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Online child pornography offender risk assessment using digital forensic artifacts: The need for a hybrid model

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Abstract

The prevalence of online child pornography is a major societal issue. The criminal justice system has struggled with assessing the risk of individuals involved in online sexual offenses against children, especially when it involves the possession of child pornography. Research suggests there are different categories of offenders involved in this type of behavior (e.g., Online Child Pornography Offenders, Dual Offenders, Contact Offenders), with each category having different motivations, contributing factors, and levels of risk to re-offend or escalate their criminal behavior to more serious offenses (i.e., collecting pictures to contact offending). Determining the risk that individuals involved in online sexual offenses against children pose to re-offend or escalate their criminal behavior has been problematic. Traditional sexual offender risk measures have lower predictive validity when dealing with online child pornography offenders. This article discusses the need for a formalized hybrid risk assessment model that combines the current online sex offenses against children risk measures with digital forensics artifact analysis. The evidence derived from digital forensics artifact analysis can supplement the predictive risk factors obtained from these risk assessment tools, thus increasing the reliability and validity of the risk assessment.

KEYWORDS
child sexual exploitation material, digital forensics, forensic artifacts, offender behavior, online sexual offenses against children, risk assessment

Highlights

- The article provides an overview of individuals engaging in online sexual offenses against children.
- The article provides a critical analysis of some of the current offender risk assessment tools.
- The article discusses using risk assessment tools and digital forensics to assist with offender risk predictions.

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1 | INTRODUCTION

The world's current online hyper "connectedness" has provided unique opportunities for individuals to engage in technology-related criminal behavior. One such example of this type of illegal activity is the distribution and collection of child pornography [1]. While child pornography is the legal definition/term, there is a movement to replace the term as it implies consent, similar to traditional forms of adult pornography. The differences that underlie these materials have led some organizations to encourage using terms that articulate they are sexually explicit images of children: sexual exploitation material (CSEM), child sexual abuse material, and child sexual abuse imagery [2]. These terms generally refer to any sexually explicit image or video of a minor [3].

Numerous studies have reported a staggering increase in the prevalence and frequency of online child pornography, the ease at which this type of contraband material can be located, and the number of individuals incarcerated for child pornography offenses [1,4,5]. Despite the apparent increase, it is difficult to tell whether there has been an actual increase in child pornography offenses due to the Internet or whether these offenses are now more focused on by law enforcement and the public, as accurate statistics are lacking [6]. What is clear is that potential access to child pornography material is more readily available since the advent of the Internet.

While the legal justice system in the U.S. appears to be acutely focused on the prosecution of child pornography offenders [5], there needs to be more empirical support for the classification of the individuals charged with online sexual offenses against children [2,6–10]. The proper classification impacts the penalties, treatment, rehabilitation plans, and the accuracy of risk assessment tools [2,6–10].

Dealing with individuals charged and convicted of online child pornography offenses is challenging [11–13]. In the U.S., the legal justice and correctional systems struggle to determine if individuals charged and convicted of online child pornography offenses (and related sexual offenses against children) constitute a homogeneous category, or are there significant differences that require special categories [7,14,15]. Based on the current research findings, it is more likely that this is not a homogeneous group, and there are distinct differences between offender categories [1,2,6,14,16–18]. These differences have important implications related to recidivism rates or escalation to more serious offenses [1,2,6,14]. In order to effectively deal with individuals charged with online sexual offenses against children, we need to understand better who these offenders are and what, if any, unique requirements (e.g., risk assessment, treatment programs) are necessary for this population of offenders [6,9,19,20].

What is required is a more holistic approach to predicting offender risk [11]. This holistic or hybrid approach needs to consider data collected from current risk assessment tools and the wealth of information available from digital investigative tools and techniques [21,22]. Additionally, the hybrid approach must be informed by the findings from empirical studies that look at the ontology of individuals charged with online sexual offenses against children, personality, and demographic characteristics of potential categories for these offenders [6,12].

This article discusses the need for a formalized context-based framework or model that can be used to understand better the risk that online child pornography offenders pose. This can be accomplished by supplementing traditional sexual offender risk assessment tools and tools designed specifically for online child pornography offenders with data derived from digital forensic artifacts [11,23]. The article only discusses the need and initial idea of a hybrid model and does not summarize the empirical validation of any model. We will first look at the current research, which indicates that the individuals who engage in online sexual offenses against children are not a homogeneous group but more likely heterogeneous [6,12,13,24,25]. We will examine how the current risk assessment tools used with individuals charged with sexual offenses against children have low predictive validity for online child pornography offenders. Rather than abandoning or creating new risk assessment tools for this population of offenders, it is more logical to supplement these assessment tools with data derived from digital forensic analyses [23,26,27]. Thus, we discuss a potential model for supplementing the current risk assessment tools.

