

Understanding parents’ concerns with smart device usage in the home

Aarathi Prasad¹, Ruben Ruiz¹, and Timothy Stablein²

¹ Skidmore College, Saratoga Springs, NY

² Union College, Schenectady, NY

Abstract. Several studies have been conducted to determine parenting strategies in the age of digital technology. However, we are not aware of any qualitative research regarding parents’ safety and privacy concerns about their children’s use of smart devices in the home. Given the rise in use of smart devices within the home in general, and among children in particular, we wanted to explore the privacy and safety concerns that parents have about their children’s device use, their experiences using devices with their children, children’s independent use, and restrictions parents place on device use. In this paper, we present findings from an exploratory study of 29 participants through three focus groups and 14 semi-structured interviews. Our study revealed that encouraging device usage may help build familial relationships and foster open communication between parents and children. We also discovered that parents feel it is their responsibility to keep their children from harm when they use smart devices, and that parents do not trust applications, devices, smart device manufacturers or Internet providers to do so. Our findings can help researchers better understand the different device usage scenarios, parents’ concerns about their kids’ device use, and parent-child relationships, which will help them design better tools that encourage parents and children to work together to develop device usage rules and better safety and privacy practices.

Keywords: smart home, smartphones, tablets, children, privacy, trust, security, safety, family

1 Introduction

A survey conducted by CommonSense Media discovered that the number of 0-8 year olds using smartphones have increased from 45% in 2011 to 95% in 2017, tablets 8 to 78% and their own tablet from <1% to 42% in the home [5]. Smart devices have been shown to be useful to child development, and as such, electronic books, tablets, and laptops are used in classrooms across the nation [25, 8]. For example, over the years, researchers have explored different ways to use smart devices to determine whether a child has a learning disability or a developmental disorder [1], and also to enhance children’s learning ([4], [10], [20]). On the other hand, media is rife with stories about the negative impact of smart

devices and applications (apps) on children ([22, 21, 23, 19]). Nonetheless, a national survey of 2300 parents with children under 8 demonstrated that only about 30% of parents were very or somewhat concerned about their children’s media usage, and only 3% admitted that media usage caused conflict in the home [28]. Researchers have also addressed concerns about addiction [18], and smartphone safety [29], which raise additional concerns about the well-being of children when using smart devices.

Smart device proliferation within the home, and virtually all aspects of our social and personal lives also raises questions about the confidentiality and security of information transmitted and collected through them. Prior research has explored ways to help users better manage their privacy when using smartphone apps [2, 24, 3]. Researchers have also demonstrated the risks and recommended ways to mitigate risks when using smart toys [31, 14]. Researchers also interviewed experts on teen online behavior, risks and risk mitigation strategies [13]. But there is still a lack of understanding of the security, privacy and safety concerns that parents have about their children’s smart device use.

We conducted an exploratory study to understand parents’ concerns about safety, security and privacy, children’s interactions with devices, and restrictions parents placed on device use. Through focus groups and semi-structured interviews, we address the following research questions:

- How and in what contexts do children use smart devices?
- What kind of security, privacy and safety concerns do parents have about their kids’ device use?
- What restrictions do parents place on their children’s device use?
- How does smart device use affect familial relationships?

In this paper, we present our findings from the focus groups and interviews. Our findings reveal different device usage scenarios, parents’ concerns about their kids’ device use, and how device use affects familial relationships.

2 Related Work

In this section, we present prior research on understanding children’s smart device usage, and parents’ concerns about the device usage, as well as studies on how to protect child safety on the Internet.

Children’s device use: Common Sense Media conducted studies about media-use patterns among children from birth to age 8 in America as well as surveys about people’s use of media use (twens, college students, and adults) [5, 6]; the research showed that media use was a source of tension among parents and children, and that the latest technologies, such as smart toys, often appear first in households with young children. Moreover, Manches et al. analyzed social media sites, conducted home visits to observe children’s use of smart devices and conducted workshops to explore children’s understanding of video games [12] and discovered that parents and children do not necessarily understand how

technology captures their activities. Finally, Magee et al. used diary studies, interviews and creative activities to understand how teenagers use technology and how factors such as relationships and life goals affect their technology use [11].

