TableChat: Mobile Food Journaling to Facilitate Family Support for Healthy Eating

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Support from family members is an important determinant of health. In this work, we probe opportunities for facilitating family support with TableChat, a chat-based mobile application for food journaling. Leveraging food as a test case of family support, TableChat virtually extends the experience of bonding over the dinner table. We surveyed 158 people about their existing family support practices and deployed TableChat with 10 families in the field. We found that tangible support was the most common form of support shared in TableChat and also the most appreciated by participants. However, we found that participants valued not only supportive actions taken by their family members, but also those deliberately *not* taken (e.g., *not* buying junk food). Finally, families reported that journaling meals eaten apart aided the exchange of support, satisfied curiosity, and provided a "check-in" that everything was alright, whereas journaling meals eaten together felt redundant. We conclude with a framework that illustrates how informatics tools can be designed to complement rather than compete with existing family interactions.

CCS Concepts: • **Human-centered computing~Empirical studies in collaborative and social computing** • *Human-centered computing~Field studies* • *Human-centered computing~Social media* • Information systems~Chat

KEYWORDS

Family informatics; personal informatics; social support; food journaling; tracking; mHealth; chat; online health communities

1 INTRODUCTION

Social support is an important determinant of health [43]. Family members, by virtue of their strong bonds and physical proximity, are often uniquely situated to support each other. Prior studies suggest that support from family is more strongly associated with health outcomes than support from other sources [55]. Yet most health tracking tools focus on individuals, as reflected by the terms self-tracking and personal health informatics. When social features exist in these tools, they tend to connect individuals with a list of contacts that does not distinguish friends from family. This can lead informatics tools to miss opportunities to enable family members to support each other in living healthily.

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Family informatics technologies are designed to account for how the health of family members is interrelated [42]. Prior work has examined how family members can collectively set health goals [14], reflect on their health [28], improve eating habits [48], track sleep practices [42], and motivate exercise through family games [46]. This paper builds upon this work by applying a family-centered approach to the design and study of TableChat, a mobile application for food journaling and chatting. TableChat extends the supportive environment of the family dinner table to the virtual realm to encourage healthy eating throughout the day.

Our work differs from prior work in family health informatics in four important ways. First, our study focused specifically on opportunities for social support, especially tangible support, that arise from the awareness created by tracking together. Second, our deployment used open-ended chat groups that encouraged families to be creative in how they logged and communicated. Third, we explored design considerations when piggybacking a family informatics system on top of an existing communication tool (in our case, the mobile application *WhatsApp Messenger*). Fourth, we studied a multiethnic Asian population, whereas prior studies have focused on Western populations.

We conducted two studies to explore how family health informatics tools can facilitate social support. First, we surveyed 158 residents in Singapore about how they exchange support for healthy eating with family members. Second, we designed TableChat to complement existing family routines and deployed it with 10 families (31 participants) in the field for 12 days. We interviewed families to gain insight into their experiences using TableChat.

Our three contributions to family health informatics are:

1. We use a common typology to examine the social support that family members exchange in TableChat. We found that tangible support was the most common form of support shared in TableChat and also the most valued by participants.
2. Our deployment study sheds light on the kinds of family awareness that facilitate social support. Families reported that journaling meals eaten apart aided the exchange of support and provided a "check-in" that everything was alright, whereas journaling meals eaten together was experienced as redundant.
3. Based on our deployment, we present a framework for designing informatics tools that complement existing family routines rather than compete with them.

Although we studied healthy eating, we believe that many of our findings could apply to family informatics tools in other domains too.

2 RELATED WORK

2.1 Food Journaling as a Family

Food journaling is a practice that supports a variety of health goals, including weight loss, identifying food allergies, and managing diet-related diseases like diabetes [17]. People are increasingly turning to commercial mobile apps like MyFitnessPal, FatSecret, and CalorieCount to journal, which provide reminders and automate parts of the logging, analysis, and data visualization process. These mobile apps for food journaling are typically designed according to a single-user model.

Yet tracking health as a family rather than as an individual can be important because the health of family members is interrelated [22]. This may be particularly so in the case of diet. Eating together as a family has been found to support physical health, mental health, and family cohesion [38]. Risk for diabetes, a diet-related disease, is correlated between family members due to both genetic [4] and environmental factors [56]. Social support from family has been found to have a

positive relationship to the treatment adherence of diabetics [36]. This suggests that a family-centered approach to food journaling could support people in reaching their healthy eating goals.

2.2 Family Informatics

While most research on tracking has focused on *personal* informatics, there is a small but growing literature on *family* informatics. Colineau et al. found that families would often rather set family goals than individual goals for healthy behaviors [15]. Schaefbauer et al. designed a mobile app that helped families become aware of other's snack choices [48]. Grimes et al. suggest that families' overlapping routines provide opportunities for reflecting upon health data [28]. This work shows that family informatics tools can help families set goals, raise awareness, and reflect upon health behaviors.

Family informatics can also bolster the provision of social support. Schaefbauer et al. found that snack journaling led family members to encourage each other and engage in positive dialogue about health [48]. Yamashita et al. reported that information about other cases helped family caregivers initiate sensitive discussions with care recipients about their depression [57]. Pina et al. identified an opportunity for tracking tools to be designed to allow a secondary caregiver to support a primary caregiver in the demanding work of tracking family health [42]. These studies suggest that family informatics can increase social support, although questions remain as to how best to do this and what types of support result.

2.3 Characterizing Support with the Social Support Behavior Code (SSBC)

Social support can be broadly defined as the resources provided by others [13]. To distinguish between different types of social support, Cutrona and Suhr developed the SSBC, based on their study of stressful events in the lives of romantic couples, including married spouses [20]. The SSBC consists of 5 supratypes: (1) tangible (providing or offering goods or services needed in the stressful situation); (2) informational (providing information about the stress or how to cope); (3) emotional (communicating love or caring); (4) esteem (communicating respect and confidence in abilities); and (5) network (communicating belonging to a larger group). Each supratype contains multiple subtypes. For example, the subtypes for tangible support are: direct tasks, indirect tasks, loans, active participation, and willingness.

The SSBC has been used to characterize social support in numerous online health communities (OHCs), yielding insight into how peers and strangers support each other online. Braithwaite et al. applied it to an online community of people with disabilities [7], first demonstrating the applicability of the typology in digital communications. Turner-McGrievy and Tate recruited participants looking to lose weight, provided them with diet and exercise advice, and studied the messages they shared in a Twitter community [54]. Coursaris and Liu studied the messages shared in an OHC for men with HIV/AIDs [18]. Andalibi et al. examined how participants in a Twitter community supported each other to cope with depression [2]. Adams et al. explored how the staccato form of mobile messaging affected the provision of social support in a general health community [1].

These OHCs varied widely in terms of the health issues they covered, the communication medium, and the nature of the intervention (if any). However, two common results were that (a) participants found the support to be helpful in addressing their health concerns; and (b) informational, emotional, and esteem support accounted for the vast majority of support, with tangible and network support constituting less than 10% of the remainder. The SSBC has proven to be a useful tool for characterizing social support in OHCs.

Given its original design for close romantic ties, we argue that the SSBC is also a suitable typology for characterizing support in family communications. Using the SSBC would allow us to explore differences in how families provide social support as compared to OHCs. Measures of support often assess family and friends as separate sources, due to the different tie strength of the relationships [58]. For example, family support has a major influence upon diet that is distinct from the effect of support from friends [47]. Family members also often share physical proximity, the lack of which has been cited as a reason for the lack of tangible support in OHCs [7]. We take up Adams et al.'s call to investigate how group makeup affects the nature of support exchanged online [1].

3 RESEARCH QUESTIONS

Our study asked the following three research questions:

RQ1: How do family members currently support each other to eat healthily?
Understanding existing practices can inform future technologies that facilitate social support. We were especially interested in technologies that families use to exchange support for healthy eating, whether they were explicitly designed for that purpose (e.g., food logging tools) or not (e.g., messaging apps).

RQ2: How do family members exchange social support in a mobile application for food journaling?
Whereas prior work has studied social support among strangers and peers in OHCs, we wanted to understand how family members provide support. We expected that the unique characteristics of family groups (e.g., strong ties, physical proximity) could lead to different patterns of social support.

RQ3: How can health informatics tools facilitate family support?
We adopted a research through design approach to our work [59]. Our TableChat deployment was intended to generate insights into how to design for social support in family informatics tools.

4 STUDY 1: SURVEY

In August 2017, we conducted an online survey (n=158) with Singaporeans who lived together with family and had an interest in eating healthily. The survey had two purposes. First, to answer RQ1: How do families currently support each other to eat healthily? Second, to recruit participants for our field study. This section presents our methods, results, and discussion.

4.1 Methods

4.1.1 Recruitment
To be eligible, participants had to be adults (21 years or older in Singapore), residents of Singapore, smartphone owners, and live together with at least one family member.

158 respondents were recruited from two channels. Our primary channel (n=153) was the Singapore Population Health Studies (SPHS), a longitudinal cohort study that tracks how lifestyle, physiological, and genetic factors relate to the health of over 50,000 adult Singaporeans [51,60]. A random sample of 1500 cohort study participants who met our eligibility criteria were sent an email by a principal investigator of the SPHS cohort study inviting them to take our online survey. Our second recruitment channel (n=5) was an online community for Singaporeans with diabetes. We had originally considered studying families with persons with or at-risk for diabetes, but

found this population very difficult to recruit, so we focused on a more general population instead. This research was approved by the National University of Singapore Institutional Review Board (S-17-193).

