The Frustrations and Benefits of Mobile Device Usage in the Home when Co-Present with Family Members

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ABSTRACT

Mobile devices have begun to raise questions around the potential for overuse when in the presence of family or friends. As such, we conducted a diary and interview study to understand how people use mobile devices in the presence of others at home, and how this shapes their behavior and household dynamics. Results show that family members become frustrated when others do non-urgent activities on their phones in the presence of others. Yet people often guess at what others are doing because of the personal nature of mobile devices. In some cases, people developed strategies to provide a greater sense of activity awareness to combat the problem. Mobile phone usage was sometimes perceived as beneficial by providing a mechanism for needed disengagement from family members. These findings suggest several opportunities for redesigning mobile device software to mitigate emergent frustrations, and open up new opportunities for nurturing social interactions among family members.

Author Keywords

Families; mobile phones; social connection; disconnection

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

INTRODUCTION

Technology has taken a prominent place in domestic life—providing access to information, mediating interaction with those outside of the home, and even supporting our interactions with collocated family members [3,8,20,30,42].

Mobile phones, in particular, are critical for domestic communication and coordination; they provide families with ways to coordinate actions and activities from nearly any location at any time [7,20,36]. Nonetheless, there are growing accounts of the unanticipated effects of the disruption that mobile devices are now creating in society [13,40,45]. These range from the potential social awkwardness of answering a mobile phone call in a public setting [21] to issues around parenting and the possible erosion of family relationships because of mobile devices being used in the presence of others [13,40,45].

There exists a wealth of research around mobile phone usage. Yet, very little explores the ways in which people use mobile phones in the presence of others when at home and the effects of these actions. Additionally, little research has explored if and how the *design* of mobile device hardware or software may be shaping particular kinds of in-home behaviors. This is despite a growing amount of popular press articles describing how experiences of social disconnection and digital overload are emerging from the pervasiveness of technology in everyday life (e.g., [6,15]).

The goal of our paper is to explore these intersecting issues as a means to uncover potential challenges that might suggest mobile device design improvements. We wanted to understand when and why family members used their mobile devices at home when in the presence of others, how this may affect their relationship with other family members, and what strategies they employ, if any, to reduce behaviors perceived to be negative. Our study focuses on handheld mobile devices, such as smartphones and tablets, which can be easily moved around the home and frequently mediate people's domestic leisure or downtime. We conducted a diary and interview study with twenty participants from different households. We deliberately focused on the perceptions and experiences of one individual within each household, rather than the household as a whole. This choice was motivated by our concern over worsening any social tensions, if they existed, by having multiple family members comment on the behavior of others in their home.

Importantly, we did not aim to judge participants' behavior. We wanted to see what range of behaviors existed and to highlight what family members found to be either problematic or beneficial from their personal perspectives. Thus, we explore both the benefits and drawbacks of collocated mobile device usage, though, given participant experiences, our findings surfaced and highlighted more drawbacks than benefits across many participants. This is not to say that more benefits do not exist. Instead, it reflects the complex emotions tied up within mobile device usage.

Our results showed that mobile device usage in the presence of family members was commonly triggered by notifications, boredom, and a need to look up information. Participants tended to not raise issues over family members' practices of using mobile devices to assist in urgent tasks. However, there was a common perception that usage could wait until later when the person was not with others, and when this normative behavior was not adhered to, it could create a great deal of frustration (often harbored for long time periods). Not all device usage was perceived as negative; mobile devices were thought to be beneficial for occasionally disengaging from family members, finding information in a timely fashion for group purposes, and aiding parenting.

Our research makes two main contributions. First, it provides descriptions of how mobile devices mediate and shape interactions and relationships amongst collocated family members in the home. Second, it describes implications for future research and design where we raise questions around how designers might reduce feelings of frustration amongst family members and open up new opportunities for nurturing co-located social interactions.

RELATED WORK

The Role of Mobile Devices in Domestic Life

Family life is complex and requires continual efforts by family members to stay connected and aware of each other's activities and needs [3,8,30,42]. Typically, there is a strong need to coordinate activities amongst immediate family members [28,30] and technology is now playing a pivotal role in supporting these processes [4,5,30]. Over the past two decades, mobile phones have increasingly played a central role in connecting family members with one another [3,30,42]. Throughout this time period, the way in which mobile phones are used has gradually expanded from periodic usage for 'security' and 'safety' [20] to much more frequent usage for a range of activities and needs, often centered around the Internet and connectivity [13,15,45].

Mobile phones have been found to be important for micro coordination among work colleagues, family, and friends [20]. They are also considered very personal devices, used by a single owner [4,20,21] and parents typically carry them in case of child emergencies [36]. Mobile phones are often used in the transitions between activities (e.g., down moments) and have been seen to extend the concept of 'home' to mobile settings [36,38]. Mobile phones are even frequently used by people to access the Internet in their home even when a computer is nearby because mobile phones are perceived to be faster to use and more convenient than a computer since they are often with their owner [32]. Over the years, mobile phone usage has expanded from a small number of locations in the home to heavy usage across various settings, such as the kitchen, living room, and even bathroom [15]. Mobile device activities include social networking, online gaming, communication, shopping, and video watching [15].