2 | OFFENDER CATEGORIES

The research to date indicates that individuals involved in online sexual offenses against children are likely a heterogeneous group [2,6,15,20,24,28]. The literature has identified at least three sub-categories of offenders who engage in these offenses. These categories consist of online child pornography offenders, dual offenders, and contact offenders. Each category of offender differs in various factors such as their motivation for engaging in the criminal behavior, willingness to take risks, etc. [6,8,12,14]. Research results have concluded that these three categories represent different risks related to re-offending or engaging in more serious sexual criminal behavior [1,6,13,27].

2.1 | Online child pornography offenders

Some researchers have concluded that online child pornography offenders are primarily interested in fantasizing about children as sexual objects [12,13,18]. These individuals have little desire to engage in the physical world with children in a sexual manner despite their fantasies and pose a low risk of contact [2,6,29]. Online child pornography offender's activities are "online" and primarily centered around the collecting (possessing) of CSEMs (CSEM) that add to or enhance their fantasies [2,6,13]. This material includes child pornography pictures, movies, stories, etc. In some cases, the collecting behavior borders an obsessive-compulsive need to hoard images resulting in extensive collections of CSEM [2,13,15]. Other studies have indicated that online child pornography

offenders may still be motivated by a sexual interest in children and that often their previous contact offenses have not been identified [29,30].

2.2 | Dual sexual offenders

Dual sexual offenders (sometimes referred to as mixed offenders) share motivations similar to the online child pornography offenders and the contact offenders categories [13,14]. This group vacillates between using CSEM for fantasy fulfillment and the physical, sexual assault of children. With these offenders, the use of the Internet and Internet technologies (e.g., chatting, texting, social media, online gaming) is used to not only collect CSEM but also to identify and groom potential victims or to communicate with other contact offenders to increase their pool of potential victims [8,21,31].

2.3 | Contact offenders

In this third category, offenders are primarily motivated by having sex with children in the physical world. The Internet and online technologies are directed at finding and grooming potential victims [13,21,32]. CSEM and mainstream pornography are used to desensitize potential victims, making them more open to sexual advances [31]. This group is more likely to include individuals with a pedophilic disorder [13,33,34]. The goal of the contact offenders is to have sex with children.

It may be more accurate to conceptualize the categories mentioned above as existing on a continuum with online child pornography offenders on one end and contact offenders on the other, with dual offenders somewhere between the two. While it is assumed that in some cases, an offender will progress from online child pornography offenders to contact offenders (referred to as the crossover offenders), the specific factors that influence this are not well understood [21]. This progression does not appear to be a common occurrence [12,24,25]. This continuum also represents the relative risk that these offenders will either re-offend or physically sexually assault a minor [12,21,31].

3 | RISK ASSESSMENT

The criminal justice system's critical concern when dealing with online child pornography offenders is determining the risk these individuals pose to the community for pre-sentencing conditions, sentencing, and parole/probation [15,18,20,26,35]. The risk to the community includes the offender's risk to re-offend for the same crime, a different crime, or escalate their behavior to more serious offenses (e.g., possession of child pornography to contact offending). The current approach is to use psychometric risk assessment tests that have been designed for individuals charged or convicted of contact sexual offenses against children. These risk assessment tools include the Static 99/R, Risk Matrix 2000 Revised (RM2000/R), and the Vermont Assessment of Sex Offender Risk-2 (VASOR-2). Another commonly used risk assessment tool in the U.S. is the Federal Post Conviction Risk Assessment (PCRA) instrument. The PCRA is a general instrument used by Federal Probation Officers to assess the risk of individuals on supervised release [35,36]. However, the PCRA was not developed to be used with federal sexual offenders in general or online child pornography offenders specifically [37,38]. Studies indicate that the PCRA has issues predicting the likelihood of recidivism with online child pornography offenses [35].

The growing body of research suggests that traditional approaches to understanding offender risk, such as the motivation-facilitation model, are inadequate for use with online child pornography offenders, as longitudinal studies are lacking [39]. Moreover, traditional sex offender risk measures tend to perform poorly with online child pornography offenders and dual offenders [6,18,26,40]. The poor performance of the risk assessment tools illustrates the need to develop other risk assessment tools, such as CPORT, that are specific to these types of offenders [35]. Research indicates that the risk factors common for more traditional sexual offenders (e.g., substance abuse, antisocial, multiple paraphilic interests, and marital status) are not present with online child pornography offenders [1,24]. Studies have found that online child pornography offenders have less frequent and less violent criminal histories and higher levels of education [13]. Online child pornography offenders were also found to exhibit a high prevalence of pedophilic interest, which results in an interest in CSEM [13].