Concerns about device use: A 2016 survey from Common Sense Media found that 50% of teenagers felt addicted to their devices, and 78% checked their devices at least hourly [6]. However, teenagers also had privacy concerns. For example, researchers conducted a two-month, web-based diary study to understand teenagers’ online risk experiences when browsing the web on their computers and mobile devices and discovered that teenagers rarely communicated their concerns with their parents [30]. Prior research also offered insights of differing views of parents and children about device use and presented the need for technologies that can support ways to reach agreements on device usage restrictions [15]. Additionally, researchers conducted semi-structured interviews with parents and children to understand their privacy and interaction expectations from Internet-connected toys [14]. Researchers also discovered security and privacy flaws in smart devices. Manches et al. found that commercially successful IoT designs such as the Skylander and Disney Infinity influence children’s attitudes and behavior and also reveal information about their daily activities [12]. Valente et al. discovered security flaws in Internet-connected toys [26].

Safety measures and parental controls: In addition to discovering security flaws and privacy leaks, researchers also proposed ways to mitigate risks. For example, Yong et al. proposed risk mitigation strategies against online pedophiles when using Internet-connected robot toys [31]. Prior research has also presented ways to improve security and privacy controls on smart devices. For example, researchers have provided recommendations for mobile apps for online safety that embed better family values [29]. McReynolds et al. gave recommendations for Internet-connected toy manufacturers and policy makers that take into consideration security, privacy and better child-toy interaction [14]. Jang et al. presented design recommendations for IoT device manufacturers to provide fine-grained access control and authentication to multi-user devices in the home [9]. Finally, researchers have also interviewed experts on teen online behavior, risks and risk mitigation strategies and proposed solutions to promote online safety while protecting teen privacy [13].

Our work will complement existing work by exploring different device usage scenarios, presenting parents’ concerns about their children’s safety, security, and privacy and how and why parents control their children’s device usage.

3 Methods

We recruited participants for our exploratory study via flyers posted at childcare centers, and public places such as schools, bookstores and public libraries and via campus-wide emails (at the authors’ respective institutions) and emails sent personally to friends and family. Participants were given \$10 Amazon gift cards for their participation. We conducted focus groups and interviews with 29 parents

about their concerns regarding their kids use of smart devices (mainly smartphones and tablets) in the home. We conducted interviews in addition to focus groups, since we expected some people to not divulge their true behavior when in the company of others in the focus group because of societal expectations.

Prior to the focus group discussions and interviews, participants were also asked to fill out a brief survey to collect demographic information including, age, sex, race/ethnicity, income, occupation, education level, family form/marital status, number of children, and questions concerning their smart device experience.

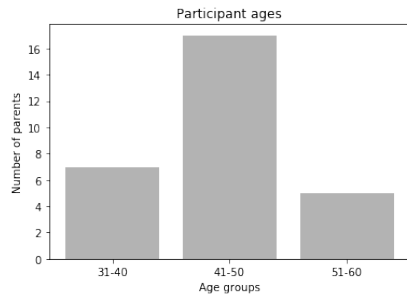
Out of the 29 participants, 25 were female, and 4 male. 17 out of the 29 were between the age of 41 and 50; detailed age ranges are shown in Figure 1a. 24 identified themselves as white, 3 as Asian, 1 as Hispanic or Latino, 1 as white, black and American Indian and one did not wish to disclose their race, as shown in Figure 1b. All the participants had at least an Associate degree; 2 had Associates degree, 8 had Bachelors, 7 had Masters, 1 had a professional degree and 11 had a doctorate degree, as shown in Figure 1c. All participants were full-time employees and earning wages. 1 participant had an annual household income of \$35000-\$49,999, 5 between \$50000-\$749,999, 4 between \$75000-\$99,999, 10 between \$100,000-\$149,999, and 7 above \$150,000, as shown in Figure 1d. 26 out of the 29 participants were married or in a domestic partnership, 2 were separated and 1 was single and never married.

As shown in Figure 1e, 10 of the participants had one child, 12 had two children, 4 had three and 3 had four children. Out of the 29 participants, 3 had adopted at least one child. Figure 1f shows the age ranges of all the kids of the participants. In the case of all except one participant, the children lived with the parent participating in the study.

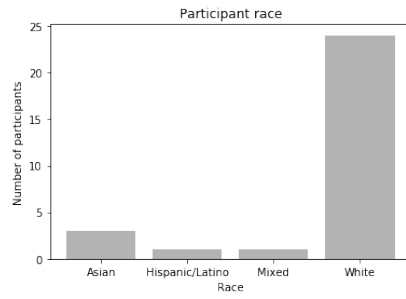
4 Findings

Except for one participant, all others had at least one smartphone in the home; the maximum number of smartphones in a home was six. Similarly, all except one participant had at least one tablet at home, the maximum number of tablets in a home was five. 15 participants had at least one gaming console and 11 had at least one smart assistant or appliance at home.

