"Kid-in-the-Loop" Content Control: A Collaborative and Education-oriented Content Filtering Approach

by

Yasmeen Essam Hassan Hashish

A thesis submitted to the Faculty of Graduate Studies of
The University of Manitoba
in partial fulfillment of the requirements of the degree of

Master of Science

Department of Computer Science
University of Manitoba
Winnipeg, Manitoba, Canada

February 2014

Thesis advisor
Andrea Bunt and James E. Young

Author
Yasmeen Essam Hassan Hashish

"Kid-in-the-Loop" Content Control:
A Collaborative and Education-oriented Content Filtering Approach

Abstract

Given the proliferation of new-generation internet capable devices in our society, they are now commonly used for a variety of purposes and by a variety of ages, including young children. The vast amount of new media content, available through these devices, cause parents to worry about what their children have access to. In this thesis we investigated how parents and children can work together towards the goal of content control and filtering.

One problem to the current content control filtering tools and approaches is that they do not involve children in the filtering process, thus missing an opportunity of educating children about content appropriateness. Therefore, we propose a kid-in-the-loop approach to content control and filtering where parents and children collaboratively configure restrictions and filters, an approach that focuses on education rather than simple rule setting. We conducted an exploratory qualitative study with results highlighting the importance that parents place on avoiding inappropriate content. Building on these findings, we designed an initial kid-in-the-loop prototype which allows parents to work with their children to select appropriate applications, providing

parents with the opportunity to educate their children on what they consider to be appropriate or inappropriate. We further validate our proposed approach by conducting a qualitative study with sets of parents and children in the six to eight year-old age group, which revealed an overwhelmingly favorable response to this approach. We conclude this thesis with a comprehensive analysis of our approach, which can be leveraged in designing content control systems targeting both parents and children.

Contents

List of Tables

List of Figures

Acknowledgments

My first thanks would be to Allah for granting me the patience and strength to go through and complete this journey and for rewarding me with success.

Andrea and Jim, simply put, you are the best supervisors one could possibly ask for. Knowledgeable, helpful, thoughtful and care about your students on a professional and a personal level. Thank you for being so understanding, giving me the confidence to perform better and for helping me stay on track.

I would like to thank my insightful committee members Dr. Neil Bruce and Dr. Melanie Glenwright for their precious time and valuable comments.

To the HRI lab members, thank you for making the lab a place that I looked forward to being in. We had fun, pushed each other forward, shared a lot of the highs and lows and I found friends in you. Hope we could always keep in touch.

Mom, even with us being thousands of kilometers away you jumped to my rescue and not just once, but 3 times. Thank you mom, and thank you dad for letting me "borrow" mom during this stressful period of my life, and for all of your support.

Hesham, this degree is yours as much as it is mine. Reaching this happy ending wouldn't have been possible without you by my side all through the way. Saying "thank you" doesn't do you justice, but none the less thanks!

To Hesham, for your never ending love, encouragement and patience.

Publications

Some ideas and figures in this thesis have appeared previously in the following publications by the author:

Yasmeen Hashish, Andrea Bunt, and James E. Young. Parents' views on their children and technology: Exploring the potential for adaptive interfaces to improve child-computer interactions. University of Manitoba, Technical report (2013).

Yasmeen Hashish, Andrea Bunt, and James E. Young. Involving children in content control: A collaborative and education-oriented content filtering approach. In *Proceedings of the ACM Conference on Human Factors in Computing Systems* (CHI 2014), 10 pages, to appear.

Chapter 1

Introduction

Technology has infiltrated many aspects of our daily lives and is being used for many different purposes ranging from basic living necessities (e.g., refrigerators, stoves) to fun activities (e.g., gaming platforms, music players). Modern technology's user pool includes a wide range of individuals of various ages, including children as young as two years old, who can now navigate and operate tablets and smart phones [23]. With young children's increased access to different technologies, parents have concerns over media content that their children may be exposed to through these venues, for example, websites with adult content, highly violent movies, or even games that encourage gambling, evidenced by the range of content rating and labeling schemes (e.g., PG13 vs. R for movies, or the ESRP video game ratings). One modern challenge is that there is an increasing number of devices connected to the internet, providing gateways to unfiltered content that many parents want to control. Many parents have come up with their own strategies for controlling content, such as monitoring access by placing computers and televisions in a common area in the house or

using the internet together [28], or by employing blanket passwords on devices.

There are a number of existing commercial tools designed to help parents limit their children's exposure to inappropriate content, for example Net Nanny, or CYBERsitter for PC web browsers, or child-friendly filtered versions of software tablets such as Netflix's children's area or Apple's pre-configured adult filter on the iPad. A common feature of these tools is that they rely on sets of rules created and maintained solely by parents (or by companies) and are not designed with the intent of involving children in the process; as such, they do not support helping the children understand the restrictions placed. Leaving children out of the process may be problematic in light of pedagogy and psychology research showing that educating young children about rules and morals, and to some extent helping them form their own opinions, may be more effective than simply creating and enforcing rules without explanation [11, 16], and is similar to how the Positive Youth Development framework suggests that providing structure, positive norms, and opportunities to be involved can support youth in making good decisions [32]. Finally, this has the added advantage of providing parents with a healthy way to communicate their opinions on media, which has been shown to have a strong impact on how children themselves see media [36].

The importance of educating children and the lack of tools that support children's involvement in the content filtering process point to the need for *"Kid-in-the-Loop"* approaches and tools that involve both parent and child in setting the rules used for filtering. A potential benefit of such tools and approaches would be facilitating a collaborative and discussion-oriented parent-child opportunity for educating about issues surrounding content appropriateness. For example, having the parent and

child go through different content categories to set filtering rules opens up discussion opportunities about content appropriateness; such conversation may not occur if only the parent set the rules.

In this thesis, we describe our process of exploring, developing and evaluating a novel interaction approach that we call kid-in-the-loop which has the purpose of facilitating children's education about content appropriateness.

1.1 Research Questions

Our exploration of the kid-in-the-loop approach to content filtering involves the following research questions:

Q1. How does current-generation technology, such as smart phones or tablets, fit into homes? What are parents' opinions of their children's technology usage?

Q2. How important is the issue of content control to parents and what are their filtering strategies for current-generation technology?

Q3. How can the kid-in-the-loop approach be built into the content control process?

Q4. How will parents and children respond to such tools and approach?

1.2 Methodology and Approach

We investigated our research questions through the following steps, i) we conducted an exploratory study to learn about the current-generation technology usage in homes and the parental concerns surrounding this usage, ii) we designed an initial

kid-in-the-loop interaction approach to content control and implemented a prototype as an instantiation of our approach, and iii) we conducted a study to evaluate our prototype by examining how parents and their children responded to our approach. Below is a summary of our method's three main components.

1.2.1 Exploring Current Technology Usage

To explore current-generation technology uses we applied qualitative methods, namely semi-structured interviews and affinity diagramming [4], in our investigation and analysis. These methods helped us learn about how technology fits into homes and the parents' opinions of their children's technology usage, they also enabled us to assess the importance of the content control issue and learn about the parents' strategies. Qualitative methods here were particularly useful because they provided the flexibility we needed for our exploration purposes (Chapter 3).

1.2.2 Designing and Prototyping our Interaction Approach

In addressing our research question of how to develop the kid-in-the-loop tool for the content control process, we took a prototyping approach [42] to developing our novel interaction approach kid-in-the-loop. We used low fidelity sketching for idea generation for designing kid-in-the-loop, and for refining design decisions of our medium fidelity prototype, which we hereafter refer to as *"We-Choose."* We created We-Choose as an instantiation of kid-in-the-loop, with the main purpose of being a proof-of-concept to our proposed approach. This enabled us to have a viable tool through which we could ask our research question of how parents and children would

perceive kid-in-the-loop (Chapter 4).

1.2.3 Evaluation

To evaluate our kid-in-the-loop interaction approach, we conducted an in-lab study with parents and their children where we observed the parent-child interaction while using We-Choose prototype. In doing so, we were able to go back to the user population and gauge their reaction to the prototype, and more importantly to the interaction concept of the kid-in-the-loop behind it to learn if it helps in addressing the challenges they face and how our approach can be further developed (Chapter 5).

1.3 Research Contributions

In this thesis we present a new kid-in-the-loop approach to content control that focuses on child involvement and education rather than control only. We first present an open-ended study that explored children's interaction with current-generation technology and parental opinions, with the results supporting the importance parents placed on content control in current-generation devices. We designed and implemented an initial kid-in-the-loop software platform that served as a prototype for educational content-control sessions and enabled us to conduct a qualitative study with parents and their children using the prototype. Our findings show that parents consider the collaborative, educational approach to be an effective and engaging way to initiate conversations with their children. Parents also believed that the kid-in-the-loop approach provides a novel way to discuss topics which may otherwise be difficult to breach (or find time for), and our findings show that children learn (at

least in the short term) from these sessions. Overall, our results strongly suggest that the kid-in-the-loop approach to content control has promise and can serve as an important part of modern internet-capable technologies.

The remaining of this thesis is organized as follows: in Chapter 2, we provide a review of the related work relevant to our exploration. Chapter 3 describes our method for conducting the exploratory study and provides a comprehensive analysis of our results. Chapter 4 details our prototype design decisions and technical implementation, followed by Chapter 5 which describes the lab-style evaluation that we used to investigate the effectiveness of our proposed approach and prototype. We conclude the thesis in Chapter 6.

Chapter 2

Related Work

In this chapter, we provide a high-level overview of the field of Human-Computer Interaction (HCI) and its most common methods of investigation, as well as our method of choice throughout this research. We present prior work that highlights families' attitudes towards technology and the risks of unsupervised media consumption on children and we show how our work fits in this research area. We end this chapter by introducing media content control strategies previously presented in the literature, and discussing how we plan to complement them and overcome their shortcomings.

2.1 HCI Research Goals and Methods

Human-Computer Interaction (HCI) is defined as "a field that studies the interaction between people and computers with a focus on the physical, psychological and theoretical aspects of this process" [8]. As computers become more pervasive in our

culture, designers are increasingly looking for ways to make interfacing with devices easier, safer and more efficient. A user interface, such as a GUI, is how a human interacts with a computer, and HCI goes beyond designing screens and menus that are easier to use and includes studying the reasoning behind building specific functionality into computers, and the long-term effects that systems will have on humans.

Methods of investigation in HCI are very broad and they range from qualitative exploration, such as surveys and interviews, that provide feedback from the point of view of the users [37], to ethnographic methods that focus on the observation of people in their cultural context [38], and to controlled studies that make quantitative comparisons between, for example, different input methods or design approaches by manipulating an independent variable, like screen size or input method (e.g., [7, 40]), and observing the outcomes on performance. In this thesis, we mainly employ qualitative methods due to the exploratory nature of our investigation, as discussed in section 1.2. We use the qualitative methods to address families' interaction with technology through investigating children's interaction with technology and the parents' view on it.