Research indicates that child pornography offenders and dual offenders differ from traditional sex offenders [2,6,12]. As a result, newer risk assessment tools have been developed that focus on online sexual offenses, such as the Child Pornography Offender Risk Tool (CPORT) [1], Correlates of Admission of Sexual Interest in Children (CASIC) [41], or the Kent Internet Risk Assessment Tool-2 (KIRAT-2) [42].

3.1 | CPORT

The CPORT is relatively new and consists of a seven-item structured tool designed to assess the likelihood that a child pornography sexual offender will re-offend sexually over a 5-year fixed follow-up [1,26]. The items include 1) age of the individual, 2) prior criminal convictions, 3) prior failure on conditions such as probation, parole, or conditional release, 4) contact sexual offense history, 5) indication of pedophilic interests, 6) more boy than girl in the child pornography content, and 7) more boy than girl content in the child nudity and other child content excluding the child pornography content [43]. Recent attempts to validate CPORT have resulted in mixed findings with moderate to low predictive validity, and sample sizes have been small, impacting statistical power [1,2,26]. However, these limited studies have supported that online child pornography offenders and contact offenders are two different types and not part of a homogenous category [26].

3.2 | CASIC

The CASIC instrument is not a risk tool. CASIC is used to assess sexual interest in children. It measures six factors that are correlated with the individual's sexual interest in children [41]. Several of these factors or behaviors are directly tied to the content of the CSEM collection (i.e., child sexual abuse videos, child sexual abuse stories/text) [41]. CASIC also considers evidence of online solicitation of a minor (i.e., grooming) [41]. Current validation studies of CASIC indicate that it is significantly correlated with the individual's self-reported or clinical diagnosis of sexual interest in children [41].

3.3 | KIRAT-2

The KIRAT-2 was explicitly designed by law enforcement in the U.K. to help predict whether individuals engaging in online sexual offenses against children will become contact offenders [42]. The KIRAT-2 uses "17 variables with four filters or decision steps that include examining previous convictions, access to children, current evidence of both online and offline behavior, and other relevant factors" [42]. The tool's focus is to help law enforcement better direct limited investigative police resources; it is not a clinical or diagnostic instrument [42]. It was not designed as a traditional post-arrest risk assessment tool. It concentrates on prior criminal behavior as a predictor or potential contact offending pre-arrest [42]. While the KIRAT-2 has been helpful in the E.U. with CSEM investigations, it is not helpful for the kind of risk assessment we are discussing. KIRAT-2 focuses on dual offenders and their risk before being arrested, rather than the risk of recidivism or engaging in new criminal behavior post-arrest or post-release from prison (i.e., parole, probation, supervised release). These are essential factors that the U.S. courts use for sentencing, parole or probation, and court-ordered therapies [44].

Law enforcement typically conducts a thorough analysis of the suspect's computing technology, including phones, laptops, desktops, tablets, social media, and geolocation data [11,22,23]. However, current risk assessment tools do not consider, or only partially consider, digital evidence that is routinely collected by law enforcement agencies when investigating online child sexual exploitation [26,41]. One exception is the COPINE scale.

3.4 | COPINE

The COPINE Scale (Combating Paedophile Information Networks in Europe), while not an actual risk assessment tool, can be used to more fully understand the context that CSEM collections have to the offender [19,45]. The scale consists of 10 categories or levels, based on level of victimization to the child, ranging from level 1 - Indicative (non-erotic, non-sexualized pictures) to level 10 - sadism and bestiality (i.e., pictures that depict pain or sexual activities with animals [19,46]. Many jurisdictions have modified the scale from 10 levels to 5, but the essential nature of the scale and its use remain the same [47].

This scale was created based on the hypothesis that the seriousness of an offender's behavior could be determined not just by the number or severity of the previous offense but also by the context of the CSEM collection [19,46]. The scale identifies three main characteristics of the illegal content that are useful in determining the seriousness: 1) quantity of the material, 2) quality of the material and 3) usage of the material [19,46].

