Child sexual abuse material networks on the darkweb: a multi-method approach

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CHAPTER 8

GENERAL DISCUSSION AND CONCLUSION

Chapter 8: General discussion and conclusion

This chapter presents the conclusions of this dissertation. The scientific objective of this dissertation was to describe and explain the criminal process and offender behavior on child sexual abuse material (CSAM) fora on the Darkweb using a quantitative as well as a qualitative approach. The practical relevance of this exercise is that the results of the research inform professionals working in areas such as law enforcement, offender management and treatment and probation services about a previously hidden population that they may come across in their future work. The research questions, as outlined in Chapter 1, are:

1. How can the criminal process of Darkweb CSAM fora be characterized?
2. How organized is the crime of CSAM on the Darkweb?
3. Which offender profiles and behavioral patterns can be distinguished on Darkweb CSAM fora?
4. How can keyplayers on Darkweb CSAM fora be identified?
5. How is trust on Darkweb CSAM fora established?

This final chapter summarizes and critically reflects on the main findings of the six empirical studies that make up this dissertation, provides an appraisal of methodological strengths and limitations, and discusses several specific implications for policy and practice, along with suggestions for future research.

8.1 Main findings

The main findings will be presented organized along the lines of the research questions. The conclusions for each research question will be discussed using the results of the various papers presented in this dissertation. The first and broadest research question will be elaborated upon extensively as the answer to this question sets the basis for the following research questions.

8.1.1 How can the criminal process of Darkweb CSAM fora be characterized?

In order to contribute to the knowledge on the steps involved in the criminal process of Darkweb CSAM offending, Chapter 2 provided a crime script analysis (Cornish, 1994), using a large sample of the communication data of four CSAM Darkweb fora and suspect interviews of a Darkweb offender who was the administrator on one of these fora for cross-validation. A content analysis (Braun & Clarke, 2006) of forum

posts and threads resulted in a step-by-step description of the criminal process, distinguishing four successive phases.

In the first phase, preparations necessary to access the Darkweb CSAM forum are being made. Building a Darkweb forum, but also merely accessing it, does not occur incidentally, and asks for certain technical and motivational preparations. Second, when members enter the forum for the first time – the preactivity stage -, they start with creating an online identity, introducing themselves by disclosing their nickname and past and current experiences with and fantasies about child abuse. This creates an open atmosphere characterized by a sense of belonging in which the boundaries between the legal and illegal easily become blurred. The third phase, the activity stage, consists of the actual execution of the main illegal act of exchanging CSAM. Members are actively encouraged by other members to contribute to the forum by posting messages, images, and videos and by taking the time to respond to others and to reply to questions asked. Finally, the postactivity stage consists of behaviors of safely and securely exiting the crime scene and preventing detection. Some overall and more general findings regarding this criminal process are worth mentioning.

When describing the criminal process, findings of various chapters in this dissertation suggest that a distinction between keyplayer members and general forum members has to be made, because of major differences in their role and behavior on the forum. Keyplayer members often have a higher forum status, such as moderator or administrator, but they could also be 'regular' forum members who carry out important forum tasks. Keyplayers are much more active, and often play a role in services important to the forum's establishment, maintenance and management. Keyplayers for instance make sure that the forum environments are organized in a logical way, and that forum members place their content in the right locations. Moreover, they offer other forum members guidance in issues such as safety and security and they are often involved in the forum's branding and marketing. Contrarily, general forum members primarily use the forum's infrastructure for the exchange of CSAM and sometimes to communicate with like-minded others, but their role and activity is not pivotal for the forum's existence and development.

Another general finding, leading from Chapter 2, is that the most important characteristic of the criminal process of Darkweb CSAM offending is the continuous focus on technical security and support. The importance of acquiring or sharing sufficient technical knowledge (for example in the form of tutorials) is highlighted in all four stages of the crime script. This can partly be explained by the growing number of offenders active and images exchanged on the Darkweb (Goodman, 2015; Bleakley, 2018; Leclerc et al., 2021; Owens et al., 2016; Woodhams et al., 2021). The more traffic to and activity on CSAM fora, the more security-related mistakes are likely to be made by

forum members. Novice forum members therefore continuously need to be tutored in basic technical practicalities. Moreover, fora are under continuous threat, for example in the form of law enforcement interference and hacker attacks who may perform DDoS attacks or spam the forum website. This places a burden on forum administrators, who not only need sufficient and up-to-date technical knowledge, but who also have to invest more and more of their time to keep the forum safe and secure.

