Adolescent Online Safety: Moving Beyond Formative Evaluations to Designing Solutions for the Future

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ABSTRACT
We present a comprehensive and structured review of 132 peer-reviewed publications between the years of 2008 and 2015 to inform Human-Computer Interaction (HCI) researchers and interaction designers about the current and multi-disciplinary knowledge on the topic of adolescent online safety and risks. Overall, we found that the existing literature has deeply studied the phenomena around adolescent online safety through an in-depth examination of the prevalence, perceptions, behaviors, characteristics, and outcomes associated with various online risk experiences. However, very few studies have moved beyond formative evaluations that inform design to novel design interventions or summative evaluations of new designs that serve to effectively change the status quo.

Author Keywords
Adolescent online safety; online risks; interaction design.

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

INTRODUCTION
We synthesize the current research related to adolescent online safety in a way that can help inform the SIGCHI and Interaction Design for Children (IDC) communities on how we can best join in the valiant efforts to keep teens safe online. We report important trends from the literature and highlight potential gaps that are particularly relevant to HCI researchers and interaction designers. Specifically, our goal is to show how the SIGCHI community can help move the current state of adolescent online safety research from a focus on the prevalence of and factors that contribute to online risks, to one of designing solutions to effectively protect, mitigate, and empower teens to cope with the risk that they will inevitably encounter online. Online risks teens encounter may include cyberbullying, contact with strangers, sexual messaging, and pornography [20], among others. Our analysis was guided by following research questions, which employed an HCI-focused lens:

- ***Who*** are the users and stakeholders studied within the adolescent online safety and risk literature?
- ***What*** methodological approaches have been used to study the phenomena of interest?
- ***How*** does the research conceptualize the topic of adolescent online safety, risk, and harm?

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BACKGROUND
In 2014, Livingstone and Smith [20] published a comprehensive review of interdisciplinary research published since 2008 with a focus on summarizing the prevalence of various "content" and "conduct" related online risks, contributing and protective factors towards these risks, and the potential aggressive or sexual harm resulting from risk exposure. The researchers concluded their review by stating, "the challenge is now to examine the relations among different risks, and to build on the risk and protective factors identified to design effective interventions" [20:635]. Building upon a deep understanding of human behavior to design effective sociotechnical interventions is a hallmark of our field [44]. Thus, we argue that the SIGCHI community can make a significant impact in the area of adolescent online safety if we clearly understand how our expertise is situated and may be leveraged to complement the extant literature. While HCI researchers have addressed the challenges associated with conducting interaction design research with adolescents [28], none have specifically addressed the intersection of interaction design for adolescent online safety. Thus, our paper makes the following research contributions:

- Synthesizes a representative subset of 132 peer-reviewed articles relevant to the topic of adolescent online safety.
- Makes recommendations for future HCI and interaction design research related to adolescent online safety.
- Presents a conceptual framework for engaging HCI researchers and interaction designers in adolescent online safety research.

METHODS

We conducted a structured literature review, which consisted of three distinct stages: 1) literature search, 2) relevancy coding, and 3) article content coding. Approximately eight months elapsed between the first round (February 2015) of our literature search and the last (November 2015). In Round 1, we queried three electronic databases (ACM Digital Library, PsychInfo, and Web of Science) that span the interdisciplinary domains that study adolescent online safety and risks. We limited our search to peer-reviewed journals and conferences and used seven keywords based on prior literature [42] in combination with the words "adolescent" or "teen" to capture relevant literature. Keywords included: "technology use," "online safety," "online risk," "information privacy," "sexual solicitation," "cyberbullying," "online harassment," "pornography," and "explicit content."

For Rounds 2-4 of our literature search, we cross-referenced the citations from the previous round to identify additional salient articles. We stopped at the fourth iteration because the number of relevant articles fell from 52 in Round 1 to only eight in Round 4, signaling that we had reached a reasonable level of saturation. Near the end of 2015, we conducted a fifth iteration in order to capture articles published during the months between the initial literature search and the composition of our review. Our literature search identified a total of 232 articles that were then coded for relevance. Next, we reviewed these articles to ensure that they met certain threshold criteria prior to inclusion in our review. A total of 132 articles met these inclusion criteria:

1. Peer-reviewed published work (conference or journal).
2. Published between 2008 and 2015.
3. Involved teens and/or parents of teens (ages 13-17).
4. Focused on online activities (not offline).
5. Involved some aspects of online safety and/or risks (not just general technology use).