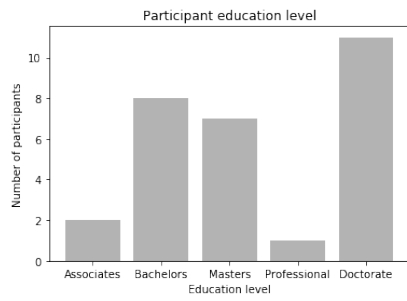
Device usage statistics: Out of the 28 that had smartphones at home, children used the participant or their spouse's phone in 20 households and children had their own phones in 7 households. Similarly, out of the 28 that had tablets at home, children used the participant or their spouse's tablet in 15 households and children had their own tablets in 16 households. Similarly, out of the 15 that had gaming consoles at home, children used the gaming consoles in 10 households. Similarly, out of the 11 that had smart assistants at home, children used the smart assistants in 6 households. Children in 20 households started using devices when they were less than 5 years of age, 3 when they were between 5 and 9, 2 when they were between 9 and 13 and 2 when they were between 13 and 18.



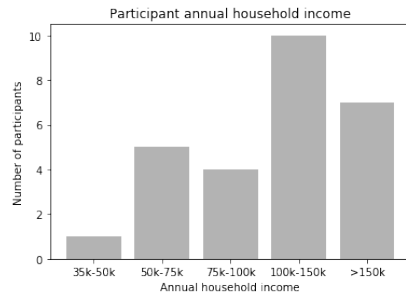
(a) Participant ages



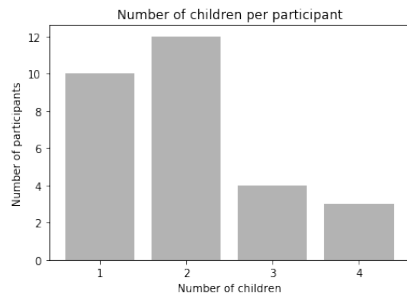
(b) Participant race



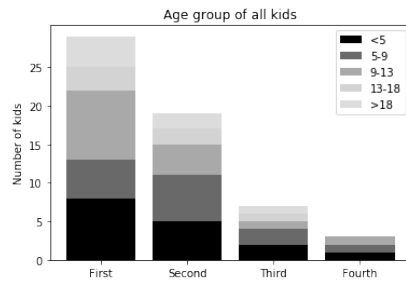
(c) Participant education level



(d) Participant annual household income



(e) Number of kids per participant



(f) Age groups of first, second, third and fourth kids

Exposure to devices: Some parents encouraged smart device usage since they found it helped their children. For example, one participant described how her son, who was on the autistic spectrum, used technology as a place of comfort where he was able to express himself without judgment. Other parents wanted their children to use smart devices so they could connect with their family and friends when they could not physically be with them; one participant said “[my daughter] can still be with all her friends who she grew up with [but who go to different schools] through the [online video] game.”

Parents also used smart devices to help them take care of their children. One parent noted, “technology becomes a baby sitter. They tend not to fight with one other, especially when they each have [a] device”. One participant also used an Internet-connected camera to check in on her son from her office, when he got home from school; “I see when my son gets home. He can talk to me through that. I can see he is sitting on his couch and doing his homework. He is not supposed to have anyone home.”

Most children learned about devices from watching their parents use it. Meanwhile, other parents did not want their children to be exposed to devices at a young age, so they often attempted to stop using their smartphones in an obvious way in front of their children. In these cases, young children still noticed when the parents used the phones even for a brief moment, for example, to play music. One participant said, “I try to keep the smart device completely out of her sight. But we are music people. So my husband uses [his phone] as [a speaker]. [Our daughter] recognizes his phone as a speaker. ”

Some parents were forced to expose their children to technology because of school work that required access to the Internet; the children of some of the participants went to schools that required laptops, as early as middle school. One participant said, “We don’t have screen time on the weekends. [But] then [when my daughter] has homework on the weekend, then its like restricting a textbook.”