Our recruitment ad stated that the survey would "inform the design of technologies that enable families to track their eating and health together." The survey took an average of 15 minutes to complete and participants were compensated with a 5 SGD (3.60 USD) shopping voucher.

4.1.2 Respondents

51% of respondents identified as female, 49% as male. Median age was 51. Ethnicity was 65% Chinese, 23% Indian, 9% Malay, and 3% other. We asked respondents about other family members who lived with them under the same roof. 66% reported living together with a spouse. The most common composition of families were adult(s) with children under 21 (42%), adult(s) with adult children (18%), and couples without children (16%).

4.1.3 Data Analysis

Respondents were asked, "What's one way that your family supports you to eat healthily?" They were also asked to share one way that they provide support to their family. These 316 responses were coded according to Social Support Behavior Code [20]. To test the application of this typology on our data, the first three authors each independently coded the same 100 responses. Differences in coding results were reconciled in a group discussion. Fifty additional responses were then independently coded and analyzed for interrater reliability (Fleiss' Kappa = 0.80) at the level of the five supratypes, as done in previous studies [1,2,18,54]. Each coder then independently coded one-third of the remaining responses.

4.2 Results

Survey results are presented in three parts: 1) family interactions around food; 2) types of family support; 3) interest level in food journaling together as a family.

4.2.1 Family Interactions Around Food

This section summarizes existing practices around family meals, food journaling, and communication. The frequency of shared family meals varied: 25% ate together for two or more meals per day, 50% one meal, and 25% less than one meal. The percentage of meals eaten apart may be high relative to other countries due to the long work hours and the popularity and affordability of food courts (hawker centers) in Singapore. Women (including the mothers of adult respondents) most often did the work of grocery shopping (75%) and cooking (91%), indicating that they often serve as a "kitchen manager," as was also found among diabetic families in India [29].

One-quarter of respondents had actively recorded or journaled their food in the previous week. Of these respondents, 80% took photos, which they shared on Instagram, Facebook, and WhatsApp with family or friends. Another 30% journaled using a mobile app; while we had expected these respondents to list dedicated food logging apps (e.g., MyFitnessPal), they again cited WhatsApp, Facebook, and Instagram, suggesting the practice of food journaling on social media [12] may be even more widespread than previously thought. An additional 18% journaled on paper.

Of the 90% of families that used smartphones to message with each other, 99% used WhatsApp, 49% SMS, 7% Facebook Messenger, and 4% WeChat. Of families who messaged with each other, 53% did so at least once per day.

4.2.2 Types of Family Support

In the 316 responses, we found 230 instances of social support (Table I). Responses that shared general health advice (e.g., eat less, less salt and exercise) were not coded (27%), as it was unclear how the respondent received or provided support.

Table 1. Distribution of Support Types

Support type	#	%	Example
Tangible	157	68%	*As a Chef, i cook healthily with more vegetables.*
Informational	45	20%	*Share information from youtube/tv/friends on healthy eating.*
Emotional	25	11%	*Encourage them to select healthier choices*
Esteem	3	1%	*By praising me. Like saying I look slimmer when I eat healthily.*
Network	0	0%	NA

Tangible support (68%): When the tangible support responses were further coded by subtype, 73% were direct tasks, such as cooking or grocery shopping. Of these direct tasks, 23% were about actions *not* taken (e.g., *Avoid to buy food with preservative, unnatural colour* or *Not cooking rice for my dinner*[1]).

The other common subtype (24% of tangible support responses) was active participation, taking an action for the purpose of supporting the family in eating a healthy diet (e.g., *My father also eats healthy*). Many respondents cited the simple act of eating home-cooked food as both a way that support is received (e.g., *They eat the brown rice which I mixed with white rice in 50/50 portion*) and provided (e.g., *I eat what they prep*). This may be because many respondents viewed home-cooked food as healthier than outside food: *I try my best to cook more home cooked meal. Avoid hawker Centers cooked meal.*

Informational support (20%): By subtype, 77% of informational support was suggestion/advice, such as recommending healthy foods. Reminders were also included under this subtype, although they called attention to information that recipients already knew (e.g., *We remind each other not to over eat*) rather than providing new information. Other subtypes of informational support included situational appraisal, such as providing feedback when a family member ate an unhealthy snack, and teaching, such as educating family members on the benefits of healthy eating.

Emotional support (11%): Emotional support consisted entirely of the subtype encouragement, defined as providing hope and confidence. When responses contained the word "encourage" we chose to code these as emotional support, though these cases may also be similar to the informational support provided by reminders (e.g., *Encourage me to eat less sugar and starchy food*). We also chose to code discouragement under this subtype, such as the response, *My wife discourage me from eating food that are not so healthy for me, such as fried and junk food.*

Esteem support (1%): Respondents shared only three instances of esteem support. The two subtypes found were validation, agreeing with another's perspective, and compliments.

Network support (0%): No instances of network support were shared.

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[1]In the rest of this paper, participant responses are quoted in italics.

4.2.3 Interest in Family Food Journaling

At the end of the survey, we asked respondents to describe their interest level in mobile food journaling with family. Respondents were split between being somewhat or very interested (39%), neither interested nor uninterested (25%), and somewhat or very uninterested (36%). Explanations for interest and disinterest clustered into several different groups. The most common reasons for *interest* in journaling together as a family were to improve health (34%) and to increase family awareness of each other's eating habits (32%). Respondents also mentioned viewing interesting content (17%) and connecting with family members (12%). The most common reason for *disinterest* were the time or effort required (39%), that content would not be interesting (20%), and that this was not their habit or that other family members were not interested (19%). Other reasons included that not all family members could participate due to a lack of technology or skills (8%), privacy concerns (6%), and a desire to keep phones away from the dinner table (3%), which was also reported in [30,35].

4.3 Discussion

4.3.1 Relative Frequency of Support Types

Tangible support was 68% of reported family support. By contrast, in prior studies of OHCs, tangible support was less than 5% of supportive messages [1,7,18,54]. Comparing self-reported examples against coded messages is not apples-to-apples, as instances of tangible support may be more salient in the mind. However, it does suggest that tangible support plays a larger role in families than it does in OHCs. This aligns with prior literature that finds that tangible support may be scarce on social networks because of a lack of physical proximity [7], a limitation that does not hold for colocated families.

The near absence of esteem and network support in our data matches findings from previous studies. Esteem support can be difficult to distinguish from emotional support [1] and factor analysis for social support measures has suggested that these two supratypes should be collapsed into one [4]. Network support is rare in most studies and has low interrater reliability, leading Cutrona et al. to drop it from later analyses [19].

4.3.2 Negabehaviors: non-action as a source of support

Actions *not* taken were reported as a major source of social support across tangible, informational, and emotional support. As a form of tangible support, respondents described both refraining from action (e.g., *I don't buy junk food*) as well as reducing certain actions (e.g., *cooking with less salt, and less oil*). As informational support, respondents advised each other what *not* to do (e.g., *I will tell them the reasons not to eat fast food… It can cause blockage in our arteries, diabetics, etc.*). As emotional support, respondents discouraged certain actions (e.g., *Discourage me from eating at fast food joints*), which can also be thought of as encouraging someone *not to do something*.

This fits with the concept of negabehaviors, deliberate non-action that replaces undesirable action [45]. Negabehaviors were first introduced in the context of environmental sustainability, where deliberate non-action (e.g., not buying a new shirt) can often be more beneficial than action (e.g., buying an eco-friendly shirt), but is often overlooked. Focusing attention on the subtractive impact of negabehaviors (e.g., carbon saved by not driving to work) may encourage more people to consider them.

Technologies that encourage family support for healthy eating may wish to promote negabehaviors too. For instance, a food journaling app could suggest items to skip at the next grocery shopping trip that would reduce a family's sugar consumption (e.g., "Don't buy Coca-

Cola this week"). Incorporating negabehaviors into food journaling technologies could increase the salience of this option and allow family members to take credit for and receive feedback upon this valued form of social support.

5 STUDY 2: TABLECHAT FIELD DEPLOYMENT

Study 2 explored how this family support functions in an online environment. Specifically, we sought to answer RQ2: What types of support do family members exchange in a mobile application for food journaling? The design of our mobile application was informed by the results of Study 1, as detailed below.

5.1 Methods

To examine how families exchange support via mobile messaging, we conducted a 12-day field study with 10 families (31 participants) in August 2017. Each family had their own chat group in the WhatsApp mobile messenger app in which they journaled their food and responded to daily challenges.

5.1.1 Design of TableChat

Based on the results of the Study 1, we decided to "piggyback" on top of WhatsApp, an approach that can help researchers focus on the dynamics of social interaction rather than convincing users to adopt a new technology [27]. This option promised minimal development costs for our research team and a gentle learning curve for most participants, as 89% of survey respondents already used WhatsApp to message with family. People choose which app to use for communication based on not just its features, also on the personal meaning it holds (see [40], "WhatsApp is for family; Messenger is for friends") and Study 1 found that WhatsApp was already established as a place for family communication for Singaporeans. We also hoped that this familiarity would reduce the high dropout rates that have plagued prior studies of online health interventions that required participants to adopt a new system [14,25]. For instance, a study of a wellness intervention that piggybacked on top of the Facebook social network reported favorable adherence rates [37].

