016 Conference on User Modeling Adaptation and Personalization. ACM, pp. 239–247.
- Rapp, A., Cena, F., Kay, J., Kummerfeld, B., Hopfgartner, F., Plumbaum, T., Larsen, J.E., Epstein, D.A., Gouveia, R., 2017. New frontiers of quantified self 3: Exploring understudied categories of users. Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers. ACM, New York, NY, USA, pp. 861–864. <https://doi.org/10.1145/3123024.3124456>.
- Romero, N., Markopoulos, P., Baren, J., Ruyter, B., IJsselsteijn, W., Farshchian, B., 2007. Connecting the family with awareness systems. Pers. Ubiquitous Comput. 11 (4), 299–312. <https://doi.org/10.1007/s00779-006-0089-0>.
- Saksono, H., Castaneda-Sceppa, C., Hoffman, J., Morris, V., Seif El-Nasr, M., Parker, A.G., 2020. Storywell: designing for family fitness app motivation by using social rewards and reflection. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, pp. 1–13.
- Saksono, H., Castaneda-Sceppa, C., Hoffman, J., Seif El-Nasr, M., Morris, V., Parker, A.G., 2018. Family health promotion in low-SES neighborhoods: a two-month study of wearable activity tracking. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 309:1–309:13. <https://doi.org/10.1145/3173574.3173883>.
- Saksono, H., Castaneda-Sceppa, C., Hoffman, J., Seif El-Nasr, M., Morris, V.,

- Parker, A.G., 2019. Social reflections on fitness tracking data: a study with families in low-SES neighborhoods. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 313:1–313:14. <https://doi.org/10.1145/3290605.3300543>.
- Saksono, H., Parker, A.G., 2017. Reflective informatics through family storytelling: self- discovering physical activity predictors. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 5232–5244. <https://doi.org/10.1145/3025453.3025651>.
- Saksono, H., Ranade, A., Kamarthi, G., Castaneda-Sceppa, C., Hoffman, J.A., Wirth, C., Parker, A.G., 2015. Spaceship launch: designing a collaborative exergame for families. Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing. ACM, New York, NY, USA, pp. 1776–1787. <https://doi.org/10.1145/2675133.2675159>.
- Santana, P.C., Rodríguez, M.D., Gonz´alez, V.M., Castro, L.A., Andrade, A.G., 2005. Supporting emotional ties among mexican elders and their families living abroad. CHI '05 Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2099–2103. <https://doi.org/10.1145/1056808.1057107>.
- Schaeffbauer, C.L., Khan, D.U., Le, A., Sczechowski, G., Siek, K.A., 2015. Snack buddy: supporting healthy snacking in low socioeconomic status families. Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing. ACM, New York, NY, USA, pp. 1045–1057. <https://doi.org/10.1145/2675133.2675180>.
- Schäfer, H., Hors-Fraile, S., Karumur, R.P., Calero Valdez, A., Said, A., Torkamaan, H., Ulmer, T., Trattner, C., 2017. Towards health (aware) recommender systems. Proceedings of the 2017 international conference on digital health. ACM, pp. 157–161.

- Schroeder, J., Chung, C.-F., Epstein, D.A., Karkar, R., Parsons, A., Murinova, N., Fogarty, J., Munson, S.A., 2018. Examining self-tracking by people with migraine: goals, needs, and opportunities in a chronic health condition. *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, New York, NY, USA, pp. 135–148. <https://doi.org/10.1145/3196709.3196738>.
- Seiffe-Krenke, I., 2006. Leaving home or still in the nest? Parent-child relationships and psychological health as predictors of different leaving home patterns. *Dev. Psychol.* 42 (5), 864.
- Stanley, K.G., Livingston, I., Bandurka, A., Kapiszka, R., Mandryk, R.L., 2010. PiNiZoRo: A GPS-based exercise game for families. *Proceedings of the International Academic Conference on the Future of Game Design and Technology*. ACM, New York, NY, USA, pp. 243–246. <https://doi.org/10.1145/1920778.1920817>.
- Steinberg, A.B., Phares, V., 2001. Family functioning, body image, and eating disturbances. *Am. Psychol. Assoc.*
- Sun, R., 2016. Intergenerational age gaps and a family member's well-being: a family systems approach. *J. Int. Relat.* 14 (4), 320–337.
- Tang, L.M., Meyer, J., Epstein, D.A., Bragg, K., Engelen, L., Bauman, A., Kay, J., 2018. Defining adherence: making sense of physical activity tracker data. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2 (1), 37:1–37:22. <https://doi.org/10.1145/3191769>.
- Tee, K., Brush, A.B., Inkpen, K.M., 2009. Exploring communication and sharing between extended families. *Int. J. Hum.-Comput. Stud.* 67 (2), 128–138.
- Thaler, R.H., Sunstein, C.R., 2009. *Nudge: Improving Decisions About Health, Wealth, and Happiness*. Penguin.
- Toscos, T., Connelly, K., Rogers, Y., 2012. Best intentions: health monitoring technology and children. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, pp. 1431–1440. <https://doi.org/>

10.1145/2207676.2208603.

Veinot, T.C., Kim, Y.-M., Meadowbrooke, C.C., 2011. Health information behavior in families: Supportive or irritating? *Proc. Am. Soc. Inf.Sci. Technol.* 48 (1), 1–10.

<https://doi.org/10.1002/meet.2011.14504801070>.

Vutborg, R., Kjeldskov, J., Paay, J., Pedell, S., Vetere, F., 2011. Supporting young children's communication with adult relatives across time zones. *Proceedings of the 23rd Australian Computer-Human Interaction Conference*. ACM, New York, NY, USA, pp. 291–300.

<https://doi.org/10.1145/2071536.2071583>.

Vutborg, R., Kjeldskov, J., Pedell, S., Vetere, F., 2010. Family storytelling for grandparents and grandchildren living apart. *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*. ACM, New York, NY, USA, pp. 531–540.

<https://doi.org/10.1145/1868914.1868974>.

White, G., Singh, T., Caine, K., Connelly, K., 2015. Limited but satisfied: low SES older adults experiences of aging in place. *Proceedings of the 9th International Conference on Pervasive Computing Technologies for Healthcare*. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering), ICST, Brussels, Belgium, Belgium, pp. 121–128.

Wiles, J.L., Leibing, A., Guberman, N., Reeve, J., Allen, R.E.S., 2011. The meaning of 'aging in place' to older people. *Gerontologist* 52 (3), 357–366. <https://doi.org/10.1093/geront/gnr098>.

Wu, M., Birnholtz, J., Richards, B., Baecker, R., Massimi, M., 2008.

Collaborating to remember: a distributed cognition account of families coping with memory impairments. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, pp. 825–834. <https://doi.org/10.1145/1357054.1357186>.

Yamashita, N., Kuzuoka, H., Hirata, K., Kudo, T., 2013. Understanding the

conflicting demands of family caregivers caring for depressed family members. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2637–2646.
<https://doi.org/10.1145/2470654.2481365>.

Yarosh, S., Tang, A., Mokashi, S., Abowd, G.D., 2013. “Almost touching”: Parent-child remote communication using the sharetable system. Proceedings of the 2013 Conference on Computer Supported Cooperative Work. ACM, New York, NY, USA, pp. 181–192.
<https://doi.org/10.1145/2441776.2441798>.