2.2 Technology Adoption and Risks

One common theme in HCI is investigating how people use technology and looking at new ways for them to use it in a manner that solves existing problems (e.g., [5, 41]). Why families adopt technologies and their usage patterns have been broadly studied, for example, showing how family values and social class can shape attitudes and adoption [1, 44]. There is also investigation of how technologies can have an

impact on the home and its social structures [28]. This vein of work is not limited to investigating the family as a unit, but extends to studying children's interactions with technology, which has been a common theme in sociology, psychology, and human-computer interaction. For example, children and television in general [21, 39], how video games may promote exercise [17], or how internet use may impact psychological development [18]. Some work explicitly involved children by including their attitudes and points of view as a part of the investigation [31]. Our work continues this theme by exploring how children use current-generation technologies and parents' attitudes toward them, but more importantly, we primarily focus on actual interactions between parents, children, and technologies in contrast to broad patterns of behavior.

Through these investigations, the risks of unsupervised media and internet access have been documented. For instance, exposure to inappropriate (e.g., adult, violent) content may impact childhood aggression, education, and psychological development [6, 14, 18]. Work in the literature has also indicated that parents have a great deal of concern over their children's exposure to inappropriate content, primarily pornography [34] and violence [13]. Furthermore, such exposure may impact the parents' ability to shape their children's values [3, 33]. Therefore, lot of effort was invested in raising awareness of such risks and finding solutions to alleviate them [13, 29]. Our work provides some updated insight into the risks of current-generation technologies from the parents' point of view.

2.3 Approaches to Media Content Regulation

Work on technology usage regulation and content control in families has articulated parental strategies, for example, through discussions with children, co-use, or direct restriction [28, 30, 43]. Co-use and interaction rules (e.g., not on sunny days) may be preferred over employing hard restrictions such as control software (e.g., for older children and teenagers [30]), in part due to a lack of trust in the robustness of the system [34]; our new approach encourages and scaffolds discussion between parents and their children on what is or not appropriate so as not to fully rely on the system. Another theme addressed the sociological perspective of technology usage regulation, by studying the effect of different parenting styles on technology mediation techniques [9, 12, 27]. However, this theme primarily focused on the parents' role in the content control process and did not address how technology itself could be used to support the parents' task. In our work we propose an interaction approach that is manifested in a technical solution to support the parental task of content regulation and educating children about content appropriateness.

While there exists some technical solutions for content control, a 2005 study provided evidence of families' low uptake of control software - only 33% - and showed that this may be correlated with the age of the child, with more use for families with younger children [34]; this study also indicated that perceived ease-of-use of such tools may be a barrier. Further, commercially-available control software generally provides rule-oriented (sometimes query-like) control methods, for pre-configuration by parents [25], or machine-learning approaches such as automatically detecting adult images [2, 22, 24], none of which involved children in the process. Work that has in-

volved children in filtering content has looked at helping them form appropriate search queries [10, 15], as opposed to involving them in content control. Our approach attempts to address all of these concerns: we target younger children and involve them directly, and aim to reduce parental barriers to filtering use by simplifying the task to be easily performed by both parents and children.

In general, work in the literature has documented the risks of unsupervised media consumption and has looked at how parents address this issue, as well as provided some technical solutions for content control. However, the increased accessibility to uncontrolled content, due to the proliferation of new-generation internet capable devices, raised new challenges and necessitated revisiting the control techniques developed in the literature. We point out that, to the best of our knowledge, none of the existing work on content control involves children in the content filtering process. In our work we address the issue of content control in current-generation technology, and attempt to involve both parent and child in setting the rules used for filtering, to support the parents in educating children about content appropriateness.

Chapter 3

Exploratory Study

In this thesis we explore the development of a collaborative educational approach that targets involving parents and children in the content control and filtering process. To inform the design of such approach, we wanted to have a better overview of what kinds of current-generation technology children use, and the range of thoughts, opinions, and concerns that parents have about such technologies. Therefore, we conducted a qualitative exploratory study with parents of children in the 4-10 year old age group (published in [19, 20]). The knowledge gained from our exploration provides updated insight into these issues; many prior studies pre-date the current smart phone and tablet trends (e.g., [28, 30, 34, 43]). We explicitly did not target content control schemes, a theme in this thesis, since a part of this study was to determine if content control was indeed a strong current parental concern. We let that theme emerge from the data, thus motivating further exploration in that direction.

3.1 Study Method

Given the exploratory nature of the study, our approach was to use qualitative techniques to gain knowledge about how current-generation technology fits into homes, parents' opinions of their children's technology usage as well as the parental filtering strategies for current-generation technology. In particular, we decided to interview parents of children in the 4-10 year old age group, since this age range is common for analysis related to family and children technology usage (e.g., [1]). We used semi-structured interviews, as they provide flexibility in probing for further details based on participants' individual responses. In these interviews, we asked parents to describe the usual interaction of their children with technology through the day; as they described, we probed about the following:

- What are the different types of applications and aspects of technology their children interact with?
- What are the difficulties that the children and parents face throughout this interaction?
- What are the parents' likes and dislikes about the technology their children are using and interacting with?

These questions led to discussions, during which we asked the participants to describe specific events to aid with recall and thus provide us with more information and nuances about their children's technology interaction. For the full list of questions refer to Appendix A.

Parent	**Occupation**	**Children age/gender**
P1	Daycare worker	Boy: 5 years
P2	Graduate student	Boys: 8 years, 10 years
P3	University support staff	Boy: 8 years Girl: 5 years
P4	Daycare worker	Boy: 9 years Girl: 4.5 years
P5	Stay-at-home parent	Boy: 7 years Girl: 10 years
P6	Graduate student	Girl: 8 years
P7	Unreported	Boys: 8 years, 10 years
P8	Daycare worker	Girl: 7 years
P9	Daycare worker	Boy: 9 years
P10	Graduate student	Boy: 7 years
P11	University support staff	Girl: 5 years
P12	University professor	Boy: 8 years Girl: 10 years

Table 3.1: Demographic information of the participants in the exploratory study.

We conducted our interviews with one parent per family from 12 families who had one or more children in the 4-10 year-old age group. Demographic information for our participants is listed in table 3.1. Participants were recruited through snowball sampling, beginning with the authors' personal contacts, and through advertisements placed throughout the University of Manitoba's campus. The study was approved by the University of Manitoba's Joint-Faculty Research Ethics Board (Appendix A).

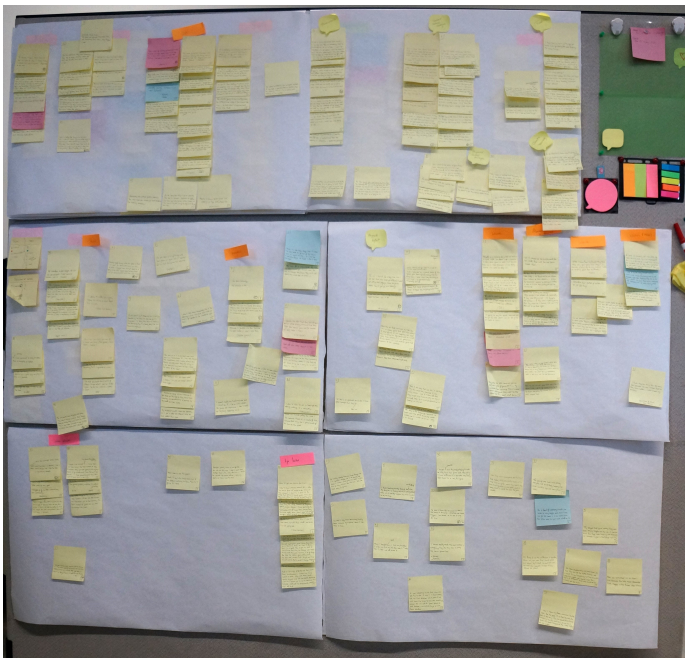
When possible, interviews took place at a participant's home to facilitate note-taking (7/12). The interviews lasted 20-45 minutes; the participants received a $10 gift card as an honorarium for their participation. Data was collected via audio recordings, which were later transcribed.

3.2 Data Analysis

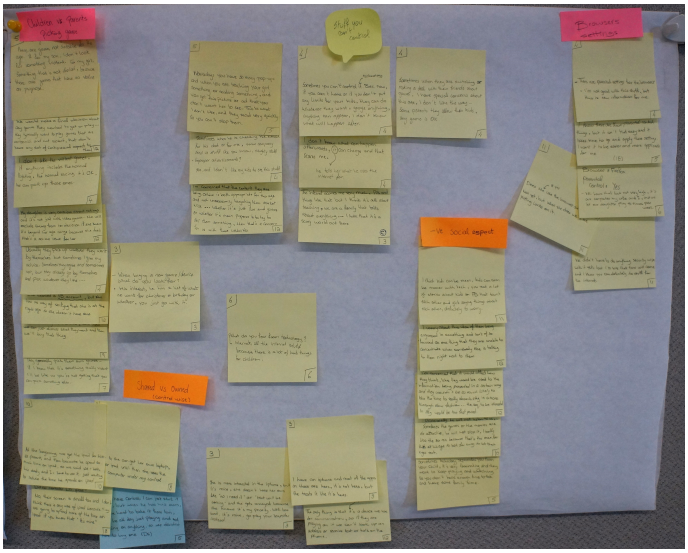
We analyzed the transcripts using qualitative analysis techniques heavily inspired by the affinity diagramming method from *Contextual Design* [4]. In particular, we created the affinity diagrams (shown in Fig. 3.1) to identify themes relating to children's technology use and parents' perceptions of technology. In creating the affinity diagrams, we clustered and axial-coded related statements to uncover themes and commonalities in the parents' discussions.

3.3 Study Results

Parents indicated that their children use a variety of devices ranging from those specifically manufactured for children (e.g. Leapster), to dedicated gaming platforms (e.g., Wii, Xbox), multi-purpose devices (e.g., tablets, laptops, desktops), iPods and even smart phones; we found smart phones to be the most commonly used device. Overall, while parents were supportive of their children using technology, a major theme of discussion was about parents' concerns regarding their children's use of technology and their struggles with regulating that use, for example, in terms of allowing technology use for specific purposes, applying strategies to monitor the content types and trying to mitigate the undesirable social impact of technology on children. We elaborate on these concerns below.



(a) Full diagram (more paper sheets with quotes are layered beneath the ones visible in the picture)



(b) Subsection of the diagram

Figure 3.1: Diagrams resulting from affinity diagramming analysis technique. Similar quotes are clustered together to represent an idea or a theme.