For each family, we created a chat group within WhatsApp that included all family members and the "TableChat Bot." Our research team used the TableChat Bot to observe the chat group and to send reminder and daily challenge messages (described below), which were pre-scheduled to send using *Scheduler for WhatsApp* [31]. While we used this third-party app as a workaround, many messaging applications (e.g., WeChat, Facebook Messenger) already offer official support for chat bots and WhatsApp launched special accounts for businesses shortly after our study concluded [61], so piggybacking on top of messaging platforms is rapidly becoming an easier and more powerful approach.

We pilot tested TableChat with 4 groups (12 people). Instructions for the family chat group were drafted to be general enough for families to choose how to communicate around healthy eating, but not so vague as to confuse them. Families were told: "In this group, you and your family can journal what you eat. Just post a photo of your meal with a short description. You can also give each other feedback." In addition, family members received two daily reminders to journal their food, one before lunch and one before dinner. We decided not to include a breakfast reminder because pilot participants expressed concern that it might disrupt their sleep.

We added 'daily challenges' when pilot participants did not share many supportive messages. Our daily challenges (Table 2), inspired by Epstein et al. [23], asked families to complete tasks

based on the 3 kinds of support that we found in Study 1 (collapsing emotional and esteem support into one type since they were hard to distinguish). From an initial brainstorming of 91 prompts, we selected nine final daily challenges based on how easy and engaging they were rated by members of our research team and how they performed in pilot testing. Challenges were intended to encourage families to send supportive messages and shed light on the type of support that families found most helpful.

Table 2. Daily Challenges

Type of Support	# of Prompts	Example Prompt
Tangible	3	"Take an action to help a family member eat healthily"
Informational	3	"Share a tip for a healthy snack"
Emotional/esteem	3	"Encourage a family member to eat a healthy food"

The 12-days of participation in the field study were divided into four 3-day blocks. In the first three days we hoped that families would build the habit of food journaling, so there were no daily challenges. For each of the remaining 3 blocks, families were randomly assigned to complete daily challenges from one of the three types of family support found in the survey. Participants were informed that participation in the daily challenges was optional.

At the end of the 12-days, we conducted a one-hour exit interview with each family. This semi-structured interview was focused on understanding changes to family awareness and support that were not shared to the chat group, as well as soliciting feedback from participants on their day-to-day experience using TableChat. For example, we asked, "Did you learn anything about the eating habits of your family members?" and "If yes, did you act based on what you learned?"

5.1.2 Recruitment

We recruited from among survey respondents who already messaged with family members and who were interested in participating in our field study together with their family. Children (ages 8-21) were able to participate together with their parents, if both they and their parents independently granted consent for participation. A researcher met with each family in-person to explain the study and request signatures on consent forms.

The demographics of the 10 families who chose to participate are shown in Table 3. We decided to deploy TableChat to families with different structures to test where it would prove most helpful. Families ranged from a couple in their 40s and 50s with 3 children (F10) to a couple in their 20s with no children (F3). In Singapore, where housing prices are high, over 90% of singles live together with their parents until marriage [3], so six of our families included adult children. All families included a husband and wife living together, except for F6. In the rest of this paper, the family role and family identification number of the sender of a message are stated (e.g., mother, F2) when this context is important. Parental roles (e.g., mother) were prioritized over spousal roles (e.g., wife) in our shorthand descriptions to clarify for the reader whether or not the family included children. The ethnicity of families was 8 Chinese, 1 Malay, and 1 Indian, which roughly reflects the present demographics of Singapore.

Table 3. Family Demographics

Family Role	Age	# Messages Sent	# Photos Sent	# Supportive Posts
F1		23	15	26
Father	40s			
Mother	40s			
Teenage son	14-19			
F2		201	80	85
Mother	50s			
Father	50s			
Adult daughter	20s			
Adult son	20s			
F3		11	33	6
Husband	20s			
Wife	20s			
F4		82	85	31
Father	50s			
Mother	50s			
Adult daughter	20s			
F5		57	46	26
Father	60s			
Mother	50s			
Adult son	20s			
F6		17	9	1
Mother	60s			
Adult son	40s			
F7		35	52	4
Husband	30s			
Wife	20s			
F8		91	54	39
Father	50s			
Mother	40s			
Daughter	20s			
F9		211	86	94
Father	60s			
Mother	50s			
Adult son 1	20s			
Adult son 2	20s			
F10		125	108	23
Father	50s			
Mother	40s			
Teenage son 1	14-19			
Teenage daughter	14-19			
Teenage son 2	14-19			

For ethical reasons, we excluded the 10% of families in which a foreign domestic worker (also referred to as a "helper" or "maid") was involved in grocery shopping or cooking. We feared that foreign domestic workers would feel coerced if asked to participate by their employer. At the

same time, enrolling these families without their foreign domestic worker would have meant that the individual most often responsible for meal preparation would be missing from the chat group.

Participants received shopping vouchers for each day that they sent a message or photo to the chat group (3 SGD / 2.20 USD for adults, 1.50 SGD / 1.10 USD for children). At the end of the study, 9 of the 10 families participated in an exit interview for which they received an additional 50 SGD (37 USD); Family 1 did not respond to requests to schedule an interview. The exit interview was conducted either in-person (n=3) or via phone (n=6).

5.1.3 Data Analysis

Our study yielded two kinds of data: 1421 messages and photos from the family chat and 9 transcripts from the family exit interviews.

Messages and photos

The first three authors ("we") again coded the chat group messages according to the Social Support Behavior Codes (SSBC). We viewed messages in the context of the conversation, which helped to determine whether or not they were supportive and the type of support they offered. Nonetheless, we still encountered two major decisions in applying the data to the records of the family chat groups.

First, as coders, we decided *not* to judge whether the food in a post was healthy. We chose this because people perceive the healthiness of dishes differently [16] and the same dish may be healthier for one person than another (e.g., a marathoner vs. a couch potato). As a consequence, photos and messages in which a family member simply journaled their own eating were coded as non-supportive, although participants in Study 1 found seeing family members eat healthy foods to be supportive. An exception was when family members themselves described how the food they ate was a healthy choice (e.g., healthy snack, extra veggies, less salt), in which case the post was coded as supportive. Lastly, in accordance with Cohen and Syme's definition of social support [13], we chose to code any post that provided resources for another family member's eating as supportive (e.g., buying McDonald's for the family), without assessing whether or not it was healthy.

Second, we chose to take the perspective of the sender when coding messages. Consider an image of a steamed pork bun with broccoli placed on top with the caption: *Effort to make it healthier* 🍀. From the perspective of the sender, this is a physical action, which we coded as active participation in the family's healthy eating, a subtype of tangible support. From the perspective of the recipient though, this could be seen as social pressure to reciprocate, modeling, or encouragement (a subtype of emotional support). Another case was critical feedback such as *Wow, only fry chicken, should add some veggies or fruit*, which was often seen as supportive by the sender but as unsupportive by the recipient, according to interview responses. Both the provider and the recipient perspective are important in the study of social support [26]. We chose to code from the perspective of the sender because this better aligned with the use of the SSBC in studies on social support in OHCs [1,7,18,54]. Conflicting perceptions of support are further addressed in the results section.

To test for interrater reliability, the same 250 messages were coded independently for support type (Fleiss' Kappa = 0.79). Differences in coding results were again reconciled in a group discussion. Each coder then independently coded one-third of the remaining messages.

Images were coded as supportive if they contained supportive content (e.g., image of a recipe for a healthy snack) or if they were accompanied by a message that indicated support (e.g., photo of juice followed by *Today i helped to prepare fresh orange juice for breakfast*).

Fig. 1a: Participants valued tangible support highly, as with this mother (F2) who shared a photo of the medicinal tea she prepared for her family.
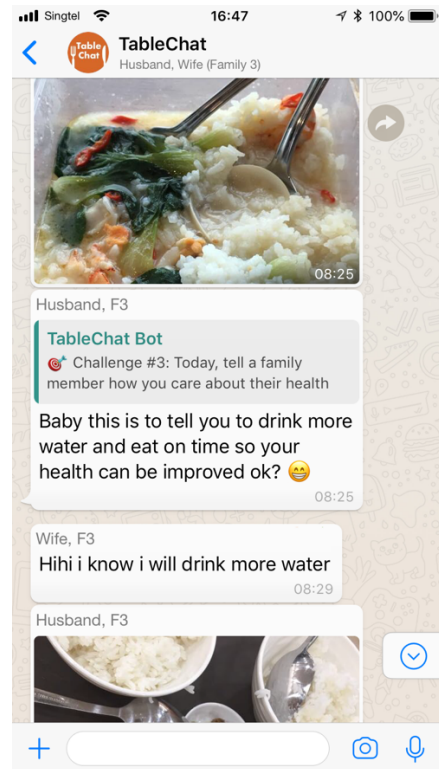
Fig. 1b: Participants checked in with each other to convey that they cared and ensure that everything was alright, as the husband in F3 did here.

Fig. 1. Screenshots of Supportive Messages in TableChat

Interviews

Interview transcripts were analyzed by the first three authors. Affinity diagramming [6] was used to collect interesting quotes and identify emergent themes. The themes that emerged from the interview data were compared against the data from the chat groups and discussed by all authors. Analysis of chat group and interview data is presented together in the results that follow.

5.2 Results

Results of the field study are presented in three parts. First, we summarize engagement with TableChat. Second, we describe the types of social support that families shared. Third, we highlight findings about food journaling as a family that go beyond social support, such as conflicting perceptions of what constitutes "scolding" and the role of photos in stimulating appetite.