Mobile phones raise interesting social questions because people sometimes use them in the presence of others who are collocated [15]; this can result in a sense of social disconnection and a lack of engagement with those collocated [21]. Incoming interactions through a mobile phone are often seen as being more important than in-person conversations that might already be occurring [21] and people often feel pressure to respond to their phones [27]. Wajcmann et al. [49] reported that only 1/5 of people turned off their mobile phone during leisure activities and 1/6 of people turned it off during mealtimes and other times at home. Przybylski and Weinstein [39] studied pairs of strangers in face-to-face settings and found that those with a mobile phone present felt less close to one another after conversation. Jarusriboonchai et al. [14] explored people's reactions to 'backside displays' on mobile devices and found some people did not want others to know what they were doing on their device, even though co-present use of mobile devices was sometimes bothersome.

In addition, we have seen the emergence of issues around work-life balance [19,25,31,49]. Some companies have an expectation that employees are constantly available whether in or outside of the workplace; a trend directly supported by mobile devices [25,26]. To combat this trend, people have used various methods to 'craft' work and personal time [46] and deal with the feeling of needing to be connected [9,26]. For example, people may move closer to their job location or choose a job that allows them to 'disconnect' [25,46]. Yet, in contrast, we have seen the purposeful merging of work and home life to balance family and work activities, in particular, in farm families [19].

Mobile Devices and Children

Studies have explored how parents use mobile devices with children present. Radesky et al. [40] reported on how caregivers often used mobile devices including smartphones and tablets when eating lunch at a restaurant with children present. Children noticed such usage and sometimes would start to misbehave as a way to attract the caretaker's attention [40]. Caretakers who were 'absorbed' in their device typically had poor social interactions with the children as a result [40]. A study of mobile phone use by caregivers at playgrounds found adults engaged in a range of mobile phone use and non-use while watching the children [13]. Some caregivers believed that it was okay to

use their phones as long as the children were safe while others believed that phone use should be minimized [13]. Phone usage was found to cause caregivers to take longer to respond to children in need of attention [13]. Some people reported not knowing how to change their phone behavior, even if they wanted to [13].

Steiner-Adair [45], a clinical psychologist and educator, describes how children can be over stimulated by 'screens' and may be losing out on in-person social skills as a result. Through anecdotes and interviews with children, she describes that children (even babies) notice when their parents use devices and are distracted by them [45]. This reduces the necessary physical and emotional connections that children need for cognitive and social development [13,45].

Despite the above research, no studies to date have investigated situations in which people use mobile devices in their home while in the presence of other family members, what factors lead to such behaviors, and the potential strategies and workarounds people use in attempts to mitigate potential issues or social tensions.

Technology Non-Use and Slow Technologies
Research has also begun to explore people's desire to limit their technology usage [2,41]. There is an increasing sense in Western society that life is busy and people struggle with anxiety, guilt, and a loss of autonomy over their time [6,19,43]. This is despite the use of time management and productivity tools that aim to help people feel less burdened with time [19,43]. Lindley [22] describes how humans' sense of time has changed across history and how we now live a life of busyness, trying to fill time and do more. There are even efforts to design for slowness, disconnection, solitude, and mental rest [11,33,34]. Studies have explored people who have tried to reduce mobile device usage, including the use of social media or email, but it has repeatedly been shown to be challenging to do [12,18,24,44]. Our work builds on these topics to explore how family members in our study were able to avoid social challenges when using their mobile devices at home.

STUDY METHODOLOGY
The goal of our study was to understand when and why people use mobile devices when at home and in the presence of others, how this affects co-present family members, and what strategies people employ, if any, to reduce behaviors perceived to be negative. Participants completed diaries and participated in semi-structured interviews in which they reported on how *they* and *other* household members used their mobile devices when present with others at home. We focused on mobile devices such as smartphones and tablets at the exclusion of other portable devices such as laptops because mobile devices tend to be more ready-at-hand to be used sporadically [50].

Participants
We recruited 20 participants (11 female) from various locations across North America using snowball sampling, advertisements on Facebook and Twitter, and word of mouth via email. Our recruitment messages deliberately called for people who may be feeling tensions over mobile device usage in their home, as well as those who used mobile phones in the presence of family members. Thus, our sample is likely biased in this regard.

We selected participants with a highly varied cross section of family types. Participants ranged in age from 20 to 60 years old. 7 of 20 participants lived in homes with at least one child, three had two children, one had three children, and three had one child. The ages of children varied between infants (less than one year) and teenagers (up to 18 years). 7 of 20 participants were adult children living at home with parents and/or grandparents. The remaining 6 of 20 participants were couples that were either married or living together – one was an empty nest couple. The ethnicities of participants included Caucasian, Chinese, Persian, and African, and all spoke fluent English as either a first or second language. Occupations of our participants varied widely and included social workers, researchers, web designers, pizza deliverers, archeologists, students, and business people. All participants fell within the middle class. Eleven participants owned an iPhone (one owned two: one for work and one for home) and nine had Android-based smartphones. Two people had owned smartphones for 1-2 years, seven owned them 2-5 years, and ten had owned smartphones for more than 5 years. Thirteen people owned a tablet and the remaining participants did not. All participants received $50 for participating, which we felt was a reasonable motivator for a study lasting ~2 weeks.