3.3.1 Acceptable Use of Technology

Parents in our study had set their own individual criteria for what constitutes an acceptable use of technology. In this section we present those different criteria, whether it was using technology for education versus using it for fun, setting a time limit for technology use per day or even allowing this technology interaction as a reward and declining it as a punishment.

Educational Purposes – Using technology for educational purposes was on the top of many of our parents' lists as an acceptable use of technology, and some even considered it as the only acceptable use of technology.

> *He uses computer for his religious lessons... it is not about fun and playing games - P1*

The most direct educational uses of technology that parents pushed for were through math and vocabulary games. However, some of our participants' children seemed to be rejecting this kind of use, focusing instead on using the technology for pure fun.

> *I do like it when I'm going through [iPhone] apps with her and I'm like 'oh look at this, you could learn letters or practice writing' I try to push those but she doesn't like it, she wants to bake [iPhone game] and do those things - P3*

Other educational aspects that parents welcomed the technology use for were learning logical skills, encouraging creativity or even improving manual dexterity.

> *It is a building game [Mine Craft] so I can't be too upset about it. It requires a lot of imagination, intuitivity and creativity so I kind of feel better about them playing that versus a lot of other games that maybe wouldn't be as creative - P2*

> *I feel she does learn logical kind of skills [from Leapster], like matching games and things like that because those games are very educational - P3*

> *Her dad wanted her to have more experience and manual dexterity [that is why we got DS] - P11*

Physical Activity – In addition to education, another common acceptable use was technologies that engage children in physical activity.

> *I like that both these things [XBox and Wii] have a physical aspect to them - P2*

> *It [Wii] is not just sitting and playing, there are games where they will get up and moving - P11*

However, other parents mentioned that this activity was only temporary and as soon as the glamour of the new device wore off, it was just another gaming platform.

> *When the Wii first came out it's like "Oh it's video game that gets kids active" it kind of did at the beginning but then right now he plays his lego games and he is just sitting there playing, it's not getting him off the couch it's just another video game that happens to be wireless - P3*

While some parents encouraged technology usage for physical activities, others thought that it caused their children to be more sedentary.

> *I don't like them just to sit for an hour or more in front of something doing nothing [video games]. It's unhealthy - P5*

Other parents even blamed their children's lack of outdoor activities on the children's over attachment to the technology artifacts.

> *When it's the nice days then I'm like no you need to get out of the house and he wants to play [iPod/DS], so it can be a bit of a fight - P3*

We asked parents whether they would like to have devices that would encourage their children to spend more time outdoors, and we got different responses. Some parents welcomed the idea and were willing to try it, if it existed.

> *That would be cool, I'd like that, I don't know how it'd work but I like the idea - P7*

However, other parents did not like this idea as much. They thought that outdoor activities should be encouraged for their intrinsic value and they were pushing toward non-tech outdoors activities.

> *I wouldn't be inclined to [get a device that encourages outdoor activities]... to me that's just almost like using a tool like hammer or something to achieve something you were going to do anyways, which is go outside and have fun and look around. I think that I wouldn't look for a device specifically in that way to go outside or force them - P12*

> *We prefer to go to the library or to read books things like that, we are like old school, old fashioned, go to the library, the park instead of the laptop or the Wii and technologies like that - P6*

Age – A factor that parents in our study took into consideration when defining criteria for acceptable use was age. The parents did not all agree on the a particular age for when it is appropriate to get children their own devices. However, most of the parents agreed that they would wait until they felt that their children learnt how to manage their use of these devices.

> *I don't know, maybe around 10, when he knows what he needs to do. Now at this moment I think he is still in the stage that parents should guide him, but afterwards if he can control himself to say what I have to do first and what last, then maybe [introduce new devices] - P10*

One of the parents in our study was delaying getting their child a personal device for fear it may affect their child's learnability.

> *I think that it's not the age for that [having personal devices], we think after 8 she can have some, but all that stuff before, we think it's not appropriate... I think they are in a learning level so I don't think that it's a good idea to give an iPod or cell phone and they are always with these things and they should be learning a lot of things - P6*

Reward vs. Punishment – Another purpose for which parents allow their children's use of technology is if they are rewarding them. Some parents in our study

have noticed their children's strong attachment to the use of technology and have leveraged this for rewarding or punishing them. For example, some parents allowed their children to use their technology devices as much as they want to reward them for their hard work in school.

> *I know he is very laborious, he is working very hard, so just for his relaxation I don't tell him not to use the iPod - P9*

On the other hand, declining the children's technology use was one form of punishment that some parents used.

> *If they are playing and I was trying to talk to them and they weren't listening because they were engrossed in a game, Wii, DS or even online, if they weren't listening to me then they would be in trouble and won't be allowed to use that again - P12*

In one case parents found that punishing their children by limiting TV usage was not as effective as limiting other electronic devices' usage.

> *The first form of punishment is the electronics taken away... before it was no TV and then we figured out no, no electronics - P7*

3.3.2 Strategies for Control

Most of the parents we interviewed went to great lengths to regulate their children's technology usage in order to protect them from technology's undesirable effects. For example, parents wanted to prevent their children from accessing content that is, violent, of sexual nature or that encourages gambling behaviour. They also wanted to decrease the negative impacts of using technology for extended periods of time and decrease online privacy risks. To achieve these goals, those parents have developed several strategies to monitor and control their children's technology use. In some

cases parents employed more than one strategy. We discuss those strategies below.

Supervised Use – One common strategy was for parents to only allow their children's use of technology when they are in the same vicinity. That way, parents would be able to directly supervise and monitor the content their children viewed.

> *He doesn't use the laptop alone, never! - P10*

> *I don't like them playing in the bedroom too much, because then they can't really be monitored. So I prefer them playing when they are with us - P2*

> *They have a laptop but they only use it at the dining room table, so we're always around and usually we at least know what they are doing if not what site exactly they are on - P12*

Filtering – Parents in our study told us that they would pre-filter the content which their children viewed to make sure it is appropriate. Some parents would collaboratively educate their children about content appropriateness while they are investigating that content.

> *If they ask to go on a website we haven't heard of, we'll sit with them and check it out a little bit and make sure that we know something about it before they go on it - P12*

On the other hand, some parents would hard pre-filter, both online and offline, content before allowing their children any access to it.

> *Anything new, I have to see it first, and I have the favourite bar. When I find something good and safe, I add it for them in that bar. So when they want to play something, I told them if it's in the favourite bar ok go ahead, if it's not you have to tell me first - P5*

> *You choose the songs and games you put inside [iPod] so you are very confident they are suitable and this is what you want them to hear - P5*

Software-Assisted Control – Parents infrequently described using software-based control solutions (such as parental controls in browsers), with the exception of using passwords, which many parents used either on the device or for the internet connection. Parents indicated that they were aware of such control solutions; however, many commented on the difficulty of use or added overhead for shared devices.

> *I know there are those parental control things, but it's not that easy and it takes time to go and apply these settings - P5*

> *We have that [browser settings] but not very high, it's our computer, my wife and I, and we let our daughter play - P6*

Other parents were hoping to have the ability to personalize the devices to better suit their children; like being able to activate a child mode to ensure their children are only using specific aspects of the devices.

> *[The laptop] is too multi-functional to let them loose with it, it has to be where you're monitoring it and that's a lot of extra work to do - P2*

> *I'm in control with passwords and stuff, but eventually they're going to have their own, they're going to want to go on the computer and I can't sit beside them all the time - P3*

Time Limitations – Most parents that we interviewed employed time limitations for their children's daily technology use. Parents were concerned that prolonged use of technology artifacts could affect their children's physical well-being.

> *Although the movie is at least one hour, but we want him to stop around 30 minutes, because that's good for his eyes...that's the maximum time for kids at his age to look far away to let their eyes rest - P10*

Parents found that enforcing these time limits was often challenging and stressful (e.g., lead to arguing with children). For this reason some parents simply avoided purchasing certain devices to circumvent the issue.

> *When he has his own [DS], it'd be hard to take it from him.. He'll be all the day just playing and not focusing on anything, so we decided not to buy one - P5*

Other parents developed creative solutions to avoid this, such as sharing ownership of a device - where others use it as well - as an indirect way of limiting time.

> *At the beginning we got the iPad for him as present and then because he spend so much time on iPad, so we said we, both his daddy and I, have to use it. Just wanting to reduce the time he spends on it - P10*

However, in some situations parents would allow their children to use the devices for extended periods for passing time either because of bad weather, being on the road or even the parents being busy.

> *We just got back from a long road trip and there they would play DS for hours if we let them, and we would just because it was a long drive - P12*
>
> *If it rains all day they might play as twice as long as they'd normally play - P2*
>
> *If they're watching something different and interested in these things [iPhone] it is ok, no problem. Otherwise we have to get them somewhere, if we're not taking them it's better they can enjoy themselves with these things - P9*

Privacy – Other than parental concerns related to content appropriateness and technology use duration, parents also worried about their children's online privacy and their unawareness of the risks associated with the internet. Many of the parents in our study opted for teaching their children about what is appropriate in the cyberspace.

> *They need to be aware that these virtual spaces are really public spaces and that they are not as imaginary as they appear. That what is going on there is a form of reality and so that's something that we have to teach them - P2*

However, some parents still chose to monitor their children as well.

> *He has one [Facebook account] that he uses with his friends at school but it's a closed one so no one can look him up and I totally monitor it. Like you, for example, couldn't look at his pictures and any of that stuff. You can request to be friends, but that's it - P7*

3.3.3 Social Impact of Technology on Children

With the increased amount of time that the children were spending using technology everyday, parents in our interviews reported noticing different social impacts on their children's behaviour. For example, some parents worried about their children's technology usage hindering their social and life skills development. Some parents also noted how their children's technology attitudes became affected by their peers.

Socialization – Parents in our interviews stated that they have seen undesirable social impact of technology on their children, mainly represented in their children's refusal to part with the devices and participate in other real world activities.

> *When it is the nice days then I'm like 'no, you need to get out of the house' and he wants to play, so it can be a bit of a fight - P3*
>
> *Sometimes I encourage him to go with me for shopping or for walking in the park but he refuses, he wants to stay and play - P4*

The fear of this negative impact was one of the reasons for which some parents were reducing their family's overall technology interaction.

> *Kids in this age, especially 5-6, they need some socialization, I want him to go outside to the park, play with other kids, sports, bicycles and all that stuff. Maybe that's why [we are not a very technology oriented family] - P1*

However, other parents think that technology artifacts can be used in a collaborative manner to encourage socialization. Parents have tried using the technology artifacts collaboratively to strengthen the bond between their children or to spend some family time playing together.