Younger siblings started using devices at a younger age when compared to the older children. One participant gave phones to all her children at the same time; the older one got a new phone and the younger ones received their parents’ older phones. Children’s interactions with smart devices also changed with the evolution of technology; one parent reminisced how their child was first exposed to a DVD six years ago, and gradually went on to reading electronic books on a Kindle and then to browsing the Internet on smart devices. Most participants reduced restrictions on their children’s device usage when their children became older; one participant mentioned, “As they get bigger, his world gets bigger. We are realizing he needs [access to devices].”

Some parents hesitated buying technology either because they did not see the need for it, they were not sure if their children were old enough to be exposed to the technology, or they could not justify the expense. One participant said “Should we buy it because everybody has it, or should we make do without it. It was initially one of the reasons we were delayed in jumping in sooner. A combination of [my children] are too young and [the device] is expensive. ”

Parental concerns : Parents had varying concerns about the effect of technology on their child's physical and emotional development. One parent was concerned about device usage making her child lead a sedentary lifestyle since he spent most of his free time on his gaming console. She said, "We want him active, playing outdoors. I don't know if sitting there all day [in front of the gaming console] is good for anybody". Some parents were concerned about children using a smart device in the bedroom, as it may affect their sleep. Another parent thought the content was too advanced for her toddler and she was not benefiting from watching the videos; "The shows are going fast, and for her age, the images and characters might look fascinating but she gets nothing out of it. [...] Some of them are really cute shows they are perfectly fine, but they are moving rapidly so she might not be able to process." One parent was also worried about how the devices were affecting social skills as she had observed her daughter play online games with her friends even when they were in the same room. Some parents were also concerned that their children would be exposed to content that was not appropriate to their age, because of lack of regulation on certain apps such as YouTube kids. Parents also believed more time commanding smart assistants would take away politeness from their young children.

Some parents believed even though the devices provided instant gratification, they provided no long-term benefits for the children and also distracted them from the "real world". One participant said "[her son] can use his time to do better things [than use his device] to improve himself, of course." Another participant pointed out that children were often distracted by the devices; "I think it's one of those things that's good in moderation. The things he is watching are educational and that in and of itself are not bad. [However] he gets very into it, and doesn't notice the things going on around him."

Safety, security and privacy concerns: Many parents were worried about their children's safety on social media; some were worried about their children being stalked if they revealed their location information online. Several parents were concerned about their children revealing their location on cooperative games and location-based apps; one participant said, "[My daughter] will be like, 'I have a Snapchat Map and I know where my friends are,' and that's terrifying! I ask, 'Do they know where you are?' and she responds, 'Yes!' and I don't really like that!"

Some parents with younger children were not as concerned about privacy, since they did not think any data about their children were getting disclosed. A participant, whose child was still a toddler said, "That's just me as a person, I'm not that worked up about privacy stuff. I assume that everything about me is public knowledge, and for my kids, I think it's going to be even more true. But I'm not that concerned about privacy, especially because [my daughter] doesn't use it by herself yet. I'm not worried that she is gonna stumble down some dark-hole. As she gets older, I can imagine being much more concerned about safety, just who she is interacting with. But right now, I have zero concerns." Similarly another participant, whose child was playing single player games on the gaming console, said, "I think I'll have more concerns when [my son] is older, when he's

interacting with people. All the things that he does [right now] is just him viewing content or playing a game. There is no texting, no messaging. I'll be very concerned when he is able to interact with other people, because he may not be screening them the way I would." Another parent, whose children were older and were using smart devices to chat with friends, pointed out, "At this point, given they basically chat with their friends and play games that don't involve revealing their identities, I am comfortable. Once they want to do social media, then I will be more concerned."

Some participants' concerns about privacy was based on their own negative experiences regarding the unintended disclosure of their sensitive data. For example, one participant preferred to stay off any Internet-connected device because a family member's credit card was stolen. Many participants also expressed concerns about Internet-connected cameras recording sensitive video.

Most participants were also concerned with smart assistants being always "on". One participant said, "I am sure Google is listening and collect information about what is going on in everyone's homes, not to the level that it really concerns me. There is nothing going on in my home that is proprietary. They are hearing a family going about in their day to day lives. It's not like I'm shouting out my SSN." Another participant worried that smart assistants were listening in on people's conversations and getting to know them. One participant also mentioned how smart assistants disclosed personal information about her friend when she visited her friend's house; "Her wall device announced she has a package coming. I don't know if anyone coming to my house should know if a package is coming".