5.2.1 Engagement

During the 12-day study, the 10 families shared 1421 total posts i.e., messages and photos (Table 4). Overall engagement was relatively steady over the 12 days of the study, but at the family level it fluctuated significantly from day-to-day (Fig. 2). Family 6 shared only three messages during the second half of the study, citing a busy schedule. On average, parents shared more than

children (52 vs. 42 posts). In sum, piggybacking on WhatsApp led to stable and significant engagement and yielded a sufficient volume of posts for us to investigate our research questions. No participants reported technical difficulties.

Table 4. TableChat Engagement Per Family (n=10)

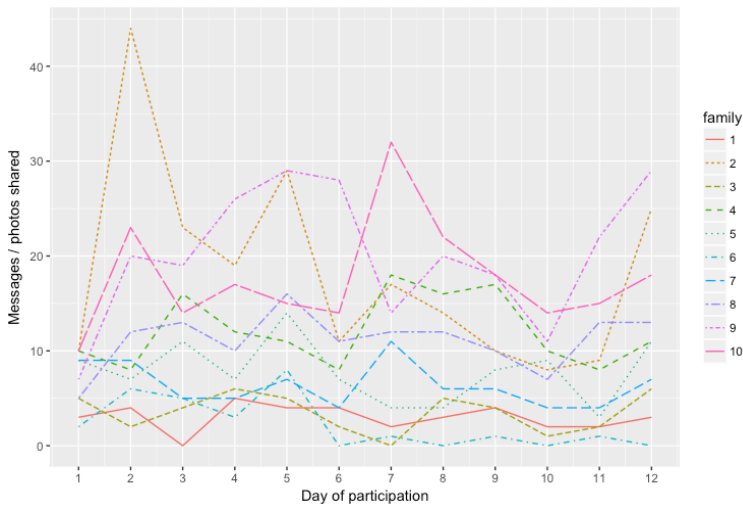|	Posts (Messages + Photos)	Messages	Photos	% Supportive
Average (per family)	142.1	85.3	56.8	23.5%
Standard Deviation	101.5	73.3	32.6	19.3%

Fig. 2. Engagement Over Time

In terms of content shared, 335 of the 1421 total messages and photos shared were supportive (23.5%). On average, parents shared about twice as many supportive posts as children (17 vs. 8) and a higher percentage of their posts were supportive (33% vs. 19%). The majority of non-supportive posts were photos of food. The content of these photos is analyzed in greater detail in a separate study on how social context affects food journaling photography [41]. Other posts included messages about daily experiences and coordinating schedules, which are discussed in a later section.

Responses to daily challenges accounted for one-third of supportive messages (113 of 335). For example, in response to the challenge "Today, take an action to help a family member eat healthily," one participant responded: *I cooked light chicken soup with veggies, and brown rice.* The three types of challenges (tangible, informational, and emotional/esteem) elicited an equal quantity of supportive messages (38, 38, and 37, respectively). Although we did not test against a control condition, the prompt responses to the daily challenge messages (median response time was 27 minutes) suggest that these challenges encouraged supportive messages.

5.2.2 Relative Frequency of Social Support Types

Table 5 summarizes support by supratype and subtype. Messages in this section come from the family chat groups, with quotes from the exit interview added for perspective.

Table 5. Distribution of Support in TableChat

Supratype	Subtype	%	Description
Tangible 39% (n = 129)	Direct task	53%	Performs task directly related to the family's eating
	Active participation	36%	Joins the family in an action to support eating healthily
	Willingness	11%	Expresses willingness to help
Informational 36% (n = 122)	Advice	43%	Suggests ideas and actions
	Teaching	30%	Provides detailed information about the situation
	Situation appraisal	16%	Reassesses or redefines the situation
Emotional 7% (n = 24)	Checking in*	54%	Conveys that someone cares, makes sure that everything is ok
	Encouragement	38%	Provides hope and confidence
	Understanding	4%	Expresses understanding of the situation
	Relationship	4%	Stresses the importance of closeness and love in relationship
Esteem 18% (n = 60)	Compliment	82%	Says positive things about recipient or their actions
	Validation	18%	Expresses agreement with recipient's perspective

(n = 335 total messages with supportive content)
Typology and descriptions adapted from Cutrona and Suhr (p. 161) [20]. Twelve of the original subtypes were absent from the data and are not listed in the table: tangible (loan, indirect task); informational (referral); esteem (relief of blame); emotional (physical affection, confidentiality, sympathy, listening, prayer); and network (access, presence, companions).
*Added based on TableChat findings and Adams et al. [1]

Tangible (39%): Families communicated three subtypes of tangible support: (a) direct tasks; (b) willingness; and (c) active participation. Direct tasks described messages such as (father, F4): *Going to make yogurt for family* and (mother, F2): *[adult daughter] buy some carrots back.* These corresponded to the cooking and shopping that was often cited in Study 1 as a source of support. Willingness was evident in the second message of this exchange: (mother, F9): *Wah seems like alot of fast food everyday* 😂 | (adult son, F9): *hahah uni life. will keep in mind and eat better over the few days.*

We coded active participation when family members reported taking an action to support the family's healthy eating, as when a father (F8) shared a photo of his meal with the caption: *My vegetarian lunch - lead by example.* To qualify as active participation, the provider of support had to take a physical action (e.g., eating a vegetarian lunch), although this support could be received in a different form by the recipient (e.g., as encouragement). We also required evidence that the action involved effort that was taken in part for the purpose of supporting the family's healthy eating (e.g., the father's comment that he is "leading by example").

We coded in this way for three reasons. First, to match the definition of the active participation subtype proposed by Cutrona and Suhr, "Offers to join the recipient in an action that reduces the stress" (p. 161) [20], which we adapted to "Joins the family in an action to support eating healthily." Second, this interpretation is consistent with previous literature on OHCs [1,54], which

coded instances where a person offered to take an action (e.g., share a picture of walking their dog (p. 656 [1])) to encourage another community member as tangible support. Third, participants in Study 1 frequently cited participation in a healthy diet as a way of providing support (e.g., *I eat whatever is cooked, be it brown rice and less oil*) and active participation was the most appropriate SSBC category for capturing this form of support.

Participants seemed more inclined towards tangible support than other types. In response to one of our daily challenges intended to elicit emotional/esteem support ("Today, tell a family member how you care about their health"), one mother (F2) responded with *Asian mother show care by actions not words.* 😜 and a photo of a medicinal tea that she had prepared for the family (Fig. 1a). A father (F9) responded to the same prompt with: *Caring by helping to buy healthy food/snacks for the family.* Similarly, in the interview, when we asked, "How do you encourage your family to eat healthily?", one mother (F8) responded: *Not just words, I put into action... And when I buy snacks, I buy those healthy snacks, like organic snacks.* Providing tangible support was a common and highly valued interaction between family members.

Informational (36%): Families expressed three subtypes of informational support: (a) advice; (b) teaching; (c) situation appraisal; and (d) reminders. Advice was messages such as (father, F8): *Try to have small portion but dont skip [your meal]* and (mother, F2): *Don't have to eat less, just eat RIGHT* 👍. Teaching was particularly common in the two families with teenage children: (father, F1): *Guava is a good source of energy, dietary fiber, and vitamins.* Situational appraisal included critical feedback which was sometimes accompanied by an alternative recommendation, as in (father, F4): *Wow, only fry chicken, should add some veggies or fruit.*

Parents tended to advise, teach, and criticize more often than children. This family role dynamic was described in an interview: (adult son, F9): *Imagine a scenario where let's say my dad is really not as health conscious as me. I don't know I'd necessarily correct him... it's not exactly my place to say it.*

Emotional (7%): Families shared emotional support, communicating love or caring, via four subtypes: (a) checking in; (b) encouragement; (c) understanding; and (d) relationship. Checking in was not a code that we used from the start. Instead, we began with a code for 'reminders,' as reminding family members about eating healthily was frequently cited as a form of social support in Study 1. This included messages like when a husband (F3) messaged his wife: *Baby this is to tell you to drink more water and eat on time so your health can be improved ok?* 😊 (Fig 1b). In the exit interview, this husband shared that he sets an alarm on his smartphone for lunch and dinner, at which time he messages his wife with a reminder to eat on schedule.

We debated between coding reminder messages as a form of informational versus emotional support. Interview responses helped us understand that family members tended to equate reminders with encouragement: (father, F2) *now every meal time I know at least there's some message coming in to remind each other, encourage each other.* When asked whether it was different when a reminder came from the TableChat Bot or from a family member, another participant replied:

(daughter, F2): *If you're talking about encouraging us to eat more healthily, then I guess so, family encouragement would be more impactful than the machine.*
(researcher): *And why is that?*
(daughter, F2): *Because it is targeted specifically at us, the individual. And I feel like you have an obligation, at least reply to a person with an okay*

In line with this interpretation that reminders from family members carried emotional significance, we chose to code this as 'checking in,' a subtype of emotional support that is missing from the original SSBC. This subtype was first proposed as an extension by Adams et. al [1] under

the name "following up," which they describe as checking in to convey a sense that someone is paying attention and taking an interest. Here we use the term "checking in" instead of "following up" because only a few messages related to earlier discussions, whereas most were simply checking in to make sure everything was alright.