Finally, the 132 relevant articles were coded based on a structured codebook. Two coders coded the entire article set independently and inter-rater reliability between the coders was calculated using Cohen's kappa [13]. In cases where codes were not mutually exclusive, we applied multiple and double counted codes. **Table 1** summarizes each dimension coded and the IRR metrics averaged across all five rounds. Our results are presented based on these dimensions.

SYNTHESIZING PAST RESEARCH

Country of Origin: A U.S. Centric Focus

Twenty-six countries were represented in the article set, with the majority of articles originating in the United States (44%). The Netherlands and Great Britain were the next largest, representing 9% and 8% of articles, respectively. Only 5% of the studies in our sample studied safety and risks multi-nationally. Of these, one compared adolescents in Canada and China [19], another U.S. and Finland [26], and the others studied adolescents from multiple European countries, e.g., [34]. Comparative studies often confirmed that different cultural and national groups had significantly different online experiences and outcomes [3].

Subject of Study: A Reliance on Teen Self-Reports

As might be expected, 83% of the articles focused specifically on teens as research subjects; 13% included the perspectives of parents and teens, 2% focused only on parents [1], and another 2% involved external sources of influence, such as teachers, school staff, and counselors [31]. Of the teen-focused studies, 83% conducted self-reported surveys where researchers asked teens to quantify their own online risk experiences and behaviors. The researchers then inferred statistically significant relationships among the variables of interest. Fewer studies involving teens used more nuanced techniques such as interviews (9%), focus groups (9%), or analysis of publically available data (2%). Only 6% of the studies used multi-method approaches. Studies that involved both teens and parents focused on how different parental mediation strategies influenced teens' online risk behaviors and experiences. Meanwhile, studies focused solely on parents often examined how they directly contributed to their teens' online safety through their own actions.

RQ	Dimension	Description (Codes)	Cohen's κ
Who?	Country	The country from which the participants originated (Country Code)	0.92
	Subject of Study	Type of participants included in the study (Teen, Parent, Both, Other)	0.81
What?	Time Horizon	Time frame the study was conducted (Cross-sectional or Longitudinal)	0.88
	Approach	The type of data collection/analysis that was conducted (Qualitative, Quantitative, Mixed)	0.90
How?	Online Risk Type	Type of online risk studied. Multiple codes permitted (Information Breaches, Cyberbullying, Sexual Solicitations, Exposure to Explicit Content, Other)	0.87
	Risk Context	Whether the researchers studied online risks as an outcome or after the risk had occurred (Pre-exposure, Post-exposure)	0.75
	Intervention	Whether the research implemented any type of intervention, system, or program (Yes, No)	0.76

Table 1: Structured Codebook and Reliability Metrics

Time Horizon and Approach: A Snapshot in Time

Cross-sectional studies dominated this literature with 85% of our articles basing their analyses on a single snapshot of time. Of the cross-sectional studies, 74% conducted quantitative surveys, 16% took qualitative approaches, and 10% employed mixed quantitative and qualitative methods. Of the more novel approaches, Menesini et al. took a scenario-based survey approach, which covered a range of online behaviors and asked teens whether they felt each scenario was cyberbullying or not [22]. Of the longitudinal studies, nearly half (47%) had time horizons that were less than one year. Most (90%) were quantitative in nature. Only three of the studies leveraged multi-year, longitudinal designs that tracked the same sample of teens over a period of time. For instance, Sumter et al. (2012) found over the course of two years that offline and online peer victimization were significantly correlated and negatively impacted perceived life experience [36].

Risk Types: A Considerable Focus on Cyberbullying

We identified four typical online risk categories within the articles reviewed: 1) harassment and cyberbullying (66% of articles), 2) privacy or information breaches (33%), 3) sexual solicitations or encounters (23%), and 4) exposure to explicit content (22%). 69% of the articles focused only on one risk category, even though the associations between multiple online risks were consistently confirmed within the literature. For example, sexual solicitations and exposure to explicit content were significantly associated [38], and information disclosures were tied to privacy-related risks, which increased overall risk exposure [3,18]. We also noted considerable variation in how each article defined risk. Generally, any information disclosure or communication with strangers online was considered risky, as well as unsafe disclosures made to known others.