> *[Any new device] has to be something that they can share, or use together that's all... Basically something that they can do together cooperatively, to me that's a big one. I just don't want to have them next to each other and doing like a parallel play, I want them interacting with each other and learning how to be brothers - P7*

> *I like it [Wii] because it can have 3 or 4 players... I like this part because all of us can play together like teams - P4*

Developing Life Skills – In addition to worrying about their children's decreased social interaction, parents were fearful that the extended technology exposure would affect their children's developing life skills. For example, parents worried about their children being so engrossed in their devices that they become unaware of their surroundings.

> *I worry about this idea of them being engrossed in something and sort of so focused on this one thing that they are unable to concentrate when somebody else is talking to them right next to them - P12*

Another worry was about children getting used to how information was presented through technology devices and being unable to process information presented in a different way than what they are used to.

> *I worry that it [technology] would affect how they think, like that they would be used to the information being presented in a certain way and they wouldn't be as much likely to take the time to really absorb something in a more thorough slow fashion like you would when you would sit down and read a book, that their requirement to be interested in something would be too fast paced - P12*

Parents even worried that technology has affected their children's ability to handle quiet time.

> *It has become like they can't handle any time of quietness...like now if there is any moment of quietness there has to be something to entertain them - P2*

Peer Pressure – We have found that children, even as young as 4 years old, were affected by their peers and would pressure their parents to get new devices similar to their peers'.

> *She asked for it [DS] for her birthday for a really long time, because all the kids at the daycare had it - P11*

> *I think they have a lot of discussions with their friends as well about what games they play, so it sort of makes this set of games that everyone knows about at their age and wants to play - P12*

In other cases parents would get their children the devices so that their children feel on par with their peers.

> *Like nowadays to be comparative with other kids I say ok this is a Wii you know how to play and all that - P1*

3.4 Discussion

The results of our interviews highlighted several themes that parents focused on, thus helping us gain insights into how current-generation technology fits in homes and about parents' views of their children technology usage. Parents in our study generally welcomed technology for their children and discussed the potential for it to impact their children in a number of positive ways, evidenced by the various technology uses that parents deemed appropriate for their children. At the same time, parents expressed concern over some of the dangers of technology use, such as inappropriate content or diminishing of physical and social activities. They further indicated a range of techniques (primarily control) for mitigating these concerns, and expressed some of the challenges of maintaining control. The emergence of the technology control theme from our exploratory interviews and the importance that parents placed on the content control goal suggest the need for an approach that helps address the challenges parents and children face in that process.

3.5 Summary

In this chapter we presented the study that we conducted to explore children's current-generation technology usage and the parental concerns surrounding this usage. The study helped us learn about the devices most commonly used, how parents and children used the technology as well as the concerns that the parents had towards their children technology usage. The results highlighted the importance parents put on the content control issue and illustrated the various filtering strategies that parents are using with current-generation technology. We also note that the children took minimal part in this content control process and that it was mostly completed by parents. These findings motivate our work in developing a new approach to content control that facilitates an educational, discussion-oriented kid-in-the-loop content control process.

Chapter 4

Prototype

The results of our exploratory study highlighted the need for approaches and tools that support involving both parents and children in the content control and filtering process. In the previous chapters we proposed kid-in-the loop interaction approach as a means of supporting such involvement and educating children about content appropriateness through that process.

We list our goals for kid-in-the-loop below, but our main goal and starting point was to create an interactive session between parents and children that they could use to set up content appropriateness rules. We also decided to include a secondary session where the child can test their knowledge of what is appropriate. For example, a parent and child can use the device together and somehow interact with it to train the filter, in what we would call "Collaborative-training mode", and then the child can use the device by themself and test their knowledge and understanding of the rules in what we would call "Game mode".

Our prototype, which we call We-Choose (published in [20]), is an instantiation

of our proposed kid-in-the-loop interaction approach. We-Choose primarily targets children within the six to eight year-old age group, based on psychology literature that indicates this is when children are capable of reasoning about appropriate and inappropriate material [35], and are also able to start making generalizations [26]. However, we do not limit the kid-in-the-loop approach to this age range. We highlight that this is the first system we are aware of which includes the child in the filtering process, and that emphasizes educational discussion over simple rule setting.

Our approach to prototyping involved using low-fidelity prototypes to generate a suitable interaction design representing the goals of kid-in-the-loop and to aid with the interface design of We-Choose. We particularly used paper prototyping which is a widely used method in the HCI field to rapidly design and develop user interfaces in a way that is unconstrained by the actual toolkit used for implementation [42]. The process involves creating rough drawings of an interface and its different interaction scenarios to use as disposable prototypes.

In this chapter, we define and describe the design process of our kid-in-the-loop approach and we outline how it was manifested through We-Choose prototype, a kid-in-the-loop application-repository ("app store") filtering system. We also outline the approach we took for designing and implementing We-Choose.

4.1 Design Goals

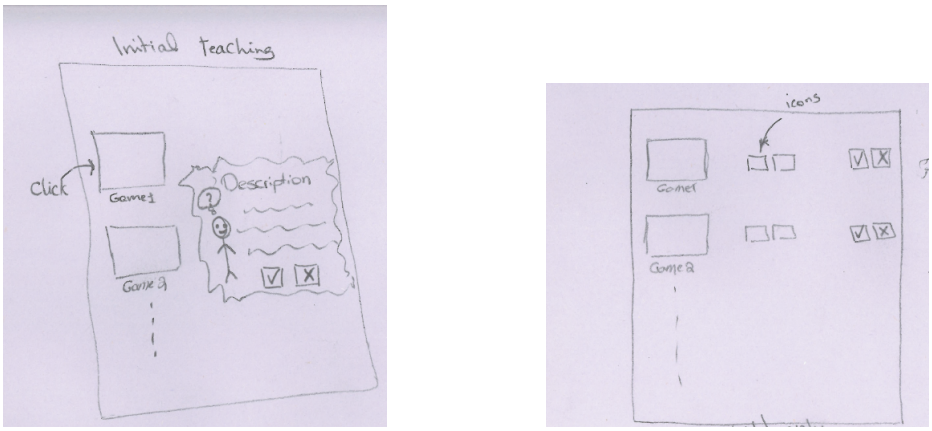
The long-term vision for our approach is to help children learn rules in an engaging setting, decrease the ongoing parental management overhead, while at the same time giving parents a control mechanism that meets their needs. We highlight that

particular design decisions (e.g., selection of icons) are not the point of our research; rather, we simply aim to construct a proof-of-concept of the overarching kid-in-the-loop approach that serves the purpose of enabling us to run initial studies in this area. Here are the following goals for our design:

1. Facilitate discussion: The idea here is for parents and children to classify some content examples together, and for the parents to provide reasons so as to why each example is appropriate or not. In going through examples of different content types, parents are provided with an opportunity to discuss topics that may be difficult to bring up otherwise without a context.

We explored different designs for how application examples and their descriptors could be displayed (Fig. 4.1). In Fig. 4.1a, the list of the available content examples are displayed and clicking on any of them brings up its text description and a check and cross icons to classify it, while in Fig. 4.1b the content examples are described by icons instead of text. The layout that we chose for our implementation is the product of merging both designs, where we display a single example at a time, to aid with focus, with both icon and text descriptors.

2. Accessible to children: While the parent can use the application's text description to help explain why it is bad or good, some children may not be able to read the application titles and descriptions. As such, a key element of our prototype is the addition of icons, which (after a quick and simple explanation from their parents on what the icons represent) creates a way for the children to develop an opinion on an application they are not familiar with. Through the discussions, we hope that children can create associations between the topics of conversation and the icon shown.



(a) Using text as content descriptor (b) Using icons as content descriptors

Figure 4.1: Examples of collaborative-training mode layout

3. Communicating appropriateness: Another goal is to have a simple and engaging means of communicating content appropriateness to children. By engaging the children in the testing setting (i.e. game mode), it could be more interesting for them to learn and apply the content appropriateness rules.

We explore the notion of using color to represent content appropriateness, as shown in Fig. 4.2, where inappropriate and appropriate content examples would be highlighted in red and green. However, a drawback of such representation is that it tells the children what is appropriate and what is not instead of allowing them to test their knowledge.

We investigated another way of communicating appropriateness through conducting a game where children could classify some content examples by themselves and get feedback and rewards based on their classification. We explore three different game designs through which children can test their knowledge of the rules (Fig. 4.3). The first game design, shown in Fig. 4.3a, is a simple categorization game, where the

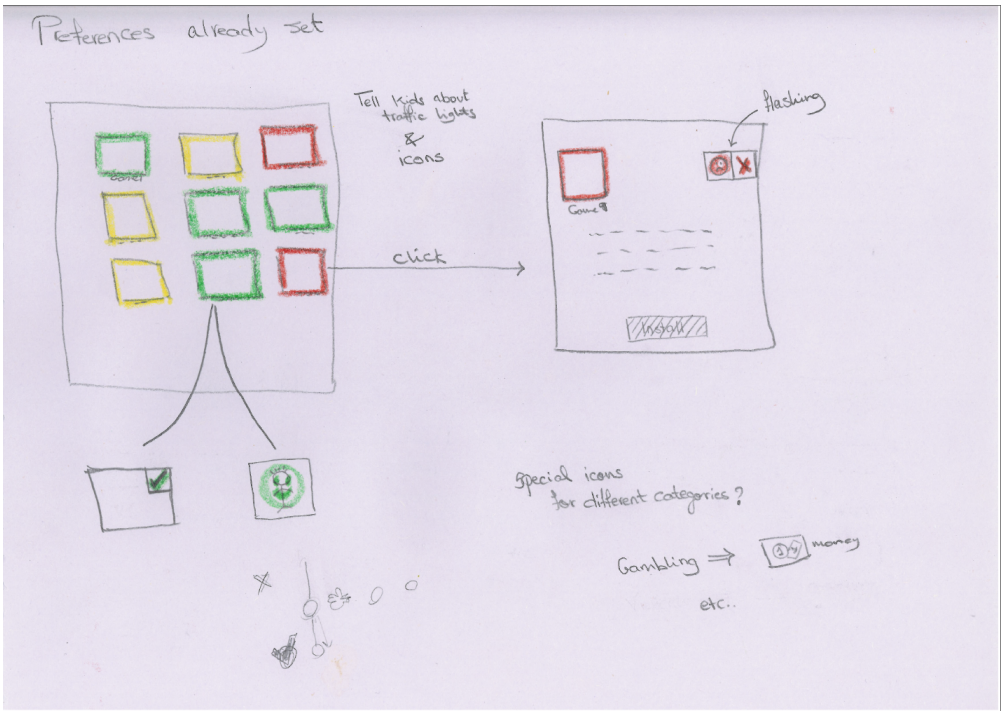
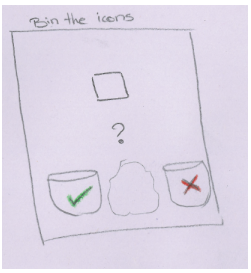


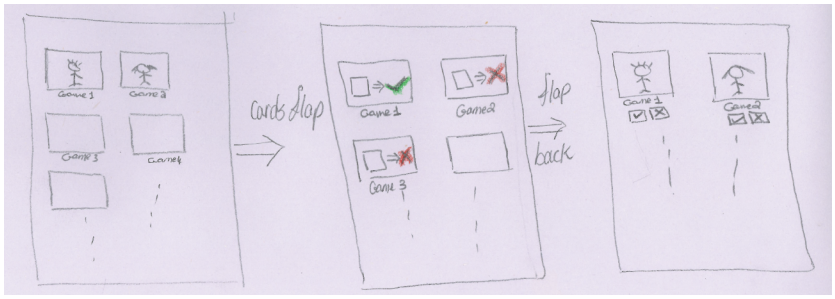
Figure 4.2: Using colors to indicate content appropriateness.

content is classified to either appropriate or inappropriate by clicking on the check or cross bins. Our second game design, shown in Fig. 4.3b, depicts a memory game, where the content's proper classification is shown for a short duration and then the child tries to recall the classification they were shown. The third game design is shown in Fig. 4.3c, where the child classifies a set of examples as a whole and then is given a score and asked to guess what they got wrong. We decided to use the categorization game since it bears resemblance to the way that parents and children classify content together in the collaborative-training mode.