Encouragement included messages such as (mother, F2): *STAY HEALTHY EVERYONE* 🌻. Understanding was communicated when an adult daughter (F4) posted her first journal while on a short vacation, *Langkawi first meal - had to eat fast food cos cannot find other food,* and her father replied, *OK, take care.* The relationship subtype was used when an adult son (F2) shared his busy schedule and his mother responded, *Take care, Dear.*

Esteem (18%): Family messages contained two subtypes of esteem support: (a) compliments; and (b) validation. Compliments were messages like (adult daughter, F2): *Wah, looks like some catalog shot.* Esteem and emotional support were sometimes difficult to distinguish, as messages often included both compliments and encouragement, as in (teenage daughter, F10): *Healthy light breakfast, good work!* 😊. Validation was coded when an adult son (F2) replied to his sister's comment that it required a lot of effort to plan healthy meals in advance: *Hahaha yeh.*

Network (0%): As in Study 1, families did not share any network support.

5.2.3 Differences in Support between Families and Online Health Communities

To compare how family support differs from that from peers and strangers, we extend the work of Adams et. al [1]. They compared their findings against Turner-McGrievy and Tate [54], Coursaris and Liu [18], and Braithwaite [7] as studies that are representative of the support types (informational and emotional/esteem) that are most frequently observed in online health communities. To this, we add TableChat. Table 6 compares the distribution of Cutrona and Suhr's support types across these five works.

Table 6. Distribution of Support Types Across TableChat and Four Online Health Communities

	TableChat	Turner-McGrievy and Tate [54]	Coursaris and Liu [18]	Adams et al. [1]	Braithwaite et al. [7]
Group composition	Colocated family	Strangers	Strangers	Strangers	Strangers
Focus	Healthy eating	Weight loss	HIV/AIDS	General heath	Disabilities
Medium	Mobile journaling (group chat)	Twitter interest community	Online support forum	Mobile journaling (social awareness stream)	Online support forum
Support type					
Tangible	**39%**	0%	1%	1%	3%
Informational	36%	**81%**	**58%**	**43%**	31%
Emotional	7%	11%	22%	23%	**40%**
Esteem	18%	7%	9%	34%	19%
Network	0%	1%	9%	0%	7%

*Table lists each supratype of support as the adjusted percentage of supportive messages in TableChat and 4 other studies. The most common type of support in each study is **bolded**. Table adapted and expanded from Adams et al. [1]*

Tangible support in TableChat (39%) is far higher than in previous studies of online health communities (<3%). This difference is even larger if we consider the results of Study 1, where

tangible support constituted 68% of examples shared. We also note that emotional support (7%) was lower in TableChat. However, emotional and esteem support were difficult to tell apart and if collapsed into one category, the difference with prior work is less clear. In section 6.3, we discuss factors which may account for the high level of tangible support that we observed in TableChat.

5.2.4 Filling Gaps in Awareness

In interviews, we asked families when awareness was helpful or not. Many participants shared that journaling meals eaten apart was more valuable than journaling those eaten together:

> (adult daughter, F4): *When you eat as a family at home... you have seen it before, it won't be anything much new. But let's say when I eat alone, and then I show it to my family. So I will see, oh so my dad eat this kind of food for his lunch, my mum eat this. It give me the idea of what they are eating when they are not at home with the family.*

Participants often singled out meals eaten outside of the home and at lunchtime as gaps in awareness:

> (husband, F7): *When I'm working, I'm not eating with her other than dinner. For lunchtime, she don't know what I'm eating, I don't know what she's eating. Sometimes this app will let me know what she's eating, whether she's eating healthily.*

Participants wanted to see eating habits that were "new" to them, rather than a log of family activities that they had experienced directly or were already generally familiar with. The adult daughter in F2, for instance, was extremely curious to know what her brother ate at his military base, joking that this was the reason that she volunteered her family for the TableChat study.

This new awareness facilitated tangible support. Five kitchen managers shared how they adapted dinner plans in response to meals that family members had journaled during the day:

> (mother, F9): *The post by [adult son 1], it's usually some dishes with no veggie at all... so sometimes when I cook at home then, I'll tend to put more veggies that they would eat, like for example spring onion.*

Another mother (F5) explained how it helped her balance "coolness" and "heatiness" in the family diet, a concept from traditional Chinese medicine: *Let's say [my son] eat more deep-fried food. Then that fish will change to steam, instead of deep-fried.* Going beyond health concerns, another kitchen manager reported that this awareness helped her avoid repetition:

> (wife, F7): *For me it's to balance to know what to cook for dinner. Let's say he always eats broccoli during lunchtime I would not want to cook broccoli again during dinner time.*

Kitchen managers used the food journals of family members to adapt their meal plans out of concern for health or variety.

Journaling also revealed daily experiences beyond food. For example, participants shared about a celebration banquet at the office, skipping meals due to busy work or school schedules, and an "unpleasant episode" at a shopping center. Even a lack of journaling hinted at what was happening in someone's day:

> (adult son 1, F9): *Besides being a food journal, it gives us a little bit more insight into some of the things that family members are each going through day by day. So sometimes you'll say why don't you report a picture, or why is it that your picture is being posted late, so you kind of know when someone is skipping lunch because they're busy, or maybe they just don't feel like eating.*

This awareness created additional opportunities for support, in particular for the 'checking in' subtype of emotional support, as in this exchange of chat messages:

> (mother, F9): *[adult son 1] not eating lunch?*
> (adult son 1, F9): *Not yet hahaha, just finish my business seminar. I'll try to get some food before teaching*

The open-ended format of chat allowed participants to share daily experiences that were both important in their own right and also affected their eating behavior.

5.2.5 Scolding or Support? Conflicting Perceptions of Messages

Whether a message constituted scolding, reminding, or encouraging was often in the eye of the beholder:

(adult son 1, F2): *I got scolded for everything I eat so I guess my eating habits are less than desirable.*
(mother, F2): *You didn't get scolded. It's very rude. No, I'm convincing, encouraging, correcting son, you ought to see son.*
(laughter)

When a participant saw a message as scolding or nagging, it often raised privacy and participation issues:

(adult son 1, F2): *I feel like my food choices are not excessively unhealthy, so personally don't like it that you have someone looking over your shoulder for every meal you eat.*

The same son shared that this was the reason he later stopped sharing some of his meals. Conflicting perceptions and a desire for autonomy were especially common between parents and children. This tension that was also reported in Toscos et al. [52], which helpfully offers age-based guidelines for designing family informatics tools. Our results show that these tensions also arise in an Asian cultural context.

Participants suggested alternatives to critical feedback in TableChat. Several expressed a desire for a positive tone in the chat, as in the husband in F7: *For me, when we're physically together, I think nagging is better. If you are not physically together, maybe encouragement?* Participants also wished family members would provide constructive suggestions: (father, F9): *Besides just telling me, 'You shouldn't drink this,' why not just tell me something that I should do instead?* Recipients felt like positive and constructive feedback were more appropriate than critical feedback in TableChat.

5.2.6 Coordination via Group Chat

While social support was the focus of this study, the open-ended nature of TableChat allowed for many forms of interaction. Families used the chat group to coordinate actions, not just journal them. For instance, it was common for the kitchen manager to ask who would be back for dinner in the evening (e.g., mother, F9: *Are you coming back for dinner tonight?*). In other cases, the group chat was used as a shopping list (e.g., mother, F2: *[adult daughter] buy some carrots back*). Prior studies in human-computer interaction have addressed how families coordinate calendars [9,21] and errands [50], so these observations are not addressed in detail here.

5.2.7 Stimulating Appetite with Photos in Logs

One side effect of TableChat was that seeing photos of food stimulated appetite. One participant shared that pictures of unhealthy foods triggered her cravings (adult daughter, F2): *When I saw my brothers western food then I started craving for western food.* Two participants expressed concern that the photo stream made it harder for them to stick to their weight loss diets. Several kitchen managers exploited this effect when calling family members to come home for dinner, with one mother (F2) posting a simmering pot of fish head soup with the message: *What u can look forward to* 😉 We had not anticipated this effect, although it is consistent with recent research that shows that images of food stimulate appetite [49]. This consideration may be unique to journaling food, since photos of other health behaviors (e.g., exercise) are not known to trigger such physiological responses.

6 OVERALL DISCUSSION

Participants were interested in family food journaling for different reasons: for example, losing weight, satisfying curiosity, and connecting with family. In this discussion section, we address these diverse motivations. We consider one alternative mode of tracking, selective journaling, that may suit families motivated by curiosity or connection. We also review factors that contributed to the prevalence of tangible support in TableChat messages.

6.1 Lived Family Informatics: Diverse Motivations for Journaling

TableChat participants had diverse motivations for journaling, which can be explained by the concept of lived informatics. Whereas personal informatics focuses on behavior change goals, lived informatics argues that there are many other common and valid reasons for individuals to track their activity [44]. Although our Study 1 recruitment email described our survey as a study of healthy eating, only one-third of respondents were interested in participating in TableChat to improve their health (e.g., lose weight).