Ethical Concerns
We were highly concerned about the ethics of our study and the social welfare of our study participants. We did not want the study to produce negative effects for our participants' relationships and raise social tensions. Based on ongoing discussion of these issues and through our research ethics protocol review, we decided to focus on only one participant from each household so that the study could be done somewhat covertly within a family, if desired.

Having multiple participants from the same household would have provided corroborating (or even contrasting) evidence of behaviors, however, we also felt it would have had the potential to increase social tension. For example, if both partners in a family were study participants, they could have easily started discussing the study and, perhaps, become agitated by the activities and opinions of the other since they would be analyzing each other's behaviors. Thus, our method allowed us to start with a relatively unobtrusive, descriptive approach to open up the research space and articulate salient issues for future work. Indeed, future research might adopt a less unobtrusive approach where, for

example, multiple family members are a part of the study and commenting on each other's behavior, but we first wanted to develop sensitivity for the research space as a whole. This would enable future research to know what areas of mobile device usage might be considered to be problematic, which could help guide future studies so they are cautious when studying these specific areas of usage.

Method

1. Survey: Participants completed an initial survey about their mobile device usage. Information collected from this survey provided insights into the family's communication routines in addition to preparing the participants for the subsequent diary and interviews stages of the study.

2. Diary: Participants kept a diary of their mobile device activities around the home as well as those of their family members for a period of two weeks. The diary was online and accessible on mobile devices as well as computers. The diary was open ended and asked participants to 'tell a story' about their mobile device usage and that of their family members when they were co-present. We also asked participants to report on their feelings about this usage with questions such as, "how did behavior make you feel?", "did anybody react to your behavior? If so, how?" At this stage, we did not want to prime their responses to focus on any one particular facet of mobile device usage. Instead, we wanted them to understand how mobile device usage and behaviors might be affecting them and their family.

We asked participants to focus their diary entries on the times when mobile devices were being used when others were present at home and in the same area as them, as we suspected these would be the times that were potentially most frustrating. We wanted to initially focus around one specific type of location (the home) to understand it specifically. Future work should consider additional locations.

While diary entries are best written 'in-the-moment,' to not increase mobile device usage unnecessarily when co-present with others, we asked participants to complete their diary entries as a reflective act when others were not around, at any point in their day. When pilot testing the study, we tried a longer diary period (e.g., three weeks), however, it was found to be too long to commit to commenting on one's device usage. Two weeks generally covered a wide variety of situations (e.g., the likelihood of several family meals, both work days and weekends) and did not feel overly long. The most diary entries completed was eight with the majority of participants completing four or five entries. Most entries were a sentence or two long for each question. While the number of diary entries does not reflect the likely high number of instances of mobile device usage in the home, it is likely indicative of the challenges with recording thoughts on one's device interactions amidst the many other things happening as a part of domestic life. For these reasons, our data relies heavily on the final interviews, which we describe next.

3. Final Interview: After the diary period, we conducted semi-structured interviews with each participant individually. These lasted between 30 and 60 minutes and were done using a Skype video chat call [12]. We purposely did not travel to participants' homes as, again, we wanted participants to feel like they could openly and honestly discuss the mobile device usage of their family members. Skype calls afforded the opportunity to take the call from a private location in one's home without the presence of a researcher, which could easily draw unnecessary attention. This also gave participants the opportunity to call us from work. Whenever possible, we had participants describe their home setting to us, and even show us some locations using the video chat camera.

Prior to each interview, we reviewed each participant's diary entries to note any focal points that we should ask participants about during their interviews. Thus, the diary entries informed and guided the interview process. Interview questions focused on understanding the participants' family dynamics, the ways in which they and other family members used their mobile devices in the home, how they felt about such usage, if they thought their behavior was appropriate, what happened if their usage was interrupted by others (adults, children), and if they thought they should change their behavior. For example, we asked, "Can you walk me through yesterday and describe the different times you used your mobile device when at home?", "How do you think other members of your household feel about your mobile device usage?", "Do you think you should change your mobile device behavior? Why or why not?", "Do you do anything to reduce your mobile device usage?" Questions were purposely asked in an order that did not presuppose overusage of devices or suggest that mobile device usage should be considered problematic; this detail was carefully pilot tested.

Naturally, we would have liked to directly observe participants' behaviors. However, we felt strongly that any such attempts to conduct observations in the home could cause participants to change their behavior or lead to undesired tension amongst family members.