4 | RISK FACTORS

It is crucial to identify factors that are correlated with online child pornography offenders being at greater risk to re-offend, the likelihood that an offender would move up the continuum to more severe criminal behavior (e.g., dual offenders or contact offenders), and what treatment and rehabilitation programs would be the most effective. Several studies have identified discriminating factors between the categories, such as antisocial orientation and sexual deviance [13,24]. Online child pornography offenders have high rates of sexual deviance but low rates of antisocial orientations [13,24,25]. Other studies have looked at the actual content of the materials that are being collected and sought out [2,21,25,33]. Here, online child pornography offenders have higher numbers of pictures that are not illegal but would be classified as child erotica or pictures with nudity but not necessarily sexual activity. Contact offenders have more pictures with sexual activity and higher severity levels of CSEM (e.g., bestiality, sadomasochism) or self-produced content [2,8,25]. Additional risk factors have been identified, such as previous convictions for criminal offenses (either sexually related or not), with online child pornography offenders having lower rates compared to dual offenders or contact offenders, and access to children with dual offenders having greater access to child relatives or children in general [2,9,25].

Other differentiating factors that can be determined from the physical or digital evidence include evidence of grooming behaviors, community support, content, and context of CSEM collections [22,23]. Dual offenders and contact offenders have higher overt grooming behaviors such as texting, chats, emails, and community support. Individuals in these categories (i.e., dual offenders and contact offenders) also engage in more online socializing with other individuals who share their interest in CSEM illicit activities, potentially as a way to marginalize or justify this behavior and to obtain access to explicit CSEM [11].

Dual offenders and contact offenders tend to have CSEM collections that include more severe content (e.g., more graphic sexual activity). In contrast, online child pornography offenders have extensive collections, usually due to bulk downloads (e.g., Zipped or Bin files), containing 1000 or more pictures or videos. In some cases, there is more CSEM in a collection than the person could ever view in their lifetime [11]. The CSEM can be a "stopgap" for dual and

contact offenders to use in between actual sexual encounters with minors [2,21,25].

The evidence discussed above can be quantified and qualified using digital forensic techniques, as artifacts relating to these data are persistent (i.e., not easily erased) on most computing devices (i.e., phones. Laptops, tablets, P.C.s) [22,23]. This corroborating evidence can help the legal justice system better understand the context of the offending and the actual risk that an offender poses. Thus helping to concentrate the court system's limited resources on those offenders that are genuinely a higher risk to society [23,48].

5 | DIGITAL FORENSIC ARTIFACTS AND RISK ASSESSMENT (HYBRID MODEL)

By combining current child sex offender risk assessment tools and the results of digital forensic analysis using a hybrid model, we should better predict whether an offender will recidivate and progress in the severity of online child pornography offenders to contact offenders [11,23]. As was previously stated, the traditional tools (e.g., STATIC 99/R) have low predictive validity with online child pornography offenders [1,24,35]. Risk assessment tools specific to online child pornography, such as CPORT, would benefit from an increased ability to predict recidivism [2,26,41]. Furthermore, CPORT includes behavioral metrics that may not be readily available at the time of assessment (e.g., the ratio of boy to girl child pornography pictures and boy to girl in other child content – non-child pornography). [1,24,49]. Research has also shown that there may be an under-reporting of true previous sexual offenses with online child pornography offenders, which lowers the official numbers related to previous charges or convictions [29,30]. Additionally, research indicates that online child pornography offenders do not internalize the true nature of their behaviors and tend to downplay its deviance and harmful consequences to the victims [6,13,25]. This lack of empathy can result in the offender providing inaccurate information about prior sexual offenses against children, negatively impacting the assessments' predictive validity.

6 | DIGITAL ARTIFACTS

Digital forensics is defined as "a sub-discipline of Digital & Multimedia Evidence, which involves the scientific examination, analysis, and evaluation of digital evidence in legal matters" [50]. This digital evidence results from artifacts created during the use of computing technology (e.g., web browsing, downloading files from the Internet, texting, emailing, connecting to wireless networks). The digital artifacts can be found on any computing device (e.g., desktop, laptop, mobile phone, tablet, smartwatch) [11,22]. These devices are routinely seized by law enforcement in online sexual offenses against children investigations. Using technology is necessary for engaging in these illicit activities. The offenders use internet Web Browsers, email, Peer-to-Peer (P2P), ToR, social media, gaming platforms, and texting/messaging applications. The use of technology is so ubiquitous with these types of offenses that there is a movement to remove the "use of technology" as a mitigating factor for consideration in the U.S. Sentencing guidelines for child pornography offenses [16,17].

Since individuals engaged in online child pornography offenses use computing technology, either personally owned or publicly available (e.g., computer in a public library), they leave a trail of digital "breadcrumbs" and digital "footprints" behind [11,22,23,51,52]. Contrary to popular belief, especially in the criminal community, today's technologies record and retain a tremendous amount of information that can be used to quantify and qualify offending behaviors [11,52]. These digital artifacts provide a large data set that often becomes essential in criminal investigations [22,51].