Instead, TableChat participants were more likely to hold one of several alternative motivations. Prior work on lived informatics has already reported two of these motivations: curiosity and a desire to document activities [24,44]. In the personal informatics literature, curiosity is presumed to stem from a desire to understand the self. In family informatics however, the desire to understand others may be stronger than the desire to better understand oneself. Of survey respondents, 32% were interested in participating in TableChat to better understand the diets of their family members and 17% were motivated by the chance to view interesting content. TableChat participants were especially eager to see what others ate when they were away at work or on travels (e.g., the adult daughter (F2) who wanted to know what her brother ate at this military base). And when asked what they had learned from TableChat, participants tended to cite what they had discovered about their family members rather than what they had learned about themselves. The curiosity in TableChat may also have a cultural component as there is even a special term in Singaporean English, *kaypoh*, for a person who takes an (unwarranted) interest in the business of others [11]. Several participants also shared that they were motivated by a desire to document past meals, without any specific behavioral changes in mind. One father (F2) thought that a such a record might prove useful when considering which restaurant to visit again in the future.

TableChat study findings suggest 'checking in' as an additional motivation in lived family informatics. Check-in messages served a dual purpose: (a) to convey a sense that someone cares; and (b) to make sure that everything is ok with each other. Of Study 1 respondents, 12% were interested in family food journaling to connect with family members. In Study 2, TableChat participants sent reminder messages to each other that contained informational content, but also showed that someone cares (e.g., mother, F2: *Remember 1st cup of drink should be plain water* ❤️ *)*. The response to check-in messages like this offered a sense of connection and reassurance that family members were doing fine (e.g., adult son, F2: *1st mouth is water after that coffee ok?*😂).

Yet photos of food often satisfied the need to check-in all on their own, revealing far more about a family member's day than just what they had for lunch (e.g., social context and location information [16]). Even the absence of a photo could serve as an important signal, such that a family member was having a stressful day and did not have time to eat lunch. In this way, tracking in TableChat provided a similar benefit to the location awareness provided by the Whereabouts Clock, a clock designed to display the location of family members [8]: it helped family members keep track of their loved ones and make sure that everything was alright with them.

Motivations for journaling varied not only between families, but also within families. Of survey respondents in Study 1, 19% were themselves interested in participating in TableChat, but declined because their family members were not. In F2, the adult son wanted to eat healthily himself, but did not want: *someone looking over your shoulder for every meal you eat.* His mother, however, wanted to better understand the eating habits of her family members. His father, meanwhile, was interested in documenting family activities for potential review in the future. Designers of family informatics should survey potential participants to better understand their diverse motivations and to decide which ones to support (or not).

6.2 Journaling Selectively to Satisfy Curiosity and Connect with Family

For many TableChat participants, curiosity or family connection was their motivation to journal. For them, journaling shared meals felt uninteresting and unnecessary. Yet informatics tools often encourage a complete log of activity; this was the approach we adopted with TableChat by sending reminders for every lunch and dinner. Comprehensiveness is important for many behavior change goals, such as when the aim is to produce a record of health behavior for the sake of review (e.g., a 3-day food journal for sharing with a physician). However, this approach is burdensome and adherence rates are low [16].

One alternative in family informatics is journaling to fill gaps in awareness rather than to keep a record. In personal informatics, an individual's memory of their own activity can often serve as an imperfect record, even if it is not journaled. In family informatics, family members often have no experience of each other's activity (e.g., a lunch meal at the office) unless it is journaled or otherwise shared. This means that journaling non-shared experiences holds particular importance in family informatics as a way of extending awareness. If a family's motivation is curiosity or family connection, members could selectively journal their non-shared activities rather than recording all of their activities.

6.3 Factors that Contribute to Tangible Support in Family Informatics

To design family informatics tools that facilitate social support, it is important to understand factors that influence the provision of support. Table 6 compared the distribution of support types in TableChat against four online health communities. Tangible support was far higher in TableChat (39%) than these other communities (<3%). We consider four factors that may contribute to the prevalence of tangible support that we observed: network composition of the social unit, Asian family values, the short communication style of mobile chat, and physical proximity.

Network composition: Family members usually have stronger commitments to each other than to strangers or peers. In a study of how households coordinate errands, Sohn et al. noted that reciprocity was expected among roommates, but not family members [50]. When roommates received support, they felt compelled to return the favor; family members did not. Similarly, in TableChat's family groups, participants did not expect reciprocity. Instead, an individual's role in the family governed their provision of social support. Parents sent twice as many supportive messages as children. It was kitchen managers (predominantly mothers) who turned family awareness into tangible support (e.g., using photos of lunch meals to adapt dinner plans for the sake of health or variety). Designers should carefully consider the tradeoffs of technologies that follow or challenge such gender-informed norms [34]. In TableChat, clear role expectations and unconditional support likely contributed to the higher proportion of tangible support.

Cultural differences: Social support functions differently in Asian compared to European cultures, with Asians and Asian-Americans less likely to make explicit requests for support out of concern for negative relational consequences [32]. In particular, Japanese have been found to more frequently provide tangible and informational support than emotional support, whereas European Americans exhibit the opposite pattern [10]. Comments in TableChat like *Asian mother show care by actions not words.* 😜 [F02, mother] suggest that the same cultural norms may be operative in a Singapore's multiethnic Asian population. The Asian cultural background of our participants may have contributed to the frequency of tangible support that we observed as well as the value that was attached to it.

Communication medium: Support in TableChat was short and bursty, a form of interaction that Adams et al. call staccato social support [1]. Like Adams et al., we found evidence for 'following up' wherein family members would check-in on each other's activity as an additional subtype of emotional support. Unlike Adams et al., we did not find clear evidence that mobile messaging led to a greater prevalence of esteem support. This may be in part because the 39% share of tangible support in TableChat, largely absent in previous studies of online health communities, crowded out other types of support.

Physical proximity and colocation: In a longitudinal study of social networking sites (SNS), Trepte et al. found that the proximity of interaction partners was a precondition for the availability of tangible support [53]. They note that requests for tangible support often go unanswered on SNSs, an uncommon situation in face-to-face interactions. TableChat was used by family members living under the same roof, so participants were frequently in physical proximity. When a family member messaged about direct tasks that supported healthy eating (e.g., cooking, shopping), it was almost always tied to the shared space of the dinner table. Future work in family informatics could explore whether health behaviors that are less connected to a shared space (e.g., exercise) also show higher rates of tangible support among family members.

7 DESIGN IMPLICATIONS FOR FAMILY INFORMATICS

For colocated families, the vast majority of interaction happens outside of technology. Designers should therefore take special care to understand existing family routines before designing informatics tools. Otherwise they risk disrupting important family practices. For instance, a designer might introduce automated reminders at meal times and inadvertently replace check-in messages from family members that are a key source of emotional support (e.g., husband, F3: *Baby this is to tell you to drink more water...).*

We therefore structure our design implications around a framework of complementarity for family informatics (Table 7). The framework presents key implications drawn from TableChat, as well as some from other studies on family informatics. Each row of the framework presents an example goal for a family informatics tool, an existing family interaction, a complementary virtual design, and an example implementation in TableChat. For each goal, additional design opportunities are discussed in the text following the table. To follow our framework, a designer would list their goals, identify existing family interactions, and then ideate complementary virtual designs.

Our framework is intended to supplement existing models of personal and family informatics. Pina et al. discuss how to adapt stage-based models of personal informatics [33] and lived informatics [24] for families [42]. We note that many of the stages in these models (e.g., collection, reflection) can also be considered in terms of complementarity: how well do they fit with existing family routines?

Table 7. A Framework of Complementarity for Family Informatics

Example Goal	Existing Family Interaction	Complementary Virtual Design	Example Implementation in TableChat
Collection	Burden of collecting data often falls upon a single caregiver [42]	Enable multiple family members to assist in tracking [42]	[*Current*] Piggybacking on WhatsApp makes it easy for all family members to participate in journaling
Awareness	Shared experience already provides awareness of many behaviors (e.g., meals eaten together)	Request journaling only for non-shared experiences (e.g., meals eaten apart)	[*Potential*] Send reminders to journal only for meals eaten apart from family (e.g., lunch)
Support cultural practices	Family eating behaviors are deeply linked to cultural norms and traditions [29,48]	Support entry of activities (e.g., meals) from different cultures [48]	[*Current*] Free-form journaling allows for photos of and messages about all kinds of meals
Social support			
Tangible	Negabehaviors (e.g., *I don't buy junk food*) are a valued form of support, but are often overlooked	Increase the salience of non-actions that contribute to the family's health goals	[*Potential*] Challenge participants to refrain from purchasing an unhealthy item and journal this non-action
Informational	Some families prefer to provide critical feedback in-person	Scaffold feedback in virtual interactions to be positive and constructive	[*Potential*] Caution sender before they send a message with critical feedback
Emotional / esteem	Family members check-in with each other to show that they care [1]	Avoid replacing personal reminders with system reminders	[*Potential*] Prompt one family member to check-in with another about their meal

Citation numbers are indicated for examples from prior work. All other examples come from our TableChat findings. In the Example Implementation column, [Current] indicates a feature that is currently implemented in TableChat; [Potential] means that it could be included in future versions.

Collection: Collecting data is a key activity in family informatics, but the burden often falls upon a single caregiver. Pina et al. point out that other family members, including children, are often willing to help, but that many tracking tools lack support for multiple users [42]. Schaefbauer et al. designed their mobile application for tracking snacks to have different interfaces suited for teens versus parents [48]. In TableChat, participants reported that using WhatsApp Messenger made it easy for all family members to contribute and no participant reported technical difficulties. Piggybacking on top of a familiar technology reduced the learning curve for all family members and encouraged wider participation. As messaging apps open up their platforms and chatbots become more capable, this should become an increasingly effective approach.