4.1 Parental control

All 29 participants said that they expected parents to be the most responsible for maintaining the safety of their child when using smart devices, compared to smart device companies, games or apps, or internet providers. Parents unanimously agreed that it was their responsibility to keep their children safe by monitoring their children's device use and by being more directly involved when their children used the device. Parents attempted to monitor their kids device usage either by perusing their search history or text messages, or by sitting with them when they were using the device or by being in the room and near enough to hear what their children were watching on the smart device.

Four parents said they had complete control in keeping their child safe when using smart devices, 17 said they had a good amount of control, 4 said they had some control and 4 had very little control. One participant said, "[Parental controls on smart devices] are capable with human oversight. I dont think the devices are inherently protecting the kid. With my oversight and my involvement, the parameters I set up are sufficient to protect [my children]." Another parent said, "I dont think it's the device, it's more the parent. They need to be more proactive."

Parents trusted the content of apps and devices that they were familiar with and had verified to be appropriate for their children. One parent said, "we know what games [our children] have, so they don't have to [play the games] around us." But

only two parents trusted smart device companies to protect their children from harm, while an overwhelming majority of 26 parents said they did not trust smart device companies to do so. Similarly, 25 parents did not trust applications and games and 27 parents did not trust Internet providers to protect their children from harm.

To protect their children, parents control their children's device usage by enforcing restrictions. A majority of parents restrict the time their children spend on smart phones and tablets; 19 parents enforce restrictions on smart phones and 22 restrict usage of smart tablets. 8 out of 9 parents restrict the time their children spend on gaming consoles. 1 out of 7 parents restrict the time their children spend on smart assistants.

Parents used several techniques to enforce their restrictions; some parents used warnings towards the end of screen time, and others used context-based rules. One participant said, "We have a timer app, and when she hears it she knows it's time to get off, or, we'll say, 'OK you can watch four videos and then get off'." Some parents created context-based rules for their children so it was clear to their children when and where they could use smart devices. One parent mentioned that their child got more time with the device when they had guests over while others banned devices at the dinner table and at restaurants, and prevented their children from using devices after 9pm or until after their chores were done.

Some participants would use the device with their children; this was mostly parents with babies and toddlers. One participant said, "We haven't set any controls on [smartphones] so he can really access anything he wants on the Internet. We have no parental controls, but we're always with him when he has it."

Some parents would be in the same room and ask their children to increase the volume when watching videos or listen to their conversations on gaming consoles. One participant said, "Even if she is using YouTube, I do not allow her to wear headphones so that I may hear what she is listening to. If she has a game on her iPhone, it has to [go] through us."

Some parents would explain to their children their reasons for wanting control so that their children would be comfortable with it. One participant said she asked her son who he was talking to every time she heard him talk to someone over the microphone when using the gaming console; "He understands that we will question who he is playing with." Some parents asked their children for passwords to monitor their usage. One participant said, "We keep her passwords so that we can spot check if [...] something is going on, and she knows that we do that."

Reasons for wanting control: Parents often made decisions on restricting device usage based on their own experience, podcasts, articles, and from discussions with other parents. One participant said, "I am making a decision by my own feel, and trying to remember back to my own childhood what shows I grew up on". Some parents also mentioned their decisions depended on their own understanding of their children's personalities and needs; one participant made

her decision based on “articles I have read, my personal encounter with my daughter and knowing my daughter and knowing who she is and how she engages the world, things in her world.” Most parents’ need for control stemmed from their belief that devices and apps were bad and addictive; one participant’s concern was that “[her child was] just becoming too dependent on them, and life [was] revolving around them”.

Some parents also wanted to restrict their children’s device usage because of their concerns regarding their own lack of control over their device usage; one participant said, “[My daughter] spends too much time on the internet, and I think this is the way people are becoming. I even notice it with myself. Sometimes [...] in the beginning I would find that I would only go on to search for such and such information. But hours later, you will find yourself sifting through all this content which had nothing to do with your initial purpose. You [lose] hours and that would frustrate me.”

Familial relationships: Restricting device usage often led to conflict in the home. Some children observed their friends’ device usage and considered their own parents to be too restrictive. One participant said, “I can see he gets very annoyed and he complains, ‘well, I didn’t have enough screen-time.’ He knows that term, but we don’t use that very often! He always almost always complains first.” Another parent was concerned that her children would use her spouse’s frequent smartphone usage behavior to negotiate for more time. Another participant said her son did not argue, but merely explained why he could not stop; “My son is a little more stubborn. You have to accomplish a goal or mission, mom I am not done, I have to finish the game.”

