Understanding User Reviews of Adolescent Mobile Safety Apps: A Thematic Analysis

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ABSTRACT

With the growing use of mobile smart phones among teens, adolescent online safety is becoming more and more challenging. To overcome this problem, parental control applications have been developed. Yet, no one knows why these apps have very low adoption rates nor if they are effective. To address this problem, we previously conducted a structured analysis of existing adolescent online safety apps. In this paper, we briefly summarize our previous results and introduce our new approach for gaining additional insights from the actual users of these apps. We summarize our methodology for doing this and present the results of an initial thematic analysis of user reviews of adolescent online safety apps.

Keywords

Adolescent Online Safety; Value Sensitive Design; Parental Control

ACM Classification Keywords

K.4.1 [Public Policy Issues]: Ethics, Human safety, Privacy

1. INTRODUCTION

Teens experience rapid, developmental growth in adolescence and are more susceptible to certain risks as they seek out new social experiences [3,4,19]. Teens are also early and eager adopter of internet and mobile technologies, which make them vulnerable to new social risks. According to a 2015 survey by Pew Research, 91% of teens in the U.S. use mobile phones to surf the internet [1]. They communicate with friends and/or strangers using social networking sites (75% of teens have access [18]), video chatting applications (47% of teens use [1]), and social media applications (37% of teens use [1]). Due to such prolific use of smartphones, it is highly likely that teens may encounter risky online situations such as cyberbullying, exposure to unwanted explicit materials, harassments, or sexual solicitations [16].

To overcome this problem, parental control software for mobile devices is available [22]. However, it is reported that only 16% of parents install such monitoring software on their teens' phones [17]. Researchers have conducted very little research on the currently available mobile apps that promote adolescent online safety. Therefore, it is unclear why parental control apps have

such a low adoption rates. To answer this question, our recent work [21] explored the features that are available in 75 adolescent mobile safety apps built for Google Android devices. We found that features were highly unbalanced in terms of focusing more heavily on increased parental control over promoting teen self-regulation. However, we were unable to understand from a user's perspective whether or not these features met the needs of the users. As such, we have designed a follow-up study to better understand why these apps get high or low ratings. We conducted an initial empirical investigation of adolescent online safety apps by unobtrusively scraping user reviews from Google's Android Play store. We then performed a thematic analysis of user reviews to explain emergent themes reflected by users who gave feedback for these parental control apps. Our initial results confirm our hypothesis that there is a disconnect between users' needs and the design of adolescent online safety apps, especially from the vantage point of teens. Our end goal is to create a parental control software prototype, which will help promote adolescent online safety that meets the needs of both parents and teens without compromising too much of a teen's privacy.

2. RELATED WORK

Technical mediation refers to the use of software to mediate teen online risk exposure and is a form of restrictive mediation used by parents to monitor inappropriate activity conducted on a teen's mobile devices [6]. Most researchers have studied technical mediation for home computers, not for smart phones [15,17]. Some research has focused on mobile contexts. For instance, Hasish et al. [11] created an app "We-Choose" for kids of ages between 6 and 8 to collaboratively configure technical mediation. Ko et al. [14] implemented similar app "FamiLync" to promote parent-teen co-learning of internet use. A common theme between these studies is that more collaborative approaches helped to reduce negative smartphone behaviors and nourish parent-teen relationships [14]. However, in our recent work [21], we found that most mobile apps currently available for adolescent online safety do not take collaborative approaches. Instead, they emphasize parental monitoring and restriction of teens' mobile activities. Therefore, the current study builds upon these findings to investigate whether there is a disconnect between the mobile apps that are currently available on the market and users' needs. If so, we aim to better understand this gap and design solutions to close it.

3. THEORETICAL FOUNDATIONS
3.1 Value Sensitive Design

Value sensitive design (VSD) is defined as "a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process" [8 p. 55]. In VSD, conceptual, empirical, and technical investigations can both reflectively

identify and proactively account for values that are embedded into the design of systems [9]. Conceptual investigations talk about philosophical discussions about values, and the design trade-offs among competing values. Empirical investigations are about the human context in which a technology is used (e.g., user studies). Finally, technical investigations involve examining existing features within technology that may support or hinder human values [9]. In our work, we used the lens of VSD and applied it to *family value systems*. Family systems are the most important institution of modern society; family values are socially constructed and become an integral part of us [13]. The values (e.g., obedience, discipline, honesty, transparency, trust, openness, etc.) we acquired throughout our life also play a pivotal role in our parenting styles [23].

The principles of VSD have been applied to the context of teen mobile safety in the past. Czeskis et al. [5] conducted scenario-based interviews with nine pairs of teens and parents regarding online safety to identify key technical challenges for design and they used the value-sensitive design approach. According to their study, safety, trust, and privacy caused tension between parents and teens and recommended design guidelines to overcome these tensions [5]. In our feature analysis work, we reverse-engineered the values embedded in the design of existing mobile apps so that we can understand how technical mediation is used for mobile online safety and identify the limitations of currently available apps that promote adolescent online safety. Our feature analysis study involved both a conceptual and technical investigation of the values embedded in the design of mobile apps that promote adolescent online safety, while our thematic analysis involves an empirical investigation by focusing on the human context of use.