Data Collection and Analysis

We kept handwritten notes and audio recordings of all interviews and transcribed relevant portions of the audio. We performed thematic analysis of the diary entries and a coding process on all of the interview data. This involved categorizing participant responses using open and axial coding by the lead researcher, and then drawing out main themes with selective coding, performed by multiple researchers on the project after reviewing the generated codes. Our high level coding categories related to the types of activities that were performed on mobile devices, how people knew what others were doing on their devices, the ways people tried to mitigate problems when using their devices, feelings associated with mobile device usage, the ways in which people felt they should change their

behavior, and the mobile device design factors that were likely affecting behaviors. We explore these topics next. Quotes from participants are listed with a P# followed by demographic details such as how many children they had, if any, or if they were adult children living at home.

WHY PEOPLE USED THEIR MOBILE DEVICES

Aside from having to do planned work on a mobile device, various other factors prompted mobile device activities. Here we describe participants' *own* device usage and their feelings about it. In the next section we describe participants' reactions to usage by *their family members*.

First, device notifications such as chat message alerts, incoming calls, or incoming messages prompted device usage. Several participants talked about feeling compelled to offer near instant responses to incoming messages, emails, or Facebook conversations.. Such messaging could then turn into longer conversations where people felt compelled to respond. When participants would check notifications, they would sometimes engage in other additional activities that were related or that they thought of once they were on their device.

Second, boredom sometimes prompted mobile device usage. For example, if conversations with collocated family members were at a lull, someone might pull out their phone to occupy his or her time. Participants generally saw this as a benefit since it gave them an opportunity to use their mobile phone when it felt like others were not interested in talking to them.

Third, participants talked about the need to periodically find out information in a group setting, such as looking up a park or recreation center where the family was interested in going, a news report, or upcoming weather. This type of activity was often seen as usage for the 'greater good' (e.g., helping the entire group out) and, thus, it was thought to be acceptable. For example, P15 talked about looking up information for others at the dinner table as beneficial act:

"I used my phone to look up the distance to Jasper while in conversation with others around the table. I wasn't sure how long it would take to drive there. I told them 'I'm not sure how far it is... hold on, I can check.' I got out my phone…and looked it up." – P15, Diary Entry

Overall, participants reported that as long as they were using their mobile devices in a similar manner to people around them, then they did not see a problem. Participants told us that most of the activities they did on their mobile devices were not urgent and it would be fine if others interrupted them. Activities considered to be 'light,' such as checking email or looking at social media, could be easily interrupted, whereas 'heavy' tasks such as reading were difficult to interrupt.

REACTIONS TO THE DEVICE USAGE OF OTHERS

Participants described a mixture of reactions to the mobile device usage of their family members.

Social Disconnect, Frustration, and Conflict

When participants felt that their family members' mobile device activities could wait until later—regardless of what they were doing on their device—they described feeling socially disconnected from those around them, or being frustrated or bothered by the way in which others used their mobile devices in front of them. Couples described feeling excluded or ignored as a result of mobile device usage. Other participants described trying to talk with their partner while he or she was on a mobile phone and being ignored or having to call the person's name several times to get his or her attention.

"I get frustrated when my wife uses the phone while we are watching TV shows." – P5, Male, Child Age 7 Months

"We were cleaning our house when I realized that my partner had stopped doing his chores and was on surfing on his phone. ...I thought the action was rude and his behavior infuriated me." – P16, Female, Adult Couple

"There's probably been a couple of times, like if I got frustrated with my wife being on the phone, using the phone while I'm talking to her, and she claims that she's paying attention, but I don't think she is." – P4, Male, Child Age 2

"[My husband] had a couple of these games where you have to go on and participate in these different phases of battles, or something. I don't mind most of the time, but sometimes the phase of the battle he has to participate in happens during dinner or when we're out with the kids, and then I watch it, and he thinks he's not distracted, but he is." – P3, Female, Children Ages 1 & 4

While we are not able to understand the longer term effects of such activities on one's relationship, it was clear from our data that people had strong feelings in-the-moment and later that day when writing about the situations in their study diary. They described negative feelings that had been building over time (prior to the study) and continued to bother them.

"[My partner's] usage makes me mostly feel frustrated because, yeah it's hard to get him motivated, so I feel like it's wasting time. Then sometimes it makes me feel sad for the opportunities that he's missing with the kids or it makes me feel sad for the kids that they're feeling ignored." – P1, Female, Children Ages 2 & 5

All participants with children felt that mobile device usage affected parenting. Children were reported to notice when their parents were using their devices and not paying attention to them (also found by [40] in restaurants). They described delayed reactions to children's needs by their partners and, admittedly, by themselves (also found by [13] in playgrounds). Two participants used their mobile devices as leverage for taking on parenting duties or not.

"Sometimes when the baby is crying I pretend to be busy but have to eventually look after the baby." – P5, Male, Child Age 7 Months

Six participants (3 young adults living with their parents, one couple, and two partners) talked about their family members telling them to use their mobile phone less. On the other hand, ten participants felt that their family members should reduce their mobile phone usage. Conversations with family about such usage were considered challenging because they could easily create more conflict (e.g., arguments) rather than resolution. Many avoided such conversations altogether for that reason.