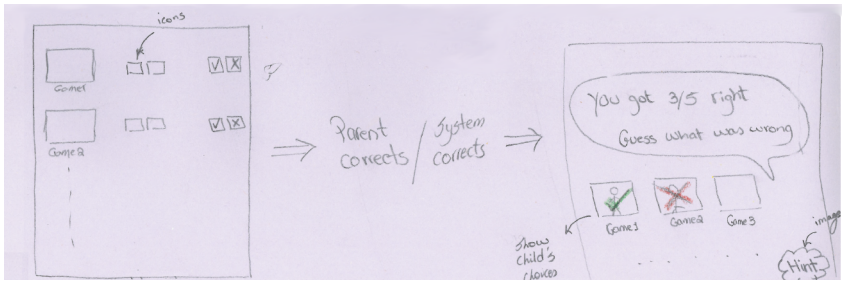
Moving forward with the categorization game, we explored different ideas for rewards and feedback as shown in Fig. 4.4. In the left most frame of Fig. 4.4, the reward is an animated character that becomes happy or upset based on the child's



(a) Categorization game



(b) Memory game



(c) Guessing game

Figure 4.3: Examples of different game designs for game mode.

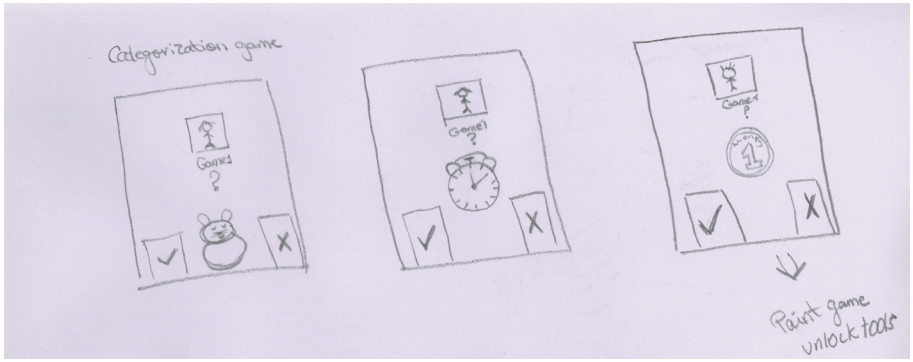


Figure 4.4: Examples of rewards in game mode.

classification. The reward in the middle frame of Fig. 4.4 is in the form of extra minutes that could be added to the child's allowed play time per day, and in the right most frame of Fig. 4.4 the reward is in the form of points or coins that can be accumulated to unlock tools or levels in a separate game that the child can play. We chose the animated character reward since it would give instant feedback and would be understood by younger and older children.

4.2 We-Choose Prototype

From the above prototyping ideas we finalized our interaction approach design and implemented the We-Choose prototype. In this section, we describe We-Choose and its two modes, collaborative-training and game modes, that we use to explore parents' and children's attitudes towards our proposed alternative model of content filtering.

4.2.1 Collaborative-Training Mode: Creating Filtering Rules Collaboratively

The collaborative-training mode follows a simple process: an application is presented on the device, and the parent and child together determine if it is appropriate. After this, another application is presented, until the parent and child together determine that they have worked through enough examples and switch to game mode.

To help drive this discussion and decision, the application includes various pieces of information that can be used by both the child and the parent. As Fig. 4.5

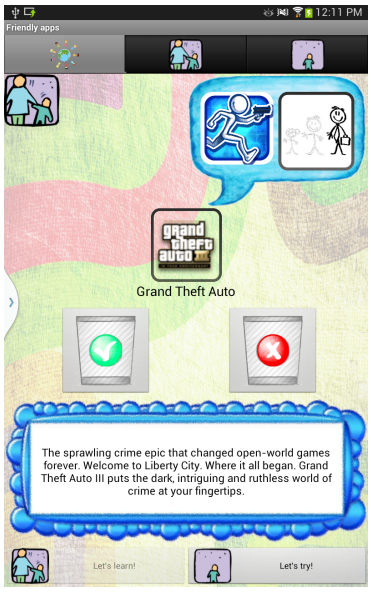


Figure 4.5: Collaborative-training mode showing an application for the parent and child to classify together. This particular application belongs to the action category, and has a high-maturity age rating (depicted by the stick figure).

illustrates, the application presentation includes: the application logo and name in the center, icons above the logo indicating the kind of content, a text description of the application at the bottom of the screen, and two bins used to classify the application: a green check box (as appropriate) or a red 'X' (as inappropriate). The parent and child can then assess the information, discuss why it may or may not be appropriate, and together classify the application.

In our prototype, conforming with our goal of accessibility to children, we have icons indicating appropriate age by relative size of a stick figure, as in Fig. 4.5 and Fig. 4.6, which indicate everyone (all three people sizes in the icon), and a range from young to high maturity (indicated by the person size). Fig. 4.7a illustrates the range of possibilities for this age icon. We also included icons for the application category,

Figure 4.6: Collaborative-training summary screen, which displays a list of applications classified in collaborative-training mode. In this example the two applications at the top were previously classified as appropriate, while the bottom two were not.

which can be one of: action, arcade, puzzle, casual, gambling/casino, educational, sports, racing and adult (Fig. 4.7b). These category and age-rating icons are intended to facilitate conversation about which subject matters or age group applications are considered appropriate for the child. For example, a parent could explain why an application with a gun (violence) may not be appropriate. They could also explain why the child is not able to use applications that have a high-maturity age rating. The same icons are used in the game mode explained below.

Users can also at any time view a summary screen (Fig. 4.6), by tapping the collaborative-training summary tab (Fig. 4.5, top-middle tab), that contains a list of the applications that the parent and child has already seen and shows how they were categorized. This enables the users to refer to previous choices to compare and

Low maturity	
Medium maturity	
High maturity	
Everyone	

(a) Ratings

Puzzle	
Arcade	
Education	
Casual	
Casino/Gambling	
Action	
Sports	
Racing	
Adult	

(b) Categories

Figure 4.7: The rating and category icons used to describe the applications in the prototype.

contrast as part of their discussion. When the parent and child decide that they have had enough training, they can switch to game mode by clicking the "Let's try!" button (Fig. 4.5, bottom).

4.2.2 Game Mode: Exploring What the Child Learned

Game mode tests the child's knowledge of the rules and provides additional discussion and learning opportunities for the child. In game mode (Fig. 4.8), the child works through a number of additional example applications (not previously shown) in a manner similar to the collaborative-training mode; however, unlike previously, in game mode the child has to try to guess whether or not each application is appropriate for them. The expectation is that the child will retain some of the rules

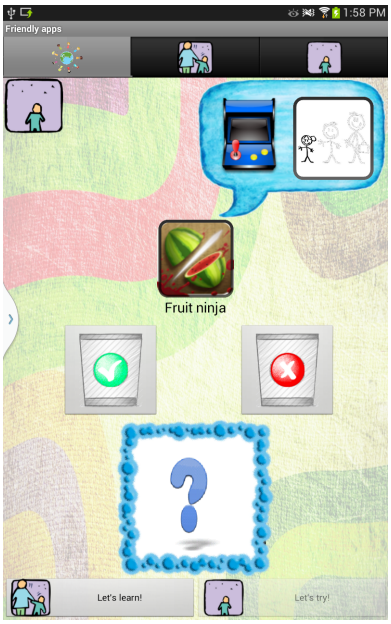


Figure 4.8: Game mode showing an application for the child to classify. This particular application belongs to the arcade category, and has a low-maturity age rating (depicted by the stick figure).

they learned previously with their parents. After guessing, feedback is provided as a happy or sad character animation (4s long, (Fig. 4.9)) accompanied by a clapping or crying sound. Upon completion of all of the examples the prototype switches to a child summary tab displaying all the applications that the child has gone through while playing the game along with their decision and highlights the incorrect choices (Fig. 4.10). This screen can then be used by the parent and child for discussion.

While game mode is primarily designed for the child, parents can continue to be involved, for example by providing discussion and explanation when the child is unsure about why something was or was not appropriate. The mode-oriented design of We-Choose enables parents and children to change back and forth between the modes to fit their own particular discussion and education style.

(a) Right classification (b) Wrong classification

Figure 4.9: Game mode showing the animated character (customizable according the child's preferences) in response to a child's classification.

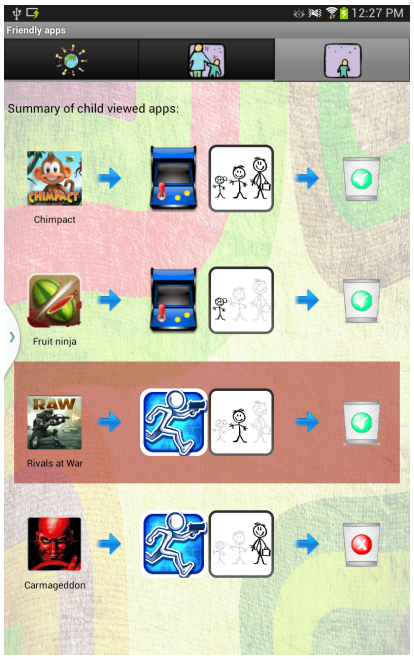


Figure 4.10: Game mode summary screen, which displays a list of applications classified in game mode. In this example the application before the last was misclassified by the child

4.2.3 Prototype Implementation

We-Choose is an Android application running on a tablet computer (Samsung GALAXY Note 8.0) and is a mock-up of an application marketplace with a set of pre-coded (category, maturity) applications based on real Google Marketplace items. We selected this platform as a modern relevant example: mobile devices with a central application repository (e.g., Apple Store, Google Marketplace, or Microsoft Store) are increasing in popularity, and the application-repository model provides a clear (although somewhat simplistic) cutting point for content: an application can either be marked as appropriate or inappropriate.