3.2 Teen Online Safety Strategies

By synthesizing literature from developmental psychology, we developed a framework of Teen Online Safety Strategies (TOSS; **Figure 1**), which consider both parental control and teen-self regulation as strategies for keeping teens safe online [21]. Our framework is built upon following assumptions: 1) parents have some control over teens' online activities [15], and 2) teen autonomy also has an influence on adolescent online safety [7]. Based on our framework, adolescent online safety is an outcome of both effective parenting *and* a teen's own self-regulatory
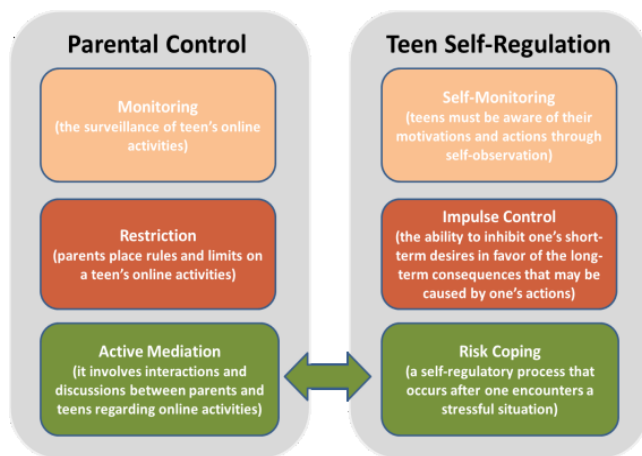

Figure 1. Teen Online Safety Strategies (TOSS) Theoretical Framework.

behaviors. Parents can influence teen online safety through *monitoring*, *restriction*, and *active mediation*. Three main strategies for teen self-regulation are *self-awareness*, *impulse*

control, and *risk coping*. In **Figure 1**, an explicit relationship between active mediation and risk coping is shown as teens seek help from their parents while they experience risk. The other strategies are placed side-by-side to show similar strategies (e.g., parental monitoring versus teen self-monitoring) that diverge based on the placement of agency on parents versus teens.

4. RESEARCH CONTRIBUTIONS

It is known from the previous literature that the existing technical mediation solutions are generally not popular parental mediation strategy for promoting adolescent online safety through mobile devices. We still don't know *why* there is a gap between the technical mediation solutions that currently exist and the solutions proposed in the research that are not readily available for use. In this work, we make the following contributions:

1) *Summarize our recent related work, which included creating a conceptual framework of Teen Online Safety Strategies (TOSS) shown in Figure 1 to represent a more balanced approach for adolescent mobile safety.*

2) *Present and build upon our results of a structured feature analysis of 75 mobile apps that mapped to the TOSS framework.*

3) *Introduce a method for conducting an unobtrusive, empirical user study of adolescent online safety apps by scraping publicly available user reviews from the Android Play store.*

4) *Highlight some of our initial results from a thematic analysis of user reviews to explain emerging themes that emerged from users who provided feedback for these parental control apps.*

5. METHODS
5.1 Data Collection

For the feature analysis, we identified 75 mobile apps designed for the purpose of adolescent online safety and conducted a structured analysis of the features available within these apps during April/May of 2016. We performed our analysis on apps available on the Android platform as Android has 83% market share of smartphones [24]. We built our initial list of 89 apps by a keyword search on the Google Play app store. The keywords we used for our search were: "online safety," "family safety," "teen safety," "adolescent online safety," "parental controls," "parental monitoring, "teen monitoring," "cyberbullying," and "sexting." We had to delete 14 apps upon installation due to various usability issues. The technical investigation of the apps was done systematically by the researchers but did not take into the perspective of actual users.

To conduct our empirical investigation, which was based on actual users' reviews, we used a program called Heedzy [25] to download all of the reviews for the 75 apps, which were included in the feature analysis. We did this in August 2016. In our dataset, each user review had the following attributes as shown in **Table 1**:

Table 1. Attributes of user review data.

Attribute	Description
App Name	Name of the app
Date	Date when the review was written
Comment	The review written by the user
Rating	A score given by the user on 1 to 5 Likert scale

5.2 Data Analysis

For the feature analysis study, we used a mixture of a top-down and bottom-up approach to qualitatively analyze the features available within each app. Two research assistants performed the data coding. The feature list was created through a grounded approach [20]. We found 42 parent/teen features (e.g., a*pplication log*, *call log*, *browser log*) within the 75 apps. A total of 382 instances were found where a feature was available within the apps in the data set. At the end, we mapped the set of features we found to our TOSS framework (**Figure 1**). This mapping helped us integrate theory building with our grounded analysis. Educational features emerged as a separate strategy for teen online safety for both parents and teens.