Some parents also identified ways in which device use brought them closer as a family; one participant pointed out her daughters would show her baking videos and say “Mommy, watch this lady make cupcakes.. can we make them this weekend?”. Another participant said her children always watched sporting events on their smart TV with the parents.

Open communication: A few parents of teenagers were also concerned about restricting device use as they wanted to have an open communication with their children. One participant said, “I would rather [she] be home and see, or give her the device and [watch explicit content], and then come to me and say guess what I saw and get some input, than try to shield her and deny access, and then have her secretly find the information and [get] misinformation and not [want] to talk to me about the things she is experiencing.”

Some parents discussed good safety practices with their children. One participant said, “[My daughter] understands that the people on the Internet, they are not [her] friends because they are not right here, because [she doesn’t] know them”. Another participant said “I am always trying to drive home the point that you never want to write or say what you don’t want to say to someone’s face. In terms of language, what is appropriate, what would you say in front of your teacher.”

A parent used an instance when her daughter talked to a stranger while playing a cooperative game as a teaching moment; “She was talking with this boy for

quite a long time, and she got off and we asked her who is that. And she said I don't know. And we were like oh my god, you don't know. You are never doing that ever again. " Another parent wanted to "have dialogues with [her kids about safety]" and during one such instance, realized that "[her son] did not understand that [strangers on the Internet] might not be 13 [as they claimed they were] in the game. "

One participant noted that it is important for parents to work with their children who grew up with easy access to technology and help them learn the skill of getting work done with distractions that they as adults did not have growing up, he said "I'm sure [my daughter] is getting work done, but she is also getting distracted. It's a skill they have to learn. I have that challenge. I'm getting work done, [then] paper comments [and] notifications [pop] up - a skill they need to learn we never had to learn growing up, to defer jumping on whatever it is you have to jump on. " Another participant said she wanted her to children to learn that it is okay to not be on their smart device all the time, for example, it is okay to wait to respond to text messages; she said she wanted them to learn that "just because a text comes through, do you have to stop what you are doing and gauge it? I don't have to check that till we are done."

Our preliminary results provide new insights into device usage restrictions that parents place on their children, the parents notions of privacy and their lack of trust in smart devices, and also demonstrate the possible failings of existing parental controls, as parents more often take it upon themselves to monitor their childrens device use, instead of trusting the parental controls to protect their children.

5 Discussion

Even though most parents found technology to be useful, for example, as a parenting tool and for keeping in touch with family and friends, they were also concerned that unregulated use of technology could be a distraction. Parents felt solely responsible for their children's safety when they used smart devices. So they monitored the content their children were exposed to via apps and devices and also restricted the time the children spent on the devices.

Parents typically enforced time and context-based restrictions on their children's device usage. For time-based restrictions, parents chose a duration that they thought was sufficient for their children to spend on a device; for example, many parents chose one hour. Sometimes, the time restrictions changed depending on the context – for example, children were allowed more screen-time when they were sick, when the parents were busy or when they were traveling. Alternately, some parents banned device use in certain contexts - when children had homework or chores to complete, when it was time for bed, when they were outdoors at a restaurant. However, enforcing the rules often resulted in conflict in the home because children refused to stop using the apps. Okeke et al. showed that reminding users about the time they spend on an app can encourage them to stop using it [16]; similar nudging techniques can be adapted for

babies and toddlers who cannot read or do not understand the concept of time. Similarly, apps could also incorporate incentives for older children to stop using the devices, for e.g., children could “collect” badges or stars for every time they stopped using the devices as soon as they had reached their daily device usage limit. It is also possible for apps and devices to use machine learning techniques to learn the different contexts in which the children use the devices; for example, apps can already predict a user’s social interactions, daily activities, and mobility patterns [7]. The apps could then associate the context with the restrictions set by the parents and the devices can learn to trigger the nudging techniques based on the context with minimal human intervention.

Another way parents monitored device usage was by monitoring the content consumed by the children, either by using the devices with the children, by vetting apps before hand, by being in the same room when the children use the apps but listening to their conversation or what they are watching, or by going through the text or browser history either because their child’s device was on the same account or by borrowing their passwords. It is important that parents explain their reasons behind wanting to monitor their children’s device usage so their children do not assume that they need to share personal information in order to gain someone’s trust. Parents may also benefit from better privacy tools that they can install on their children’s devices to detect and warn users about oversharing when they are about to disclose sensitive information.