The internal filter-learning system was simply a mock-up for the purposes of enabling interaction within our proof-of-concept prototype. Through interaction with

the collaborative-training mode the system internally builds a simple set of rules where age ratings and categories are labeled as appropriate or not. Conflicts (e.g., if an action game is rated as appropriate once and inappropriate another time) are not addressed. For a more advanced implementation and future prototype, the learning algorithm itself would need to be properly addressed.

4.3 Summary

In this chapter we presented the design goals and process of our kid-in-the-loop interaction approach, and we elaborate on the different interaction and design ideas that we considered until we reached kid-in-the-loop's final form. We illustrate how kid-in-the-loop is manifested in We-Choose prototype, a public application-repository filtering system, and exhibit the layout design as well.

Chapter 5

Evaluation

In the previous chapters, we described our exploration of parents' views about their children's current-generation technology usage and how we designed and implemented the novel kid-in-the-loop interaction approach based on the findings of our exploration. We consider the kid-in-the-loop approach and the We-Choose instantiation to be a preliminary solution that mitigates some of the concerns and challenges that parents and children face when it comes to content control and filtering. Since an important component of our exploration is to validate our proposed kid-in-the-loop approach, we conducted a lab based study where we introduced the approach, through the use of our We-Choose prototype, to parents and children (published in [20]). The primary purpose of this evaluation was to learn about parents' and children's impressions of our discussion and education-oriented approach.

5.1 Study Method

We recruited thirteen sets of parents and children in the 6-8 year-old age group. In all cases only a single parent participated, all of whom were mothers. Demographic information for our participants is listed in table 5.1. Participants were recruited through signs posted throughout the University of Manitoba's campus and daycare, and in the local community (summer day camps, daycares, bus stops, etc.). Parents received a $10 gift card and children received a small toy or craft. The study was approved by the University of Manitoba's Joint-Faculty Research Ethics Board (Appendix B).

The procedure for each session was as follows. Participants were given a brief (∼3 min.) explanation of the approach and a short demo of the We-Choose prototype; which included going through 5 examples in each of the collaborative-training mode (shown in Fig. 4.5) and the child-learning game mode (shown in Fig. 4.8). The examples shown in the demo were different from the ones used in the full version of We-Choose. The participants were provided with a reference sheet containing all icons used in the prototype (Fig. 4.7) and were told what each icon represents.

After participants completed a short practice session with each mode, we administered the main condition: we clearly explained to participants how they start with collaborative-training mode and could switch back and forth to game mode as they wished, and should not necessarily aim to try and classify all applications in collaborative-training mode. Participants were told to continue until they felt that they clearly explained, and they felt the child understood, the rules they wanted to configure. We-Choose had 40 items that could be classified, 20 for collaborative-

Parent	**Occupation**	**Children's ages and genders**
P1	Insurance agent	Girl: 6 years
P2	Nurse	Boy: 7 years
P3	Graduate student	Girl: 8 years
P4	Unreported	Boy: 6 years
P5	Unreported	Girl: 6 years
P6	University support staff	Boy: 6 years
P7	Unreported	Boy: 6 years
P8	Graduate student	Girl: 6 years
P9	Nursing-home worker/Graduate student	Boy: 8 years
P10	Maid/undergraduate student	Twin Boys: 6 years
P11	Stay-at-home parent	Boy: 6 years
P12	Unreported	Girl: 7 years
P13	Graduate student	Girl: 7 years

Table 5.1: Demographic information of the participants in the prototype evaluation

training mode and 20 for game mode.

We finished with a semi-structured interview with both the parent and child to investigate their impressions of our kid-in-the-loop approach to application selection and filter configuration, and to elicit feedback on the We-Choose instantiation. Each interview started by talking to the child (to mitigate the influence of parents' responses). One parent and child pair stopped part way through the game mode when the child became tired and irritable; however, the parent still participated in the interview. Each session lasted approximately 45 minutes. For the full list of questions refer to Appendix B.

5.2 Study Results

In this section we begin by describing parents' and children's responses to the kid-in-the-loop approach, followed by a discussion of their interactions with We-Choose.

5.2.1 Attitudes Towards the Kid-In-The-Loop Approach

All parents responded very positively to the collaborative content filtering approach, showing interest in using such a system if available. Below we discuss aspects that parents were particularly enthusiastic about.

Discussion catalyst – Our kid-in-the-loop approach and We-Choose instantiation were helpful in facilitating discussion (e.g., by acting as a conversation starter) and giving children an active voice in the content selection process, a point that parents indicated they liked about the system:

> *You can kind of set it and let them decide a little bit more so they have more choices - P4*

Parents were particularly appreciative of the opportunity to start such discussions with their children, with the interface providing context for discussions on what type of content was considered appropriate, and providing opportunities for corrections when there is a misunderstanding:

> *I'd be able to say and talk with them, 'why did you think this was ok?', 'this [application] tells me you chose the wrong answer here', 'how come you chose that?' and have a discussion and poke at the problem and see what goes on - P10*

Some parents believed that the benefits will go beyond the initial discussion session:

> *It was educative, because right now, when we leave this room we can talk about this and see there are some apps that are proper and some improper - P13*

Parents also saw opportunities to extend discussions on appropriateness to the whole family:

> *It also makes you sort of need to discuss what is appropriate and what is not appropriate and to sort of clarify the guidelines for the family - P12*

Two of the above participants went on to discuss how the approach might encourage them to carve out time for more of this type of discussion time with their kids:

> *It is often hard to find time to sort of address the values of the family or the beliefs of the family or moral and ethics. So if you have a chance to sit down and do something like this together then we can talk about it. I think it creates a dedicated time and space to do it, whereas everyone is busy all the time. Everyone is running here and there - P12*

> *I can use it when I'm ready to be present with it and really connect with them using this thing and use that opportunity to establish ourselves for a period of time so I know that the maintenance is done - P10*

In comparison to other education methods, such as the traditional sit-down conversation, some parents felt that our method would provide an easier and more fun way to teach their children the guidelines of what is appropriate:

> *It provides a conversation, it is a nice way, an easy way to bring up a topic in a way that is more visual and fun instead of me sitting there and telling him what we can and cannot do - P6*

Reducing the content-filtering burden – Parents again here (as in our exploratory study) indicated the complexity of content selection and filtering:

> *I find it hard to sort through [application store] myself, I don't know if a 10 year old would be able to figure that out because often I'd look at that stuff and I'd be like 'I don't even know' - P2*

Parents also felt that the kid-in-the-loop approach could simplify their selection process, for example, by acting as a first-pass filter:

> *It seems to be like a filter, where it alleviates or eliminates all of the other apps that I wouldn't agree to her having anyway - P1*

Many pointed to the benefits of our particular design decision of using icons for appropriateness:

> *I myself might not know if it is good for her or not, but having this thing, which gives more information if it is appropriate or not, will help the parent definitely - P8*

> *This system helps me quickly distinguish between the appropriate and inappropriate so that I can include some of the things that I may have not included - P10*

Diagnostic tool – Participants reported seeing potential for using the kid-in-the-loop approach to gain insight into their children's comprehension of rules and what is appropriate, as well as their interests:

> *It was fun and it was really interesting for me to see her work away at this herself and I guess discovering that we sort of share these feelings about what is appropriate and what is not appropriate - P12*

> *I liked that as a learning tool and I really enjoyed that when I withdrew that they knew and that they were able to follow - P10*

> *It lets you know what your child is interested in - P12*

One parent also felt that it helped develop her confidence in her child's understanding:

> *Having something like that, with all the apps out there would really boost my confidence by showing him at this age how he can tell what is appropriate and what is not - P6*

Children's reactions – While children were less vocal in the interviews than their parents, they also responded positively to the kid-in-the-loop approach. For example, expressing interest in the game or having their own voice:

> *I think that I like that game so that you can sort of choose your apps - C2*

Another child commented that it was enjoyable to work with their parent:

> *I liked playing with my mom, because sometimes it is hard [to decide] - C13*

Maintaining final approval – While parents were enthusiastic about the approach, many still indicated that they would not fully delegate control to such a system:

> *Because he still can't read, he could install something and get frustrated with it even if it is age appropriate [...] I'd prefer to know just to give him a bit of a warning first, so even though it would be age appropriate for a range of kids, for him it may not be exactly what he was thinking - P4*

Part of this is due to the inherently subjective nature of what is appropriate:

> *At the final stage [before installation] I still want to see what it is [that child has chosen]... Even though some toys are made for the kids but we may think it is not okay for him to have it, it's the same for the apps. Sometimes the industry thinks it is good but we don't - P9*

As a middle ground, many proposed that automatically approved or child-selected applications could perhaps be added to a "pending" list for review:

> *If I could say 'you pick which ones you want' and then I approve, that is probably easier. That's probably a better way of doing it instead of just letting him go ahead - P6*

Parents' reluctance to fully trust the resulting filters is not unique to our approach - similar attitudes have been expressed in prior studies on content filters and blocking software [34].

5.2.2 Explanation Styles and Discussion Strategies

Using video recordings of the sessions, we examined how parents explained and discussed application appropriateness with their children while using our prototype and approach. Most parents' explanations (9/13 parents) depended heavily on the

application age ratings (the stick-figure icons shown in Figures 2-4), perhaps even more so with children who could not yet read. To explain the icon meanings to children, some parents spent time working through the reference sheet that we provided (the sheet containing the range of icons shown in Fig. 4.7):

> *This is a game that everybody should be able to play because all the people are highlighted. This means it is for little kids. This one, just by looking at the picture, [is] for medium maturity or kids that are probably [your brother's] age [10 years-old] and up. And then high maturity is really for like adults only because they took out the little ones. So you can look at that for a clue whether it is good for you. So if you look at these which ones should you be playing? - P5*
>
> [C5 points at the "low maturity" age-rating icon]
>
> *What else has a little kid? - P5*
>
> [C5 points at the "everyone" age-rating icon]
>
> *That's right because it means it is for everyone - P5*

Other parents instead used the context of a particular application to explain:

> *Is this a good game or not? - P10*
>
> *A good game - C10*
>
> *Why? - P10*
>
> [C10 points at the "everyone" age-rating icon]
>
> *See, it shows all of us - C10*
>
> [P10 points at "low maturity" age-rating icon]
>
> *Who is this one good for? - P10*
>
> *Me, for little kids - C10*
>
> *So what are you going to push? - P10*
>
> *Yes - C10*

The application categories (action, puzzle, gambling etc.), on the other hand, were not as heavily utilized by parents, with only three parents incorporating category extensively into their discussions, for example:

> *Pool break, this is playing pool. See this one [pointing to sports category icon] it is a sports game and this is for everyone it says, anyone can play it - P7*
>
> *What does this [application icon] look like to you? You don't know? It looks like someone is looking through a gun. This looks like blood, and this guy here is running with a gun [pointing to action category icon], so I think no, that is not appropriate - P12*
>
> *Here it says puzzle and that's good, go ahead. Anything that helps us think is good - P13*

These explanations further illustrate how parents wanted their children to not only identify which categories are appropriate or not appropriate, they also wanted their children to understand why, and used the discussion as a means to communicate this.