"While his notification was set to vibrate, it was so strong that you can still hear it go off. The fact that the notification kept on going "added fuel to the fire" which resulted in a mouth off again between myself and him." – P14, Diary Entry

"Well having the phones at the dinner table was a huge source of conflict for a while, it was just constant, "Why is your phone at the table? Turn your phone off. Put your phone away." Then if it were a day where I took my phone to the table, it was, really, "Why do you get to have your phone at the table? Put your phone away, that's hypocritical." - P1, Female, Children Ages 2 & 5

The Common Good
Seven participants found the mobile device usage of their family members to be highly beneficial when the activity being done was considered useful to the family more broadly. For example, mobile device usage to look up locations for a family picnic or another outing were not considered to be problematic. These were seen as beneficial acts for others. In another case, a participant's husband did not want to spend time chatting in a WhatsApp group chat amongst extended family members. He was therefore fine with his wife chatting on her phone so that she could share the news from the group with him.

Desirable Disengagement
There were cases where technology usage also provided other family members with some alone time. For instance, one participant described how he could focus on his snack and not feel obligated to talk to his parents because they were on their mobile devices.

"I felt happy to be able to enjoy my snack without feeling obligated to talk." – P13 Diary, Male, Adult Living with Parents

P5, a parent, described how she would let her young children play on a mobile device as a way to get herself some 'free time' to engage in adult activities like cooking, cleaning, or work at home (also found by [40] in restaurant settings). She felt this was not the ideal situation but it benefitted her in the moment.

THE PRIVACY OF MOBILE DEVICES
Mobile devices are inherently personal in nature and this affected how people understood the mobile device activities of their family members.

Assumptions and a Lack of Awareness
We asked participants what activities their family members did on their mobile devices, when, and where. Responses were very similar to our participants' own usage. Yet people admitted that they were often making 'educated' guesses about what exactly their family members were doing on their device. That is, they knew the general types of things that their family member did, but in any specific moment they would not know for sure what the person was doing on their device unless they showed them, asked about it, or walked over to check. The size of mobile devices meant that they were held close to people and the screens were not often easily visible, even from a few feet away.

"I guess my frustrations is around that because it's such a personal device that there's no way to show other people what you're doing, or for other people to understand what you're doing, or how long you're going to be, or how distracted you are… It's not like the computer like I'm on now, everybody can see what I'm doing over my shoulder, and that's nice sometimes because I can see when it will be done, or you can understand what's happening, but you can't really with personal devices." – P3, Female, Children Ages 1 & 4

In place of knowing exactly what others were doing on mobile devices, participants described "rules of thumb" that they held about what others' activities might be. That is, they felt activities could be predicted based on the context of usage, including body language, interaction styles, location, and knowledge of past activities. For example:

Body Language: P3 described how she knew in general when her husband was playing a game on his mobile phone vs. when he was texting others because of his mannerisms. Text messages were routinely with his teaching partner and were of a more serious nature; thus, facial expressions would be different.

Interaction Styles: P11 described how the interaction needed for text messaging was different (e.g., two thumb presses) when compared to playing games (e.g., single finger taps); this allowed him to know in general what his family members were doing.

Location: P10 (Adult Child Living at Home) said she knew what her mother was doing on her phone because of her location: When her mother used her phone next to the computer, she was doing work activities on it.

Past Activities: P2 said she knew that her three teenage children often used YouTube, SnapChat, and Facebook on their mobile phones because she had seen them at various points using the apps. But at a specific point in time, she would not know for sure which app they were using.

As can be seen, knowledge of the activities of others was typically very general. For some people, the specific activity did not matter. They still felt ignored. For example, if a person was text messaging with someone and it was

time critical, participants said it would not bother them. In contrast, if the activity was perceived as something that could be handled later, it was bothersome. The challenge was that they were not always sure which case the behavior fell into and they would often feel annoyed as a result. Some people had absolutely no idea what their family members were doing on their devices; this most often occurred for siblings who lived at home and figured that their brothers or sisters required privacy when communicating with their girlfriends or boyfriends.

In most cases, even when a person did not know for sure what his or her family members were doing, participants assumed that the activity could wait until later. Thus, they felt that the mobile device usage was a behavioral issue rather than something that might actually require immediate action. This suggests a type of fundamental attribution error: participants tended to explain undesirable behavior as having to do with their family members' personality instead of considering the other factors that might be affecting the family members' desire to use their mobile device at that point in time, such as the actual urgency of a task. Conversely, ten participants' felt their own behaviors were reasonable given contextual factors such as urgency.

Private vs. Public Activities
We asked participants if the activities that they did on their mobile devices were indeed meant to be private, or if it would be fine for family members to have a broader awareness of just what they did on their devices—as a means to potentially lessen frustrations. In cases where young children were involved, parents did not want them to see Facebook posts since the content may not be age-appropriate. Seven spouses generally said they were fine with their partners seeing what they were doing on their device, as most activities were benign. However, the caveat is that they may have different desires in actual practice (e.g., it's easy to say one thing but do another).