Risk Context: A Mindset of Risk-Aversion

The majority (69%) of the articles framed online risk exposure as a dependent variable with the intention of identifying the factors that contribute to the likelihood of risk occurrence and minimizing future risk exposure (i.e., pre-exposure). Fewer studies examined what happened after risks actually occurred (i.e., post-exposure). Of these articles, 54% investigated negative outcomes or harm resulting from exposure (e.g., loneliness [7], psychosomatic symptoms [24], and lower life satisfaction [6]), while 46% studied coping responses in response to exposure. For instance, studies found that teens rarely seek adult help when exposed to online risks [34], but do seek support from their personal peer networks [32]. Teens also take protective measures against risk exposure [32], especially when they have a heightened level of privacy concern [18].

Interventions: Few Solutions for Mitigating Online Risks

There were only six articles (4.5%) that implemented or implied any kind of intervention as part of their research programs. These interventions fell into three categories: 1) design interventions, 2) parental monitoring software, and 2) educational programs. Four of the articles took design-based approaches for conceptualizing new (yet hypothetical) technologies for addressing adolescent online safety. Lwin et al. [21] examine the interplay between parental mediation and the use of a warning message as a safeguard for protecting children and teens from disclosing personal information in online e-commerce contexts. The three other articles took participatory design approaches; for instance Emanuel and Fraser [9] worked with teens to design their own avatars and asked about identity and privacy, while Garaigorbil and Martinez-Valderray [12] created an educational program called Cyberbully 2.0, which they found to be effective in reducing traditional and online bullying perpetration and victimization.

LOOKING TOWARD THE FUTURE

Given the state of the current literature, we make the following recommendations for future research that addresses adolescent line safety.

Differentiating between Online Safety, Risk, and Harm

Livingstone and Smith make the point that harm is only a potential outcome of risk exposure [20]. Our previous work [40,41,43] argues that many of the existing studies around adolescent online safety have predominantly taken an "abstinence-only" approach to by trying to reduce risk-exposure as a symptom of "unhealthy" online engagement. Our literature review confirmed these assertions; after systematically reviewing the literature, we found that more studies (69%) focused on factors leading to or away from risk as opposed to confirming whether exposure actually resulted in negative outcomes. We also found an overwhelming trend that adolescent online safety is predominantly studied in direct relation to online risks. In focusing solely on reducing exposure, much of the literature implicitly equates risk exposure to harm. As such, the concepts of privacy and safety have often been confounded [10], implying that if teens would just disclose less personal information about themselves online, then they would be safer due to less exposure. We caution against such privacy-focused recommendations as they do not align well with teens' over-arching goals for why they engage online with others; research has confirmed that teens are aware of risks posed by their online personal disclosures, but value the relational benefits over the potential risks [5].

In fact, by shielding teens from online risk exposure, we may actually be causing more harm than good. For instance, boyd [4] cautions us against such approaches because fear-based paternalism can push us to overprotect teens, which may hinder developmental processes that are vital to teaching teens how to protect themselves. Hartikainen et al. [14] also found that enhancing parent-teen communication and trust building was superior to more control-based approaches. Our recent diary study of teens' weekly online risk experiences illustrated how teens are often able to cope with, resolve, and even benefit by learning from their personal online risk experiences [43], showing some level of agency in their own online safety.

Yet, existing technology-based solutions have been overly focused on designs that increase parental control to reduce risk exposure instead of cultivating teen self-awareness, impulse control, and risk-coping skills [39]. We recommend that future research move away from predominantly risk-adverse perspectives of adolescent online safety to ones that are more aligned with developmental psychology, acknowledging that some level of risk is actually a healthy part of adolescent developmental growth [2].

Diversifying Our Ways of Knowing

There are a number of suggestions we can make for building upon and deepening the current body of knowledge on adolescent online safety as it relates to HCI and interaction design. First, we must diversify our "ways of knowing" [27] by using different approaches for understanding the problem-space and arriving at new, user-centered solutions. For instance, only 5% of the research in our sample studied online safety and risks multi-nationally. We urge that multi-national coalitions should work together to conduct studies across adolescent populations in different countries and with diverse cultures to design sociotechnical systems or features that promote online safety from a more global perspective. Given the wealth of cross-sectional, quantitative survey studies, it would be reasonable at this point to conduct a formal meta-analysis [16]. Statistically consolidating various inferential findings would help HCI researchers and interaction designers pinpoint ways in which we can influence positive behaviors through design.