5.2.3 We-Choose Use Strategies in the Collaborative-Training Mode

All but one set of participants completed the entire collaborative-training mode before their child started using the game mode (12/13). Most of the parents (9/13) actively involved their children while in collaborative-training mode, explaining the ratings and categories and asking their child to guess whether or not the application would be considered appropriate. Seven parents used this strategy from the start, while two parents worked through a couple of examples first before asking their child to guess. Three parents provided explanations as they went through the applications but did not ask their child to venture guesses as to their appropriateness.

One group moved back and forth to game mode before completing all examples in collaborative-training mode; when asked, this parent indicated she chose this strategy

because she wanted to both keep her explanations fresh in her child's mind and keep her child engaged by giving her a chance to actively interact with the prototype:

> *I thought maybe it will be easier for her when I let her do her task just after it. I thought that if I talk and don't let her touch anything for a long time she would have said 'I don't want this' [...] it's a break for her that I give her a chance to touch it - P8*

5.2.4 Interactions in the Game Mode

For the most part, parents let their children play the game mode completely by themselves, only occasionally stepping in to clarify misconceptions. For example, when C3 made mistakes, her mom reminded her to look at the age-rating icon and use it to decide:

> *Just look at this picture here and if it is suitable for your age or not - P3*

In the case of the twins, they played the game together, and worked collaboratively through their reasoning:

> *Is this one good for you guys or not good for you? - P10*
> *No - Twin1*
> *[Twin1's name] look - Twin2*
> [Twin2 points at "everyone" age-rating icon]
> *Little people, big people, really big people - Twin1*
> *So is that a good one or not? - P10*
> *Yes - Twin1*

The children seemed to enjoy playing the game, despite the fairly basic design (e.g., no sophisticated plots, graphics or animation) and educational focus. Children enjoyed the rewards for good performance and appeared to take it very seriously. One child

(C6) wanted to change an answer he got wrong, and commented "I'm good at this game!" when he got a series of examples correct. C10 happily exclaimed "Mom, we keep getting it right!" indicating that he was enjoying playing the game with his mom there to help. Another child (C4) upon completion turned to his mom and the experimenter and asked: "Can I play again?"

The children performed very well in game mode: average 18.2/20 correct responses (stdev 2.9) with seven children classifying all applications correctly. For the children who got wrong answers, interviews revealed that they were also factoring in whether or not they thought they would like the application in addition to the appropriateness. For one child, who scored 11/20, we noted that the parent's rules about appropriateness were not consistent with our criteria (some of which were based on particular application preference) which appeared to be the source of confusion.

5.3 Discussion

Our results indicate that parents saw a great deal of value in the discussion opportunity, above and beyond simply creating filters. The approach provides context (real applications) within which meaningful discussions about rules and values can take place, as well as an excuse, opportunity, and fun way to discuss things which may be less interesting for the child or may be ignored otherwise.

Although our approach's target activity involved setting content filters, filtering itself was seen as a secondary point (to the benefit of facilitating discussion) in our results. While some parents highlighted the time and effort saving potential of such a system, many indicated that they may not trust a filter that learns from the demon-

strations. We note that despite this, these parents still indicated the value from an educational standpoint.

The We-Choose prototype was successful in its goal of enabling initial kid-in-the-loop interaction sessions. No problems arose that hindered interactions, and participant feedback was generally positive. We do note that families approached the interaction in a variety of ways (e.g., collaborative-training then game mode, going back and forth, or pre-learning icons) and We-Choose supported these differences; future work should likewise consider such flexibility.

Overall, the results of our study support the kid-in-the-loop approach to content control and filtering. The discussion and education approach was well received by parents, who appreciated the facilitation of meaningful discussions with their children, and there was indication of at least short-term learning on behalf of the children (they learnt their parent's rules during our session). There was also some indication that children themselves appreciated having some input into these control type decisions. As such, we strongly believe that this is a promising direction for future tools and approaches to enabling parents and their children to work and discuss together to configure control and restrictions for internet-capable, modern technology.

5.4 Summary

In this chapter we presented the study that we conducted for evaluating our proposed kid-in-the-loop approach. This study involved sets of parents and their children experimenting with our approach through the We-Choose instantiation described in chapter 4. The results of our study show that parents greatly appreciated the dis-

cussion opportunity that We-Choose provided and perhaps considered it as the most important feature of the approach. The results also gave indications of the children's short-term learning of the rules and indicated the children's liking of our approach and their ability to contribute to the content control process. We also note that parents were wary of fully trusting the system to block or allow their children's access to content; this indicates the need for devising different interaction methods for parents, allowing them to better trust the system, subsequently reducing the content control burden. Based on these findings, we can see a great potential for future work in developing tools and approaches that facilitate and encourage parents and their children to work together towards the goal of content control and filtering for internet-capable, modern technology.

Chapter 6

Conclusion

In this thesis, we investigated how parents and children can work together towards the goal of content control and filtering. We conclude this thesis by discussing several areas for future research and development in this direction and presenting the research contributions.

6.1 Limitations and Future Work

The work presented in this thesis is a first step towards exploring collaborative parent-child interaction in the context of content control and filtering. Our implementation and evaluation can be seen as an initial test-bed for kid-in-the-loop education and discussion-oriented content filtering, where our positive results leave a rich breadth of future work.

One possible area for future work is to further expand the scope of our investigation to learn the impact of different demographic variables. While we targeted young

children in our work, at least some parents saw benefits for slightly older children. Looking into different age ranges, the children's gender or the family's socioeconomic status - and how this may change the requirements and mechanics - is an important direction for future work as well.

While the results of our evaluation study indicated short term learning on behalf of the children, a promising future direction would be to conduct a longitudinal study where we deploy our system in-home. A longitudinal study would allow us to investigate long-term learning effects of our approach, after the novelty effect of the system wears off. An in-home study would also allow us to observe how our approach integrates into the families' daily lives away from the social pressure of a study environment.

Another possible direction for future work is to further improve the prototype design, which could provide better support to the children's learning process. For example, we had selected the visual representations of the content types and appropriateness in our prototype heuristically. While they appeared to be accepted and understood by both parents and children; future work should take a more structured approach to developing improved representations, for example, that cover additional dimensions such as length of play session, or theme (fantasy and dragons, etc.). In addition, there may be no need to be limited to icons, and other child-friendly representations such as video, color schemes, sounds, and so forth, should be explored.

Our use of reward and feedback (through happy or sad animations) may have been somewhat simplistic, and it will be interesting to consider a more fine-grained setup, or how to maintain the reward benefit as the novelty of the animation wears

off. For example, point systems (e.g., to unlock tools or games) could be explored.

While our particular discussion facilitation structure was successful, future work should explore additional mechanics. For example, rather than having learning and training mode, perhaps a system could prompt discussion points when inconsistencies were noted, or could automatically suggest when testing should take place.

Finally, we took a minimalist approach to the technical components of content-learning as our research was focused on the kid-in-the-loop discussion aspect and not on the adaptive technologies. Moving forward, it will be important to consider how content may actually be tagged in real marketplaces, how such tags may be represented through approaches such as ours, and how a system should properly learn based on a small number of examples.

6.2 Research Contributions

In this thesis, we presented a novel approach to child-oriented content control for internet-capable devices, which keeps the child in the loop and emphasizes education and discussion over simply setting rules. To commence our investigation we conducted a qualitative open-ended study to explore the current-generation technology used by children, and to elicit the parents' opinions and concerns about their children's technology interaction. The results highlighted the importance parents place on maintaining appropriate content, and the high amounts of energy that parents expend to control content. Guided by these results, we developed a new kid-in-the-loop collaborative approach that focuses on child involvement and education. Next, we designed and implemented a prototype as an initial kid-in-the-loop software platform,

and conducted a second study to investigate how parents and children may react to and use such an approach.

The results of our second study illustrated how parents considered the collaborative, educational approach to be an easy and engaging way of facilitating discussion, and also illustrated how children can learn about content appropriateness through this approach. Our findings provided evidence that children learn (at least in the short term) from these sessions. Both parents and children in our study expressed a great deal of enthusiasm about the idea and our instantiation, and many parents provided suggestions of how it may be useful beyond our use case. This positive reception provides support that our kid-in-the-loop approach may be accepted as a valid interaction approach between parents, children and technology, and affirmed our leading research questions described in Chapter 1. Our work has contributed to the field of HCI by presenting:

- *Survey of family's attitudes towards current-generation technology*: We presented updated insight into a family's views on current-generation technology while focusing on actual interactions between parents, children, and technologies.

- *Kid-in-the-Loop approach*: We presented a collaborative and educational approach to content filtering that focuses on involving and educating children about content appropriateness.

- *We-Choose prototype*: We presented an instantiation and a proof-of-concept to our kid-in-the-loop approach with the purpose of having a viable tool for evaluating our proposed approach.

- *User population feedback*: We presented a comprehensive evaluation and analysis of our kid-in-the-loop approach, through introducing We-Choose to parents and children. This analysis can be leveraged in designing content control systems targeting both parents and children.

Based on the results of our evaluation, we believe that kid-in-the-loop approach has promise and can serve as an important part of modern internet-capable technologies for which little has been done in terms of parent-child collaborative content filtering.

Appendix A

Interview Questions

Our questions targeted finding more information about the following:

- Child's age/gender/siblings
- Whether the child goes to daycare/preschool/school and for how long
- Technology devices and applications that the child uses at home or at daycare/preschool/school
- Devices/applications that the child likes and uses the most
- Place and time at which the child interacts with technology during summer and the school year
- People with whom the child shares the technology interaction time
- Parent's likes/dislike about child's technology interaction
- Parent's criteria in purchasing new device for child

- Whether parents teach children how to use new devices
- Difficulties that children face in technology interaction
- Whether children request parent's help and how often
- Parent's wishes in devices/applications

Ethics Certificate

University of Manitoba's Joint-Faculty Research Ethics Board approval to the exploratory study (Chapter 3).