"I think it would be fine if she looked into the stuff I was doing and same for me." – P17, Female, Couple

Two participants described how they would purposely share items that they were looking at with their partners. For example, P5 said he would routinely share YouTube videos with his partner by 'sending them' to the Blu-ray player connected to his TV that was mounted in their living room. In this way they transitioned from a personal to group activity by being displayed on a large TV. Other times his wife would share Pinterest pages with him.

Nonetheless, a small number of participants did not want the specifics of their mobile device conversations or activities to be seen by their partners. Six different adult children participants that lived at home with their parents or siblings were more concerned about keeping their mobile device activities private. This was because of their desire to preserve privacy in support of feeling more independent in their personal lives.

STRATEGIES TO AVOID CONFLICTS
Many of our participants talked about actively using strategies to help avoid conflicts that might occur as a result of mobile device usage being perceived as inappropriately timed or excessive.

Regulated Interactions
First, five participants said they purposefully regulated the amount or duration of their interactions. This was sometimes done with software settings in applications or the phone where notifications or availability statuses could be changed to reduce incoming content. For example, P9 set her status in the messaging application, WhatsApp, to be 'invisible' so that people could not tell whether she had read their messages or not. She felt that this allowed her to not have to respond right away.

Other participants would try to only have very short interactions in an effort to quickly return to their current activity after checking their device. For example, P20 told us that he would quickly glance at incoming messages and then put his phone away to avoid splitting his attention when watching a TV show with his wife. Some participants were simply able to not use their devices when others were present through sheer willpower.

Awareness through Talk Alouds
Second, four participants would use 'talk alouds' to describe to others present what they were doing. For example, a family member might mention out loud what she was about to do on her mobile phone before she did it so that others would know and hopefully be satisfied with her behavior. P10 would sometimes say aloud who she was going to text before she did it.

"I often put my phone on speaker when I want family members to know what I am engaging in using my phone. Other times when I am in a private conversation I constantly remind them that I am listening to them but just talking to a friend." – P10, Adult Child at Home

Other participants talked about verbally letting those present know when they were going to look up information, what they were looking up, and what the results were. For example, if someone asked about a news story during dinner, one family member might say that he was going online to check out the latest details and then tell the family once he found the information.

This type of verbal awareness was also sometimes used with remote callers. For example, P16 would sometimes answer her phone during meal times and then quickly let callers know that she would get back to them after she was done eating. This was because she valued her mealtime with her fiancée but did not want the caller to feel neglected.

Mobile Device Placement
Third, three participants reported that they would strategically place their mobile devices in locations that made it more difficult to use them or receive notifications.

Thus, they understood the effects of having their devices close at hand or in their pocket—which often meant more device usage—and would try to avoid such situations if they did not absolutely need to be on their device. For example, P1 sometimes left her phone in a location that was not conducive to checking it, either accidentally or on purpose. She welcomed this lack of usage, but at times found it hard to do because she felt there was always a chance that an important call might come in and she would miss it.

"I think for me it's that if I don't have the phone with me, [for example] if I [left] it in the car, [...] in the diaper bag, [or] even downstairs and I'm upstairs with the kids, then I don't use it and I don't need to look at it." - P1, Female, Children Ages 2 & 5

No Strategies
Five participants said they did not have any strategies to avoid potential issues with mobile device usage. They had either not developed any or felt that their usage was fine.

"I use my phone while around the table and they usually do not seem to mind. This is because they will be talking but whenever they need my attention I put the phone down and answer them. I think people should only use the phone when something important pops up. Also, during meals we all watch TV and quickly check phones and put them back." – P12, Adult Child Living at Home

GUILT AND CHANGING DEVICE BEHAVIOR
Only three participants felt that their mobile device usage was 'worse' than their family members' usage. The other participants compared themselves to the people they lived with and felt others were using their mobile devices more, and were less self-aware of this usage. That is, participants' considered their own behavior to be a result of external factors (e.g., the requirement to respond to messages quickly) rather than misbehaviors that were a result of personality or behavioral issues.

Even still, participants were frequently thinking about how other family members perceived their attachment to their mobile phones even when they were not receiving judgmental comments from others. Participants were divided on whether they should change their existing mobile device behavior. Eleven participants felt that they should change their mobile phone behaviors for various reasons. These ranged from changing phone behavior to create more time to attend to parenting duties to doing it just to be nice around others.

Nine participants thought their behavior was fine and did not need to change. For example, P7 did not think he needed to change his behavior as none of his family members had said anything to him about it being too excessive. However, they may have easily been 'holding back' for fear of introducing conflict. P10 was generally fine with how she used mobile devices but occasionally experienced feelings of guilt when around family members. She rationalized her lack of needing to change her usage patterns because of her relative 'newness' to a smartphone:

"I also think that I should not change my behavior yet since I only got a smart phone last year mainly to talk to my parents." – P10, Adult Child at Home

Other participants had similar rationalizations as to why their high mobile device usage might be okay, even if they received comments from other family members about it. Again, they tended to think their behavior was a result of external factors, rather than their own personality.