Additionally, parents also had concerns about their children sharing sensitive information such as location with strangers; apps could easily send an alert to a parent when a stranger connects with their children, so that parents can have a conversation with their children about safety practices. Parents with younger children were not concerned about their child’s safety since they thought their children were not sharing any information. However, even though young children are not intentionally sharing information, several inferences can be made about their habits based on their usage patterns. So it is important for parents of young children to understand how information is collected, stored and shared by the different apps and devices that their children use, and to educate the children on good safety and privacy practices, once they are old enough to understand them.

The usable privacy community has been working on better tools for educating users about data management [27, 17, 24]. Parental controls should also be improved so it is easier for a parent, not only to be able to monitor the content their children consume, but also to have a conversation with the children about good safety and sharing practices. With better context-sensing and device usage controls, the devices may be able to reduce the responsibility on the parent of controlling their children’s device usage.

Exploratory studies, like ours, could benefit from a bigger sample size, better population sampling and longer duration. Nevertheless, the study provided us insights into device usage scenarios, effect of device usage on familial relationships and parents’ concerns regarding the security, privacy and safety of their children.

6 Future Research Directions

We identify the following possible research directions for smart device HCI researchers based on the findings from the exploratory study.

Safety and privacy controls: We should develop privacy frameworks for smartphone apps that educate users about how data is collected and shared through the app and warn the users when they are about to share information that may be sensitive.

Tools to encourage open communication: Parents should be able to see a summary of their children's smart device usage in a manner that allows them to communicate with their children to develop rules around their device usage and develop better safety and privacy practices.

Nudging tools: Conflict in the home may be reduced by using devices and apps that detect the contexts in which children use the devices and apps, and gradually nudge the children to stop using devices and apps when it gets close to their screen-time limit.

7 Summary

In this paper, we present findings from an exploratory study of 29 participants regarding the smart device usage restrictions that parents place on their children, the parents notions of privacy and their lack of trust in smart devices. We conclude the paper by recommending future directions for smart device HCI researchers.

References

1. Anzulewicz, A., Sobota, K., Delafield-Butt, J.T.: Toward the autism motor signature: Gesture patterns during smart tablet gameplay identify children with autism. *Scientific Reports* 6, 31107 EP – (08 2016), <https://doi.org/10.1038/srep31107>
2. Balebako, R., Schaub, F., Adjerid, I., Acquisti, A., Cranor2, L.F.: The impact of timing on the salience of smartphone app privacy notices. In: *CCS Workshop on Security and Privacy in Smartphones and Mobile Devices (2015)*
3. Benisch, M., Kelley, P.G., Sadeh, N., Sandholm, T., Tsai, J., Cranor, L.F., Drielsma, P.H.: The Impact of Expressiveness on the Effectiveness of Privacy Mechanisms for Location-Sharing. In: *Proceedings of the Symposium on Usable Privacy and Security*. ACM (2009)
4. Cingel, D., Piper, A.M.: How parents engage children in tablet-based reading experiences: An exploration of haptic feedback. In: *Computer-Supported Cooperative Work and Social Computing (2017)*
5. Common Sense Media: The common sense census: Media use by kids age zero to eight
6. Common Sense Media: Technology addiction: Concern, controversy and finding balance (2016)