Awareness: In families, shared experience already provides awareness of many behaviors (e.g., meals eaten together). For this reason, Schaefbauer et al. focused on snacking decisions that often happened while parents were away from their children at work [48]. In TableChat, families that were motivated to journal by curiosity or to connect with family, would benefit from a tool that encourages *selectively journaling* only non-shared meals. For a family with a different motivation, such as calorie counting, *comprehensive journaling* may be a better approach.

Support Cultural Practices: Family eating behaviors are deeply linked to cultural norms and practices [29]. Schaefbauer et al. call for logging applications to support food from diverse cultures [48]. For families with a specific goal (e.g., reducing calorie consumption), this might

require building a database with the nutritional information of local dishes (e.g., laksa in Singapore) that are not supported by most food journaling tools. Alternatively, TableChat suggests that using a free-form medium like chat enables families to journal a wide range of health factors that matter to them (e.g., traditional Chinese medicine), which are unlikely to be supported in a tool that requires entries to be categorized into a discrete number of categories.

Tangible Support: In Study 1, family members cited negabehaviors as a major source of support. Our initial design left TableChat open-ended, encouraging family members to journal anything related to food, including eating, cooking, and grocery shopping. We hoped that participants would journal the same supportive actions that they cited in our survey. However, participants did not journal negabehaviors, perhaps due to the human bias to overlook non-actions in favor of actions [45]. In hindsight, we wish we had of specifically encouraged family members to consider how they contributed to their family's healthy eating through the actions they did *not* take. For example, TableChat could have issued a challenge to participants to refrain from purchasing an unhealthy item of their choice at the grocery store and then journal it. We note negabehaviors as a promising opportunity for informatics tools.

Informational Support: In TableChat, participants reported that they wanted to keep a positive tone to their family journaling. A system could scaffold feedback to be positive using sentiment analysis to warn against overly critical messages as has previously been done with email [39]. Alternatively, it could analyze activity shared to the family chat and offer constructive feedback.

Emotional / Esteem Support: In TableChat, connecting with family was an important motivation for journaling. Family members checked in with each other about everyday health decisions to show that they cared and make sure everything was alright with each other. Informatics tools should not replace this emotional support with an automated reminder. Instead, a tool could remind family members to follow up with each other, as in the case of the husband (F3) who set his alarm to alert him to send a reminder to his wife. However, when an existing family practice works just fine, sometimes the best conclusion is that no technology is required [5].

Designing family informatics tools requires careful consideration of the existing interactions that form the foundation of family life and the motivations that people have for journaling in the first place. Our framework of complementarity offers a simple process for coming up with complementary virtual designs.

8 LIMITATIONS AND FUTURE WORK

Our work has several limitations. First, our study was not a controlled experiment, so we cannot say with certainty which factor(s) contributed to the distribution of support types that we observed in TableChat. For example, designers working with families from a Western cultural background may not find the same prevalence of tangible support. Second, our study focused on healthy eating. Our findings may not generalize to other health behaviors like exercise that do not usually happen in the home and are not as likely to be shared family experiences. Third, our participants were from a general population rather than a specific sub-population. Families managing chronic medical conditions (e.g., juvenile idiopathic arthritis) have been found to track behavior differently than families without a specific concern [42], so our findings may not apply to them or to other subgroups. Future work in family informatics could further explore how to facilitate support in families with different health situations and goals.

Another concern is that TableChat simply documented pre-existing support. This was likely the case in some instances: for example, when a kitchen manager posted a picture of food that they had cooked for the family. However, our analysis suggests several *new opportunities* for social support that were facilitated by TableChat. First, within the app, family members shared informational and esteem support that seemed to be a result of seeing photos of meals that were eaten apart. For example, parents often appraised the meals their children ate and many family members gave each other compliments like, *Wah, looks like some catalog shot* (adult daughter, F2). Second, outside of the app, interviews suggested that increased awareness (e.g., knowing that a family member ate a heavy lunch) led to tangible support from the kitchen manager (e.g., preparing a light dinner). Still, it would be useful for future studies to use an experimental design to more rigorously assess to what extent family informatics tools can increase the quantity and/or quality of social support provided.

Future work could focus specifically on the features of family informatics technologies that facilitate tangible support, which was highly valued by TableChat participants. In terms of design, such family informatics tools could include features, like a shopping list, that prompt family members to perform direct tasks for each other (e.g., "Remember to pick up yellow noodles on your way home"). They could also encourage active participation by prompting family members to join in on family activities (e.g., "Set an example for your family by eating a healthy lunch and sharing a picture"). In terms of evaluation, our current study was designed to use the SSBC to explore the various types of social support messages provided online, so we could only infer offline support based on online messages and interview data. One alternative approach would be to administer pre- and post-survey measures that assess the provision of tangible support, e.g., [47]. Another would be to ask participants to keep a daily journal of all actions they took to materially support their family members. Such work could yield further insights into how family informatics can encourage the provision of tangible support.

9 CONCLUSION

Families are an important source of informational, emotional, and esteem support. In this paper, we designed and deployed TableChat, a mobile application for families to food journal and chat. Analysis of the 1,420 messages exchanged in TableChat showed that family informatics tools can facilitate social support, including tangible support, which is rare in most online health communities. Families reported that journaling non-shared experiences was engaging and facilitated tangible support, but that journaling shared experiences was redundant. Findings of this nature led us to propose a framework with examples of how informatics tools can be designed to complement rather than disrupt existing family routines.

REFERENCES

[1] Phil Adams, Eric P S Baumer, and Geri Gay. 2014. Staccato social support in mobile health applications. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 653–662.

[2] Nazanin Andalibi, Pinar Ozturk, and Andrea Forte. 2017. Sensitive Self-disclosures, Responses, and Social Support on Instagram: The Case of #Depression. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (CSCW '17), 1485–1500.

[3] Tanya Angerer. 2015. Singapore's Millennials Are Escaping Their Parents for a Night With Airbnb. *Bloom. News* (July 2015).

[4] Robin A Barry, Mali Bunde, Rebecca L Brock, and Erika Lawrence. 2009. Validity and utility of a multidimensional model of received support in intimate relationships. *J. Fam. Psychol.* 23, 1 (February 2009), 48–57.

[5] Eric P.S. Baumer and M. Six Silberman. 2011. When the implication is not to design (technology). *Proc. 2011 Annu. Conf. Hum. factors Comput. Syst. - CHI '11* (2011), 2271. DOI:https://doi.org/10.1145/1978942.1979275

[6] Hugh Beyer and Karen Holtzblatt. 1997. *Contextual Design: Defining Customer-Centered Systems*. Elsevier.

[7] D O Braithwaite, V R Waldron, and J Finn. 1999. Communication of social support in computer-mediated groups for people with disabilities. *Heal. Commun.* 11, 2 (1999), 123–151.

[8] Barry Brown, Alex S Taylor, Shahram Izadi, Abigail Sellen, Jofish Kaye, and Rachel Eardley. 2007. Locating family values: A field trial of the Whereabouts Clock. In *International Conference on Ubiquitous Computing*, 354–371.

[9] A J Bernheim Brush, Kori M Inkpen, and Kimberly Tee. 2008. SPARCS: Exploring Sharing Suggestions to Enhance Family Connectedness. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (CSCW '08), 629–638.

[10] Jacqueline M Chen, Heejung S Kim, Taraneh Mojaverian, and Beth Morling. 2012. Culture and social support provision: who gives what and why. *Pers. Soc. Psychol. Bull.* 38, 1 (January 2012), 3–13.

[11] Denise Chong. "Kaypoh" strangers can make a difference as extended family network disappears. Retrieved from http://www.asiaone.com/kaypoh-strangers-can-make-difference-extended-family-network-disappears

[12] Chia-Fang Chung, Elena Agapie, Jessica Schroeder, Sonali Mishra, James Fogarty, and Sean A Munson. 2017. When Personal Tracking Becomes Social: Examining the Use of Instagram for Healthy Eating. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 1674–1687.

[13] Sheldon Cohen and S Leonard Syme. 1985. Issues in the study and application of social support. *Soc. Support Heal.* 3, (1985), 3–22.

[14] Nathalie Colineau and Cécile Paris. 2011. Family vs. Individual Profiles in a Health Portal: Strengths and Weaknesses. In *Proceedings of the 25th BCS Conference on Human-Computer Interaction* (BCS-HCI '11), 321–330.

[15] Nathalie Colineau, Cécile Paris, Peter Marendy, Dipak Bhandari, and Yanfeng Shu. 2009. Supporting family engagement in weight management. *Proc. 27th Int. Conf. Ext. Abstr. Hum. factors Comput. Syst. - CHI EA '09* (2009), 3991. DOI:https://doi.org/10.1145/1520340.1520606

[16] Felicia Cordeiro, Elizabeth Bales, Erin Cherry, and James Fogarty. 2015. Rethinking the Mobile Food Journal: Exploring Opportunities for Lightweight Photo-Based Capture. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (CHI '15), 3207–3216.

[17] Felicia Cordeiro, Daniel A Epstein, Edison Thomaz, Elizabeth Bales, Arvind K Jagannathan, Gregory D Abowd, and James Fogarty. 2015. Barriers and Negative Nudges: Exploring Challenges in Food Journaling. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 1159–1162.

[18] Constantinos K Coursaris and Ming Liu. 2009. An analysis of social support exchanges in online HIV/AIDS Self-help groups. *Comput. Hum. Behav.* 25(4), 911–918 (July 2009).