Half of our participants wanted to decrease *their family members'* usage in addition to their own. Thus, reducing usage was seen more as a group or couple activity, rather than something that was individual in nature. Typically participants who wanted to change their behavior did not necessarily know where to begin (also found by [13] in playground settings with children). Others felt that it might be hard to put their mobile phone away in case emergencies arose; they worried about missing important items.

DISCUSSION AND IMPLICATIONS
We now discuss the implications of our study with an emphasis on how we might think about mobile device usage and the design of such devices. Our study revealed that the usage of mobile devices at home among others can produce a range of benefits and drawbacks. People used mobile devices at home in ways that produced a range of positive outcomes. Many felt a strong need to stay connected with others and respond to communication exchanges quickly, look up information online in a timely fashion, and perform intermittent work activities while at home. Mobile phones even afforded a sense of social disengagement to find time for oneself amidst the other everyday happenings taking place in the home. They also allowed family members to engage in activities that were deemed as being helpful to others. These are clear benefits.

However, our study also surfaced problems associated with mobile device usage as frustrations and tensions emerged for family members when mobile devices became the focal point of one's attention more than the family members around them. We see these frustrations as an entangled social issue afforded by people's desires to stay connected and acquire timely information and a design issue as such behaviors are often shaped by key ways in which mobile devices and applications are currently designed. For example, notifications indicating that a person should return to a mobile game to advance in a level subtly suggest that she or he ought to attend to such requests. Many of our participants over time felt such attention was required immediately. A similar issue exists with notifications of instant messages or social media posts where people receive 'alerts' that can be seen as social proxies for people that they ought to not ignore.

It is clearly not easy to change social practices in the home, nor should we necessarily aspire to do so. Nonetheless, our

study has sensitized us to areas of mobile device design that could offer promise for reducing the social tensions and frustrations that can and do emerge in the home around mobile device usage. We raise these next as design issues contextualized within an understanding of the unique workings of domestic life. Our goal is to offer insights into the areas of mobile device design that could offer promise for design interventions. Our high level goal is to enable people to engage with the beneficial practices of using mobile devices, while alleviating the frustrations that sometimes arise around such behavior. We purposely steer away from posing specific design solutions as not much is known about this sensitive space and further design exploration is first required. Our insights point to open design issues aimed at motivating and structuring future research and practice initiatives.

Device and Application Notifications
It is clear from our study that there is a strong need to reconsider the ways in which notifications and alerts are used to engage with people. These were one of the main drivers behind mobile device usage when in the presence of others, which shaped people's behaviors regardless of the degree of urgency in dealing with notifications. Of course, smartphones now come with means to turn off notifications or set one's phone to 'Do Not Disturb.' In this case, a series of user-defined rules can dictate which notifications or people are able to penetrate 'the notification shield.' A small number of our participants had tried such features. However, the challenge with these kinds of tools is that they are overly simplistic and situate mobile device usage in the home as a binary choice between being 'on' or 'off,' or a series of rules that dictate domestic interactions and communication.

Family life is far more complex than such designs or rules suggest. Families have developed careful organizational routines that allow them to regulate the flow of information into and out of the home and between people within it [7,10,29,47,48]. The suggestion that one could regulate and even pre-plan domestic communications with rules or turning one's phone notifications on or off neglects to realize how dynamic domestic life is and the nuanced routines families have developed to support it. The creation of rigid rule structures for notifications could obscure the playful nature of family life where play is often intertwined amidst everyday activities [23]. For example, completely turning off notifications that promote periodic episodes of play (e.g., notifications from mobile games) may easily take away from the enjoyable activities they can promote.

That said, there is certainly an opportunity to redesign notifications to consider a broader set of contextual information such as who is around and what activities are occurring. For example, mobile devices might limit the functionality that is available after a notification is received such that the alert may be attended to without the user 'spiraling' into other device interactions simply because

they are available (which was a common occurrence among our participants even if it was undesired). Yet, this type of redesign strategy requires care and may still be overly simplistic given the many nuances of family life that are ever-changing. Such nuances may not easily map to computational algorithms. Notifications on wearable devices may offer promise for better balancing mobile device usage since people can quickly glance at a watch, for example, to see what information is incoming without having a high degree of flexibility for further interactions. However, this too would need to be handled cautiously.

Overall, there is an opportunity to redesign mobile device notifications, but it is clear that simple on/off modes, predefined rules, and context-aware features may not fully support producing real change without disrupting the social organization and routines of the home. This raises design questions such as what functionality should be made available when a notification is presented? How public should the notification be? Where should the notification be displayed to encourage improved social etiquette? Are wearable devices, such as watches, a better location for notifications or, over time, will they fall victim to the same social tensions that exist for mobile phone notifications?