Other ways to expand our formative knowledge to better inform design would be to conduct more longitudinal studies that span distinct developmental stages of adolescence, such as transition periods from early adolescence to mid-adolescence [33], so that we can design solutions that align with the developmental needs of our users. Additionally, more studies that involve the co-occurrence of multiple risk types should be conducted to better understand how they are intertwined. This is of particular importance in regards to information disclosures, which has been shown to act as a "gateway" risk behavior that led to exposure to other, more serious types of risks, such as sexual solicitation [25] and cyberbullying [23]. By distinguishing what types of disclosures are most prone to severe risk exposure, we may be able to design targeted solutions that nudge teens to make more informed online disclosures [37], as opposed to setting an unrealistic goal of limiting all information sharing by teens online.

We also need to address an obvious dichotomy in how we tend to view teens and subsequently use them to inform our research. Ironically, adolescent online safety research is often motivated by the assertion that teens are inherently risk-seeking and lack the maturity to make well-informed decisions [5]; thus, we cannot trust teens to protect themselves from online risks [18]. Yet, as researchers, we have heavily relied on teens (83% of the articles) as the experts who provide the empirical evidence in which we base our conclusions. We should reflect on whether or not we should be concerned about the validity of relying so heavily on the self-reports of teens. We should also consider triangulating our results by incorporating benchmarks to calibrate teens' perceptions with their actual behavior [35]. Only a few studies collected unobtrusive data that captured teens' actual behaviors, such as publicly available social media posts [8] and profiles [29], while no studies have delved into the private or semi-private behaviors of teens in online contexts.

Overall, we argue that teens *should* be given more agency when it comes to their online safety – not only in understanding their behaviors to inform design (i.e., formative evaluations) but, more importantly, within the design solutions that serve to protect teens (e.g., participatory design). However, we also recommend that more nuanced approaches, such as those suggested by Poole and Peyton [28] (e.g., observation, videography, and video collages) should be incorporated to create a more holistic understanding of teens' online practices prior to designing potential solutions. Future research should also take into account the viewpoints of other key stakeholders (e.g., peers, parents, teachers, or counselors) to understand their goals and values [11], which will likely need to be reconciled with those of teens [39]. Finally, future work may assess how the current knowledge regarding adolescent online safety and risks applies to younger children, as they are also engaging with technology.

CONCLUSION

The literature has come a long way in helping us better understand the *phenomena* around adolescent online safety and risks. Yet, while risk is an integral part of safety, we argue for more emphasis on adolescent online *well being* as we move forward (**Figure 1** bullets in green). By shifting the discourse from preventing online risks to maximizing the benefits teens can garner from of online engagement,

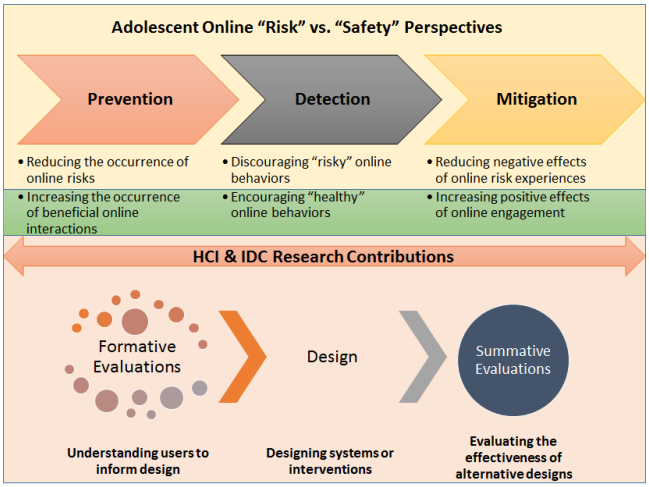

Figure 1: HCI & IDC Research Contributions

we can start building more realistic solutions that benefit, not just protect, teens. Finally, moving beyond formative evaluations that inform design, to novel design interventions and summative evaluations of existing or new designs [15] would serve to effectively change the status quo of adolescent online safety, which is where we argue that HCI researchers and interaction designers can make the most profound contributions moving forward (**Figure 1**). By iteratively designing real solutions across the spectrums of online risk and safety, we will be able to not only develop a deeper, empirical understanding of adolescents as end users, but also provide viable solutions that empower teens to positively engage with and through technology, take some risks, and remain safe from undue harm.

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