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-8880
Fax +204-269-7173

APPROVAL CERTIFICATE

July 23, 2012

NSERC

TO: **Andrea Bunt**
Principal Investigator

FROM: **Wayne Taylor, Chair**
Joint-Faculty Research Ethics Board (JFREB)

Re: **Protocol #J2012:111**
"Exploring Children's Interaction with Adaptive Interfaces"

Please be advised that your above-referenced protocol has received human ethics approval by the **Joint-Faculty Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement (2). **This approval is valid for one year only**.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **If you have funds pending human ethics approval, the auditor requires that you submit a copy of this Approval Certificate to the Office of Research Services, fax 261-0325 - please include the name of the funding agency and your UM Project number. This must be faxed before your account can be accessed.**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Quality Management Office may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans.*

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/orec/ethics/human_ethics_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

Appendix B

Interview Questions

Our questions to the children targeted finding more information about the following:

- Whether the child liked/disliked We-Choose and why
- How easy/difficult was using We-Choose
- Whether the child understood and remembered the meaning of the category and rating icons
- The children's opinion about the rewards used
- The strategy implemented by parents to control content and child's opinion
- Whether the child prefers using We-Choose with the parent as opposed to current control strategy
- The child's reasoning in classifying a specific application

Our questions to the parents targeted finding more information about the following:

- Parent's current content control strategy and its advantages/disadvantages
- Opinion of We-Choose and likes/dislikes
- Opinions of kid-in-the-loop approach
- How often parents would use We-Choose if it were available to them
- Opinion of rewards used
- How often would parents want their children to test their understanding of rules through game mode
- Whether parents would be comfortable with their kids gaining access to apps based on the rules created or if parents would still want to approve what their kids can use
- How would parents like to be notified of their children activity and their opinion of the summary page
- Whether parents foresee this approach used in things other than app market place, and if yes then what
- Which icons were more important/helpful during the collaborative-training mode and why
- Whether parents trust market place categorization
- Whether parents would use We-Choose instead of their current content control strategy

Ethics Certificate

University of Manitoba's Joint-Faculty Research Ethics Board approval to the evaluation study (Chapter 5).

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Fax +204-269-7173

APPROVAL CERTIFICATE

June 25, 2013

Grand NCE

TO: **Andrea Bunt**
Principal Investigator

FROM: **Susan Frohlick, Chair**
Joint-Faculty Research Ethics Board (JFREB)

Re: **Protocol #J2013:091**
"Creating Adaptive Interfaces for Children-Computer Interaction"

Please be advised that your above-referenced protocol has received human ethics approval by the **Joint-Faculty Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement (2). **This approval is valid for one year only**.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **If you have funds pending human ethics approval, please mail/e-mail/fax (261-0325) a copy of this Approval (identifying the related UM Project Number) to the Research Grants Officer in ORS in order to initiate fund setup. (How to find your UM Project Number: http://umanitoba.ca/research/ors/mrt-faq.html#pr0)**

- **if you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Quality Management Office may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans.*

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/orec/ethics/human_ethics_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

Bibliography

[1] Morgan G. Ames, Janet Go, Joseph'Jofish' Kaye, and Mirjana Spasojevic. Understanding technology choices and values through social class. In *Proceedings of the ACM 2011 conference on Computer supported cooperative work*, pages 55–64. ACM, 2011.

[2] Will Archer Arentz and Bjørn Olstad. Classifying offensive sites based on image content. *Computer Vision and Image Understanding*, 94(1):295–310, 2004.

[3] Erica Weintraub Austin. Exploring the effects of active parental mediation of television content. *Journal of Broadcasting & Electronic Media*, 37(2):147–158, 1993.

[4] Hugh Beyer and Karen Holtzblatt. *Contextual design: defining customer-centered systems*. Morgan Kaufmann, 1997.

[5] Michael D. Byrne. ACT-R/PM and menu selection: Applying a cognitive architecture to HCI. *International Journal of Human-Computer Studies*, 55(1):41–84, 2001.

[6] Jennifer L. Chakroff and Amy I. Nathanson. Parent and school interventions:

Mediation and media literacy. *The handbook of children, media, and development*, pages 552–576, 2008.

[7] Andrew Dillon, John Richardson, and Cliff McKnight. The effects of display size and text splitting on reading lengthy text from screen. *Behaviour & Information Technology*, 9(3):215–227, 1990.

[8] Alan Dix, Janet Finlay, Gregory Abowd, and Russell Beale. *Human-computer interaction*. Prentice Hall Englewood Cliffs, 2004.

[9] Matthew S. Eastin, Bradley S. Greenberg, and Linda Hofschire. Parenting the internet. *Journal of Communication*, 56(3):486–504, 2006.

[10] Desmond Elliot, Richard Glassey, Tamara Polajnar, and Leif Azzopardi. Finding and filtering information for children. In *Proceedings of the 33rd international ACM SIGIR conference on Research and development in information retrieval*, pages 702–702. ACM, 2010.

[11] Jonathan L. Freedman. Long-term behavioral effects of cognitive dissonance. *Journal of Experimental Social Psychology*, 1(2):145–155, 1965.

[12] Yuki Fujioka and Erica Weintraub Austin. The relationship of family communication patterns to parental mediation styles. *Communication Research*, 29(6):642–665, 2002.

[13] Douglas A. Gentile. *Media violence and children: A complete guide for parents and professionals*, volume 22. Greenwood Publishing Group, 2003.

[14] Douglas A. Gentile and David A. Walsh. A normative study of family media habits. *Journal of Applied Developmental Psychology*, 23(2):157–178, 2002.

[15] Richard Glassey, Desmond Elliott, Tamara Polajnar, and Leif Azzopardi. Interaction-based information filtering for children. In *Proceedings of the third symposium on Information interaction in context IIiX*, pages 329–334. ACM, 2010.

[16] Joan F. Goodman. Moral education in early childhood: The limits of constructivism. *Early Education and Development*, 11(1):37–54, 2000.

[17] Diana L. Graf, Lauren V. Pratt, Casey N. Hester, and Kevin R. Short. Playing active video games increases energy expenditure in children. *Pediatrics*, 124(2):534–540, 2009.

[18] Patricia Greenfield and Zheng Yan. Children, adolescents, and the internet: A new field of inquiry in developmental psychology. *Developmental psychology*, 42(3):391, 2006.

[19] Yasmeen Hashish, Andrea Bunt, and James E. Young. Parents' views on their children and technology: exploring the potential for adaptive interfaces to improve child-computer interactions. University of Manitoba, Technical Report, 2013, 2013.

[20] Yasmeen Hashish, Andrea Bunt, and James E. Young. Involving children in content control: A collaborative and education-oriented content filtering approach.

In *Proceedings of the ACM Conference on Human Factors in Computing Systems*, page to appear. ACM, 2014.

[21] Hilde T. Himmelweit, Oppenheim Abraham Naftali, and Pamela Vince. *Television and the child: An empirical study of the effect of television on the young.* Oxford University Press, 1958.

[22] Weiming Hu, Haiqiang Zuo, Ou Wu, Yunfei Chen, Zhongfei Zhang, and David Suter. Recognition of adult images, videos, and web page bags. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMCCAP)*, 7(1):28, 2011.

[23] Nicholas Jackson. More kids can work smartphones than can tie their own shoes. http://www.theatlantic.com/technology/archive/2011/01/more-kids-can-work-smartphones-than-can-tie-their-own-shoes/70101/, 2011.

[24] Christian Jansohn, Adrian Ulges, and Thomas M. Breuel. Detecting pornographic video content by combining image features with motion information. In *Proceedings of the 17th ACM international conference on Multimedia*, pages 601–604. ACM, 2009.

[25] Woongryul Jeon, Youngsook Lee, and Dongho Won. Analysis of content filtering software. In *Human Interface and the Management of Information. Interacting with Information*, pages 548–557. Springer, 2011.

[26] Robert V. Kail and Theresa Zolner. *Children. A chronological approach.* Pearson, Education Canada, 2005.

[27] Albert Kienfie Liau, Angeline Khoo, and Peng Hwa Ang. Parental awareness and monitoring of adolescent internet use. *Current Psychology*, 27(4):217–233, 2008.

[28] Sonia Livingstone. Strategies of parental regulation in the media-rich home. *Computers in human behavior*, 23(2):920–941, 2007.

[29] Sonia Livingstone and Leslie Haddon. *Kids online: opportunities and risks for children*. The Policy Press, 2009.

[30] Sonia Livingstone and Ellen J. Helsper. Parental mediation of children's internet use. *Broadcasting & electronic media*, 52(4):581–599, 2008.

[31] Susan McKenney and Joke Voogt. Technology and young children: How 4–7 year olds perceive their own use of computers. *Computers in Human Behavior*, 26(4):656–664, 2010.

[32] Clea McNeely and Jayne Blanchard. *The teen years explained: A guide to healthy adolescent development*. Center for Adolescent Health at Johns Hopkins Bloomberg School of Public Health Baltimore, MD, 2009.

[33] Joshua Meyrowitz. *No sense of place: The impact of electronic media on social behavior*. Oxford University Press New York, 1985.

[34] Kimberly J. Mitchell, David Finkelhor, and Janis Wolak. Protecting youth online: Family use of filtering and blocking software. *Child abuse & neglect*, 29(7):753–765, 2005.

[35] N. Mohseni. The relations between moral and social development in 6 to 12 year old children. *Enfance*, 34(1–2):75–84, 1981.

[36] Amy I. Nathanson. Parent and child perspectives on the presence and meaning of parental television mediation. *Journal of Broadcasting & Electronic Media*, 45(2):201–220, 2001.

[37] Michael Quinn Patton. *Qualitative evaluation and research methods* . SAGE Publications, inc, 1990.

[38] Jean J. Schensul and Margaret Diane LeCompte. *Essential ethnographic methods*, volume 3. Rowman Altamira, 2012.

[39] Wilbur Schramm, Jack Lyle, and Edwin B. Parker. *Television in the lives of our children*. Stanford University Press, 1961.

[40] Garth Shoemaker, Leah Findlater, Jessica Q. Dawson, and Kellogg S. Booth. Mid-air text input techniques for very large wall displays. In *Proceedings of Graphics Interface 2009*, pages 231–238. Canadian Information Processing Society, 2009.

[41] Katie A. Siek, Yvonne Rogers, and Kay H. Connelly. Fat finger worries: how older and younger users physically interact with PDAs. In *Human-Computer Interaction-INTERACT 2005*, pages 267–280. Springer, 2005.

[42] Carolyn Snyder. *Paper prototyping: fast and simple techniques for designing and refining the user interface*. Academic Press, 2003.

[43] Bea Van den Bergh and Jan Van den Bulck. Media use, perceived parental media guidance and supportive parent-child commmunication in fifth and sixth graders. *Communications*, 24(3):329–350, 2009.

[44] Sarita Yardi and Amy Bruckman. Income, race, and class: exploring socioeconomic differences in family technology use. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 3041–3050. ACM, 2012.