7. Harari, G.M., Lane, N.D., Wang, R., Crosier, B.S., Campbell, A.T., Gosling, S.D.: Using smartphones to collect behavioral data in psychological science: Opportunities, practical considerations, and challenges. *Perspectives on Psychological Science* 11(6), 838–854 (2016), <https://doi.org/10.1177/1745691616650285>, pMID: 27899727
8. Hu, W.: Math that moves: Schools embrace the ipad, <https://www.nytimes.com/2011/01/05/education/05tablets.html>
9. Jang, W., Chhabra, A., Prasad, A.: Enabling multi-user controls in smart home devices. In: *Internet of Things Security and Privacy* (2017)
10. Ko, M., Choi, S., Yang, S., Lee, J., Lee, U.: FamLync: facilitating participatory parental mediation of adolescents’ smartphone use. In: *ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp)* (2015)
11. Magee, R.M., Agosto, D.E., Forte, A.: Four factors that regulate teen technology use in everyday life. In: *Computer-Supported Cooperative Work and Social Computing* (2017)
12. Manches, A., Duncan, P., Plowman, L., Sabeti, S.: Three questions about the internet of things and children. In: *TechTrends* (2015)
13. Marsh, A., Downs, J.S., Cranor, L.F.: Experts’ views on digital parenting strategies. Tech. rep., CyLab Security and Privacy Institute (2017)
14. McReynolds, E., Hubbard, S., Lau, T., Saraf, A., Cakmak, M., Roesner, F.: Toys that Listen: A Study of Parents, Children, and Internet-Connected Toys. In: *Conference on Human Factors in Computing Systems. ACM* (2017)
15. Nouwen, M., JafariNaimi, N., Zaman, B.: Parental controls: reimagining technologies for parent-child interaction. In: *European Conference on Computer-Supported Cooperative Work - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies* (2017)
16. Okeke, F., Sobolev, M., Dell, N., Estrin, D.: Good vibrations: Can a digital nudge reduce digital overload? In: *International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI)*. pp. 4:1–4:12. ACM (2018), <http://doi.acm.org/10.1145/3229434.3229463>
17. Patil, S., Schlegel, R., Kapadia, A., Lee, A.J.: Reflection or action?: How feedback and control affect location sharing decisions. In: *ACM SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*, To appear (April/May 2014)
18. Schiano, D.J., Burg, C., Smith, A.N., Moore, F.: Parenting Digital Youth: How Now? In: *CHI Conference Extended Abstracts on Human Factors in Computing Systems* (2016)
19. Singer, N., Valentino-DeVries, J.: Google’s marketing of children’s apps misleads parents, consumer groups say (2018), <https://www.nytimes.com/2018/12/19/technology/google-kids-apps-misleads-complaint.html?smid=tw-nytimes&smtyp=cur>
20. Song, S., Kim, S., Kim, J., Park, W., Yim, D.: Talklime: mobile system intervention to improve parent-child interaction for children with language delay. In: *ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp)* (2015)
21. Times), A.H.N.Y.: Is Your Child a Phone ‘Addict’? (2018), <https://www.nytimes.com/2018/01/17/well/family/is-your-child-a-phone-addict.html>
22. Times), B.C.N.Y.: Is screen time bad for kids’ brains?, <https://www.nytimes.com/2018/12/10/health/screen-time-kids-psychology.html>

23. Times), C.K.N.Y.: Turn off messenger kids, health experts plead to facebook (2018), <https://www.nytimes.com/2018/01/30/technology/messenger-kids-facebook-letter.html>
24. Tsai, J.Y., Kelley, P., Drielsma, P., Cranor, L.F., Hong, J., Sadeh, N.: Who's Viewed You?: The Impact of Feedback in a Mobile Location-Sharing Application. In: Conference on Human Factors in Computing Systems. pp. 2003–2012. ACM (2009), <http://doi.acm.org/10.1145/1518701.1519005>
25. University, K.S.: The digital student: E-books, tablets and even smartphones becoming classroom staples, <https://phys.org/news/2012-07-digital-student-e-books-tablets-smartphones.html>
26. Valente, J., Cardenas, A.A.: Security & privacy in smart toys. In: Internet of Things Security and Privacy (2017)
27. Vaniea, K., Bauer, L., Cranor, L.F., Reiter, M.K.: Out of sight, out of mind: Effects of displaying access-control information near the item it controls. In: Proceedings of the 2012 Tenth Annual International Conference on Privacy, Security and Trust (PST). pp. 128–136. PST '12, IEEE (2012), <http://dx.doi.org/10.1109/PST.2012.6297929>
28. Wartella, E.: Parenting in the age of digital technology. Tech. rep., Northwestern University Center on Media and Human Development (2013)
29. Wisniewski, P., Ghosh, A.K., Xu, H., Rosson, M.B., Carroll, J.M.: Parental control vs. teen self-regulation: Is there a middle ground for mobile online safety. In: Computer-Supported Cooperative Work and Social Computing (2017)
30. Wisniewski, P., Xu, H., Rosson, M.B., Carroll, J.M.: Parents just don't understand: Why teens don't talk to parents about their online risk experiences. In: Computer-Supported Cooperative Work and Social Computing (2017)
31. Yong, S., Lindskog, D., Ruhl, R., Zavorsky, P.: Risk mitigation strategies for mobile wi-fi robot toys from online pedophiles. In: IEEE Third International Conference on Privacy, Security, Risk and Trust and Third International Conference on Social Computing (2011)