As was previously mentioned, law enforcement routinely seizes the offender's computing devices and forensically processes them to identify and extract evidence from the digital artifacts [11,51,53]. The digital forensic artifacts can be used to validate the responses by the offenders and provide context on factors either not adequately captured by the risk assessment tools (e.g., actual number and CSEM severity) or not captured at all (e.g., affiliations with other online child pornography offenders related to non-CSEM behavior) [8,15,26]. Digital artifacts can also be used to identify evidence of behaviors that the offender engaged in correlated with either higher or lower risk of recidivism or escalation (e.g., grooming behavior, membership in groups that rationalize the illicit behavior) [11,22,23]. Additionally, it can also be used as further direct evidence of the offender's intent and motivation for engaging in the illicit behavior [11,22,23].

Visualizing data is a critical part of digital forensics [54]. As the amount of potential digital evidence per case keeps increasing, this has necessitated that automated approaches be adopted to more efficiently and effectively deal with the increased volume of evidence [55]. Visualization allows an investigator to understand the amount and type of evidence and ascribe some context and meaning to the evidence (e.g., intentional downloading videos, using child pornography-specific web search terms) [11,22].

Two types of visualization are most commonly used to understand better the derived digital evidence and provide context and meaning to the digital evidence content: temporal analysis and relational analysis [56]. Temporal, in its most basic form, is timeline analysis - what occurred when. This information can be crucial for determining behavioral patterns and providing indicators of when certain online behaviors may have increased or decreased [11,22]. Relational analysis focuses on identifying links between events, and links between entities, including external entities (e.g., other online child pornography offenders, specific child pornography websites). Relational analysis uses traditional relational database approaches (e.g., Postgres, SQLite) or graph theory databases, combined with Machine Learning (ML) to identify and visualize relationships (e.g., whether the offender was part of a wide-scale child pornography trading online community) [22].

Additional evidence collected through the digital forensics analysis should be readily available to whoever is conducting the risk assessment. As has been stated, this evidence can directly impact the accuracy of the information used to determine the risk and thus the predictive validity. One example of this can be seen with CPORT. Questions six and seven require information related to the ratio of boy to girl content, both child pornography, and child but non-pornography [43,57]. This type of breakdown of digital content is not typically part of the digital investigator's analysis. Therefore, it may not be readily available to the individual conducting the assessment. Knowing that this information is required for an assessment, the digital forensic investigators can be asked to run this analysis using digital evidence and provide the ratios to the individual conducting the assessment.

7 | CONCLUSIONS

The literature review leaves little doubt that considering individuals who engage in online sexual offenses against children as one sizeable homogenous group is flawed [2,9,13,25]. Furthermore, using traditional risk assessment tools is problematic [1,15,23]. What is equally apparent now is that even newer risk assessment tools that attempt to capture online child pornography offenders or dual offender's behaviors have limited predictive validity [26,42]. The question now is how do we accurately predict the risk that the three categories (i.e., online child pornography offenders, dual offenders, and contact offenders) represent? Accurate risk prediction is a fundamental question at the heart of decisions related to a) what treatment programs these offenders require, b) should these offenders be incarcerated, and c) upon release, what conditions need to be applied to protect against further offending?

Simply locking all online child pornography offenders in prison for lengthy terms is counterproductive. It increases the already large prison population and burdens an already overwhelmed criminal justice system (especially in the U.S.) [5,6]. What is required is a more nuanced approach that recognizes that child sexual exploitation offenders are a heterogeneous group, requiring different sentencing and release conditions and different treatment programs and approaches [27,40,58]. These offenders also have significantly different risk levels to re-offend or progress to more serious criminal behaviors [12,30,59].

A hybrid model will not require us to abandon the current online child pornography assessment tools. These may still be valuable if we combine them with quantifiable results (i.e., digital forensic artifacts) derived from digital forensic investigations [11,22,23]. These artifacts can assist in identifying the factors that studies have shown a) increase the likelihood that an offender has been classified correctly (e.g., online child pornography offenders vs. contact offenders), b) provide context and meaning, and c) more accurately predict an offender's risk of re-offending or progressing to more serious criminal offenses.

Using digital forensic artifacts to supplement online sexual offenses against children risk assessment tools is a pragmatic approach. Most cases that deal with child pornography include digital forensic investigations and the introduction of digital evidence (11,22,51). Hence, this approach will not significantly add to the workload of the criminal justice system. It will require a more formalized or standardized framework that would allow digital forensic investigators and the individuals conducting the risk assessment to have better lines of communication and the ability to share data more efficiently.

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