Activity Awareness
Our study highlighted the many awareness challenges that family members face when it comes to mobile device usage. Most mobile device usage appeared to be similar in nature and it was often hard to deduce what someone was doing and whether or not it was 'important enough' to require immediate attention. This caused people to assume they knew what their family members were doing on their mobile devices and they often felt that device usage could wait as a result. This suggests a clear need for better activity awareness so that family members can make informed judgments about what others are doing and, possibly, even discuss the usage with *actual* knowledge of device activities rather than assumptions.

For example, we were intrigued by the way some participants were using talk alouds to share an awareness of what they were doing on their mobile devices with family members. This suggests that further usage of voice recognition and personal assistants (e.g., Apple's Siri, Amazon's Echo) rather than touch interaction on mobile devices may provide a more fluid way for people to share an awareness of their mobile device activities since others can easily hear what a person is doing on his or her device if interactions are spoken aloud. Yet, this idea raises the new questions about potential unintended consequences that could emerge. If people had more voice interactions with mobile devices, would this disrupt the normal act of conversing in the domestic setting and, if so, how? Would conversations migrate from exchanges between people to exchanges between people and devices, or even devices and devices? Could this trend result in people talking more to their mobile phones than to those around them?

There is also an opportunity for interaction designers to explore the more public and situated display of personal content in the home. Researchers have previously explored using watches as glanceable public displays for those nearby, though some people feel looking at another person's watch during conversation is not socially acceptable [37]. Another approach, found in our participants' practices, involved connecting mobile phones to TV displays to share content. Designers could develop new ways of more fluidly transitioning content between personal mobile devices and large shared displays that might better afford interactions by multiple family members, if the activity is deemed to be of a more public nature. Researchers have considered such design interventions in public settings (e.g., Billboard [17]); however, this strategy has not been explored in the context of the home. This approach could present a way for family members to share what they are doing on their mobile device with other co-present individuals. It may even promote a better sense of self-reflection among family members of their own mobile device behaviors.

While beneficial for awareness, these types of ideas certainly raise privacy issues. How might family members react to having their personal content more broadly visible to other family members? In what situations should content be made visible and what content should be made visible? Is it enough to know that a family member is having a conversation on Facebook, but not see the specifics of the conversation? While the idea of sharing mobile device content using large shared displays is promising, there are many design issues that would need to be explored with a careful aim at balancing privacy, awareness, and (un)wanted self-disclosure. Many participants in our study told us that they generally felt their mobile device usage was not private and could be shared with family members. Yet whether this holds true in actual practice is unknown. Such public display of one's personal interactions could detract from the benefit of mobile devices providing people with a sense of disengagement from those around them. This raises an open design issue well suited for future interactive design interventions and explorations.

Work/Home Life Balance
On a higher level, our findings point to the continued challenge of work/home life balance. Many participants performed work activities on their mobile devices when at home and, even though family members tended to understand that these acts were more urgent in nature, they still produced frustrations. This suggests there is a need for continued efforts in developing ways to better manage work/home life with mobile devices. For example, how could mobile device applications better support segregating work content from personal content on devices, or more gracefully helping people to integrate their work and home life while alleviating social tensions? A key design challenge is that 'work time' and 'home time' are not necessarily distinct [19] and a person or family may value

some interplay and overlap between the two. This suggests an opportunity for future work to explore new strategies for designing mobile devices that offer people more extensible capabilities for blending alerts and notifications to their own temporal rhythms and porous home/work boundaries.

Limitations and Future Work
We recognize that our study is not without its limitations. We did not collect data from multiple family members. This prevented us from hearing 'the other side' of the story from family members and our results largely report on the reflections of our participants. Thus, while there may be an 'attribution error' when it comes to explaining family members' mobile device usage compared to one's own, data from family members' may be needed to corroborate such a finding. There is an opportunity for future studies to develop ways of carefully collecting data from entire family groups as a means to more fully understand their domestic situation. Participant pools could be extended to include children or teens, situations that occur outside of the home (e.g., at sports practices, malls), or rural locations with less access to Internet connections. Our study should be considered as a foundation for motivating and guiding future research and practice initiatives in this space.

CONCLUSION
Our paper explores factors shaping how and why family members use their mobile devices when at home and in the presence of others. We found that people often became frustrated with their family members for using personal mobile devices when they were collocated. In most cases, our participants' assumptions were that collocated mobile device usage could wait until later because of its perceived non-urgency. Yet people often guessed at what the person was doing on her or his mobile device rather than really knowing. Thus, family members lacked awareness of one's actual activity and its potential meaning, purpose, or time-sensitivity. Overall, these results point to ways in which mobile device software, including both applications and operating systems, might be designed differently to help support alternate behaviors by family members that may reduce social tensions. This might involve family members being more aware of what others are doing on their devices, as well as opportunities to support self-reflection on mobile device usage. Ultimately, we hope this study will inspire future research into how mobile devices might be better designed to become more meaningfully situated within domestic life among family members in the future.

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