For the empirical user study, we have begun to perform some initial analysis on the user reviews. First, we carried out a thematic analysis of all reviews downloaded for the Safekiddo Parental Control App [26]. We did this by manually coding themes within the content of the reviews, which we present as our results. In the near future, our goal is to investigate the feasibility of using topic modelling techniques on the data set to extract themes. *Topic modeling* is a technique for identifying topics in texts/documents. It is normally achieved in two steps: 1) finding patterns in a collection of documents and 2) forming clusters of words based on topics. Latent Dirichlet Allocation (LDA) [2] is a popular topic modelling method. LDA is "a generative probabilistic model for collections of discrete data such as text corpora" [2]. Topic modelling was used previously by Hong et al. to perform an empirical study of Twitter messages [12]. Fu et al. used topic model on user feedback data to figure out why people hate apps [10]. We plan to use the LDA model [2] as an approach to automatically analyze user reviews and extract the main themes across all reviews, top-rated, and low-rated reviews. For our analysis, we considered a high-rated review as having 4 or more stars and a low-rated review with 3 or less stars.

5.3 Descriptive Statistics

The previous feature analysis included 75 apps found on Google Play. However, in June 2016, we checked Google Play for the same apps and only found 74 apps still available and estimated there would be about 200,000 user reviews to download. We set baseline criteria for the reviews to include in our analysis and identified 45 apps that were installed more than 1000 times, had more than 100 reviews, and were updated in 2015 or later. According to Google Play meta-data, these 45 apps should have approximately 191,000 reviews. Yet, in August 2016, when we downloaded the actual reviews based on this criteria, we realized that the number of reviews we retrieved was much lower than the number mentioned on the Google Play app store page. We realized the discrepancy was due to text-based reviews not being required when giving a star rating to an app. For example, Safekiddo Parental Control App had 218 reviews according Google Play store page, but we were able to retrieve only 57 reviews. Therefore, we decided instead to collect all user reviews for all apps that were originally identified for inclusion in the feature analysis. Our final dataset includes 29,272 user reviews for 71 apps as 4 apps included in the initial analysis were no longer found on app store.

6. RESULTS

6.1 Feature analysis

The main finding from the feature analysis was that 89% of features supported parental control strategies compared to only 11% that supported teen self-regulation strategies. Parental control features included 44% for monitoring, 43% restriction, 2% educational, and less than 1% of the features supported parental active mediation. For teen self-regulation, the percentages were much lower: risk-coping (4%), self-monitoring (2%), educational features (4%) and less than 1% of the features supported the impulse control strategies. This study used a value sensitive design approach (VSD) to reason about the staggering imbalance towards adolescent mobile online safety apps that promote parental authority over teen autonomy.

6.2 Thematic Analysis

To identify the difference between why parents like and dislike adolescent safety apps, we introduced a thematic analysis of all reviews that we downloaded from Google Play app store. We decided to perform the following thematic analyses:

1. Individual rating level across all apps: Compare themes of top (rating >= 4) vs. low-rated (rating <=3) reviews

2. App rating level across all apps: Compare themes of top vs. low-rated apps

As we are in the early stage of this study, we performed a thematic analysis manually at individual rating level for reviews of Safekiddo Parental Control app and showed the efficacy of our proposed method. For the analysis, we identified related words that described a topic. We identified three main themes for top-rated reviews and another three for low-rated reviews (see **Table 2**).

Table 2. Thematic analysis of user reviews of Safekiddo.

Rating	Words	Themes
<=3	worth, useless, app	useless
	can't, lock, playstore, device, not, easy, age, settings	problems in age-appropriate settings
	uninstalled, refuses, prevention	uninstallation problems
>=4	block, protect, limit, control, websites, porn, everything, free	block restricted content
	useful, great, works, properly, clean, user, friendly, excellent	user-friendly app
	safe, protect, children, family	protects family

Safekiddo Parental Control app received low ratings due to the following reasons: 1) some users found this app useless, 2) problems in age-appropriate settings, and 3) uninstallation problems. Below are reviews that illustrate each themes:

- **Useless:** *"Not possible to change settings and give extra time remotely. This is useless app."*
- **Age-Appropriateness:** *"The program is fine, but it is not easy to Nava gate and set age appropriate settings."*
- **Uninstallation Problems:** *"You can not even uninstall it when you need to find a different app."*

Users who rated SafeKiddo high thought: 1) it appropriately blocks restricted content, 2) the app is user-friendly, and 3) the app helps protect family. The reviews below further illustrate these themes:

- **Restricted Content:** *"Controls porn"*
- **User-friendly App:** "*Great app just need to work it out properly but quite user friendly :) impressed!!!"*
- **Protects Family:** *"So much 1 can finally protect my family thanks"*

Through our manual analysis of the user reviews, we also realized that teens were posting reviews for the apps as well as parents. For example, one teen said, "*My parents can block everything and anything this stinks for real.*" Overall, teen reviews seemed extremely negative, even more so than the parents' reviews. Given this finding, we now plan to also focus on analyzing and understanding teens' perspectives about the use of these apps.

7. CONCLUSION

In this paper, we highlighted the results of our recent feature analysis study and introduced a new thematic analysis approach of Google Play user reviews of 71 teen online safety apps to better understand factors that users consider while writing feedback for adolescent online safety apps. We showed the efficacy of our proposed thematic analysis by an example and explained how this analysis would help to better understand apps from their users' perspectives.

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