[19] Carolyn E Cutrona, Daniel W Russell, and Kelli A Gardner. 2005. The Relationship Enhancement Model of Social Support. In *Couples coping with stress: Emerging perspectives on dyadic coping.*, Tracey A Revenson, Karen Kayser and Guy Bodenmann (eds.). American Psychological Association, Washington, 73–95.

[20] Carolyn E Cutrona and Julie A Suhr. 1992. Controllability of Stressful Events and Satisfaction With Spouse Support Behaviors. *Communic. Res.* 19, 2 (April 1992), 154–174.

[21] Scott Davidoff, John Zimmerman, and Anind K Dey. 2010. How Routine Learners Can Support Family Coordination. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10), 2461–2470.

[22] Sharon Denham, Sandra Eggenberger, Patricia Young, and Norma Krumwiede. 2015. *Family-focused nursing care*. FA Davis.

[23] Daniel A Epstein, Felicia Cordeiro, James Fogarty, Gary Hsieh, and Sean A Munson. 2016. Crumbs: Lightweight Daily Food Challenges to Promote Engagement and Mindfulness. *Proc SIGCHI Conf Hum Factor Comput Syst* 2016, (May 2016), 5632–5644.

[24] Daniel A Epstein, An Ping, James Fogarty, and Sean A Munson. 2015. A lived informatics model of personal informatics. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, 731–742.

[25] Gunther Eysenbach. 2005. The law of attrition. *J. Med. Internet Res.* 7, 1 (March 2005), e11.

[26] Benjamin H Gottlieb and Anne E Bergen. 2010. Social support concepts and measures. *J. Psychosom. Res.* 69, 5 (November 2010), 511–520.

[27]   Catherine Grevet and Eric Gilbert. Piggyback Prototyping: Using Existing, Large -Scale Social Computing Systems To Prototype New Ones.

[28]   Andrea Grimes, Desney Tan, and Dan Morris. 2009. Toward Technologies That Support Family Reflections on Health. In *Proceedings of the ACM 2009 International Conference on Supporting Group Work* (GROUP '09), 311–320.

[29]   Jasmine Hentschel, Samyukta Manjayya Sherugar, Rui Zhou, Vaishnav Kameswaran, Rajesh Chandwani, and Neha Kumar. 2017. Rice Today, Roti Tomorrow: Diets and Diabetes in Urban Indian Households. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (CHI '17), 4069–4081.

[30]   Alexis Hiniker, Sarita Y Schoenebeck, and Julie A Kientz. 2016. Not at the dinner table: Parents' and children's perspectives on family technology rules. In *Proceedings of the 19th ACM conference on computer-supported cooperative work & social computing*, 1376–1389.

[31]   Infinite_labs. Scheduler for WhatsApp.

[32]   Heejung S Kim, David K Sherman, and Shelley E Taylor. 2008. Culture and social support. *Am. Psychol.* 63, 6 (September 2008), 518–526.

[33]   Ian Li, Anind Dey, and Jodi Forlizzi. 2010. A stage-based model of personal informatics systems. *Proc. 28th Int. Conf. Hum. factors Comput. Syst. - CHI '10* (2010), 557. DOI:https://doi.org/10.1145/1753326.1753409

[34]   Kai Lukoff, Carol Moser, and Sarita Schoenebeck. 2017. Gender Norms and Attitudes about Childcare Activities Presented on Father Blogs. *Proc. 2017 CHI Conf. Hum. Factors Comput. Syst. - CHI '17* (2017), 4966–4971. DOI:https://doi.org/10.1145/3025453.3025767

[35]   Kai Lukoff, Cissy Yu, Julie Kientz, and Alexis Hiniker. What Makes Smartphone Use Meaningful or Meaningless? *PACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 1 .

[36]   Tricia A Miller and M Robin Dimatteo. 2013. Importance of family/social support and impact on adherence to diabetic therapy. *Diabetes Metab. Syndr. Obes.* 6, (November 2013), 421–426.

[37]   Sean A Munson, Debra Lauterbach, Mark W Newman, and Paul Resnick. 2010. Happier Together: Integrating a Wellness Application into a Social Network Site. In *Persuasive Technology*. Springer Berlin Heidelberg, 27–39.

[38]   Kelly Musick and Ann Meier. 2012. Assessing causality and persistence in associations between family dinners and adolescent well-being. *J. Marriage Fam.* 74, 3 (2012), 476–493.

[39]   Janice Nadler. 2001. Electronically-mediated dispute resolution and e-commerce. *Negot. J.* 17, 4 (2001), 333–347.

[40]   Midas Nouwens, Carla F Griggio, and Wendy E Mackay. 2017. WhatsApp is for family; Messenger is for friends: Communication Places in App Ecosystems. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 727–735.

[41]   H. Park, Z. Wang, A. R. Kashyap, and B. Y. Lim. 2018. Biases in Food Photo Taking Behavior. In *ACM CHI Workshop on Designing Recipes for Digital Food Lifestyles.*

[42]   Laura R Pina, Sang-Wha Sien, Teresa Ward, Jason C Yip, Sean A Munson, James Fogarty, and Julie A Kientz. 2017. From Personal Informatics to Family Informatics: Understanding Family Practices around Health Monitoring. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*, 2300–2315.

[43]   Maija Reblin and Bert N Uchino. 2008. Social and emotional support and its implication for health. *Curr. Opin. Psychiatry* 21, 2 (March 2008), 201–205.

[44]   John Rooksby, Mattias Rost, Alistair Morrison, and Matthew Chalmers Chalmers. 2014. Personal tracking as lived informatics. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems*, 1163–1172.

[45]   Joel Ross and Bill Tomlinson. 2011. Negabehaviors and environmental sustainability. *Int. J. Sustain. High. Educ.* 2, (2011), 2011.

[46]   Herman Saksono, Ashwini Ranade, Geeta Kamarthi, Carmen Castaneda-Sceppa, Jessica A Hoffman, Cathy Wirth, and Andrea G Parker. 2015. Spaceship Launch: Designing a Collaborative Exergame for Families. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (CSCW '15), 1776–1787.

[47]   J F Sallis, R M Grossman, R B Pinski, T L Patterson, and P R Nader. 1987. The development of scales to measure social support for diet and exercise behaviors. *Prev. Med.* 16, 6 (November 1987), 825–836.

[48]   Christopher L Schaefbauer, Danish U Khan, Amy Le, Garrett Sczechowski, and Katie A Siek. 2015. Snack Buddy: Supporting Healthy Snacking in Low Socioeconomic Status Families. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (CSCW '15), 1045–1057.

[49]   Petra Schüssler, Michael Kluge, Alexander Yassouridis, Martin Dresler, Manfred Uhr, and Axel Steiger. 2012. Ghrelin levels increase after pictures showing food. *Obesity* 20, 6 (June 2012), 1212–1217.

[50]   Timothy Sohn, Lorikeet Lee, Stephanie Zhang, David Dearman, and Khai Truong. 2012. An Examination of How Households Share and Coordinate the Completion of Errands. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (CSCW '12), 729–738.

[51]   Kristin Hui Xian Tan, Linda Wei Lin Tan, Xueling Sim, E Shyong Tai, Jeannette Jen-Mai Lee, Kee Seng Chia, and Rob M van Dam. 2018. Cohort Profile: The Singapore Multi-Ethnic Cohort (MEC) study. *Int. J. Epidemiol.* 47, 3 (2018), 699--699j.

[52]   Tammy Toscos, Kay Connelly, and Yvonne Rogers. 2012. Best intentions: health monitoring technology and

children. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*, 1431–1440.

[53]   Sabine Trepte, Tobias Dienlin, and Leonard Reinecke. 2015. Influence of Social Support Received in Online and Offline Contexts on Satisfaction With Social Support and Satisfaction With Life: A Longitudinal Study. *Media Psychol.* 18, 1 (January 2015), 74–105.

[54]   Gabrielle M Turner-McGrievy and Deborah F Tate. 2013. Weight loss social support in 140 characters or less: use of an online social network in a remotely delivered weight loss intervention. *Transl. Behav. Med.* 3, 3 (September 2013), 287–294.

[55]   B N Uchino, J T Cacioppo, and J K Kiecolt-Glaser. 1996. The relationship between social support and physiological processes: a review with emphasis on underlying mechanisms and implications for health. *Psychol. Bull.* 119, 3 (May 1996), 488–531.

[56]   David L Whitford, Hannah McGee, and Bernadette O'Sullivan. 2009. Will people with type 2 diabetes speak to family members about health risk? *Diabetes Care* 32, 2 (February 2009), 251–253.

[57]   Naomi Yamashita, Hideaki Kuzuoka, Keiji Hirata, Takashi Kudo, Eiji Aramaki, and Kazuki Hattori. 2017. Changing Moods: How Manual Tracking by Family Caregivers Improves Caring and Family Communication. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 158–169.

[58]   Gregory D Zimet, Nancy W Dahlem, Sara G Zimet, and Gordon K Farley. 1988. The multidimensional scale of perceived social support. *J. Pers. Assess.* 52, 1 (1988), 30–41.

[59]   John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research Through Design As a Method for Interaction Design Research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '07), 493–502.

[60]   Singapore Population Health Studies (SPHS). Retrieved from http://blog.nus.edu.sg/sphs/

[61]   2018. Introducing the WhatsApp Business App. *WhatsApp Blog*. Retrieved from https://blog.whatsapp.com/10000637/Introducing-the-WhatsApp-Business-App