Additional to the qualitative approach taken in Chapter 2, Chapter 4 also provided insight into the criminal process and evolution of a Darkweb forum, but from a quantitative perspective. The forum studied in Chapter 4 was active for over four years before it was shut down by law enforcement. During the latter 16 months the forum was operational, it transformed from a relatively small, secure and hidden forum into a forum open to new registrations attracting hundreds of new members each month. Under the new forum administrator, various new topic areas were added, leading to a major increase in forum activity. Forum members monthly added between 20,000 and 30,000 posts to the forum. This relates to the notion of forum branding and marketing (found in Chapter 2), which is used to attract new forum members and to develop 'future-proof' CSAM communities. It also underlines the need for continuous tutoring of new members about the forum's safety procedures.

The studies that are part of this dissertation however, also highlight that Darkweb CSAM offending exceeds the criminal realm, and entails more than the sole act of the online exchange of CSAM. Forum members not only discuss the CSAM exchanged on the forum, but forum discussions also include topics such as societal engagement, politics and media. This leads to the conclusion that apart from criminal marketplaces, these illegal Darkweb CSAM fora can also be characterized as social communities.

Online support fora on the Clearnet enabling individuals with a sexual interest in children to engage and communicate with one another through chatrooms, discussion fora and private messaging have been identified as early as 1999 (Durkin & Bryant, 1999). The emergence of peer-to-peer networks could be seen as the first step from CSAM offenders operating primarily individually, towards them committing crimes in online networks in a semi-anonymous setting on a large scale, yet, because of their set-up and infrastructure, the social communication between offenders on these Clearnet peer-to-peer platforms remained limited (Hammond et al., 2009; Hughes et al., 2006; Westlake et al., 2011). O'Halloran and Quayle's (2010) content analysis of a Clearnet support forum indicates that an important function of such online platforms for individuals is to receive support from like-minded others. Although those observed interacting on these fora are not necessarily CSAM offenders, it does portray the need for marginalized individuals to form communities, where they can safely meet and communicate (see also: Owens et al., 2016; Rimer, 2017). At least

on the Darkweb fora studied here, some forum members appear to not only seek to be part of this community, but also to strive to acquire a higher status in the forum's hierarchy, for example by fulfilling administrative tasks or by uploading original or more extreme material. To fully comprehend CSAM crime, additional to insight into the criminal process of Darkweb CSAM offending, acquiring a more detailed understanding of the non-criminal social processes underlying the forum environment may therefore also be important.

8.1.1.1 Darkweb CSAM does not occur in isolation

The current dissertation further provided evidence that when describing the criminal process of Darkweb CSAM fora, it is important to look further than the forum environment itself. In order for Darkweb CSAM fora to work safely and efficiently, connections to other legal and illegal markets are necessary, for example to gain criminal capital. The suspect interviews and forum communication discussed in Chapter 2 and 3 provided evidence for connections of Darkweb CSAM fora to other Darkweb cybercriminal fora, for example to Darkweb drug markets. CSAM offenders may have a 'sleeping account' on such other cybercriminal fora, used to obtain security advice and techniques. The knowledge obtained on these cybercriminal fora is then used to improve the criminal process and security of the Darkweb CSAM forum.

Moreover, offenders active on Darkweb CSAM fora may also be connected to non-anonymous parts of the internet. Chapter 3 found offenders to have extensive offending histories that originated on the Clearnet. Many Darkweb CSAM offenders had for example been previously active on peer-to-peer networks. Other platforms that were mentioned as a means of accessing CSAM were Google, Skype and Grindr and the Russian website IMGSRC.ru. Furthermore, the case files demonstrated connections to legal pedophilia support websites on the Clearnet. Some offenders also appear to be active on support platforms where the aim is to communicate with peers and where the barter of CSAM is not allowed.

Finally, connections to legal companies and services are pivotal for initiating and maintaining Darkweb CSAM criminal structures. For example, individual members cannot refrain from using legal infrastructures, such as their internet provider and computer operating system, and from using various forms of encryption, data recovery, storage and utility software. The fora itself also need connections to legal platforms in order to operate properly. Firstly, fora need to be hosted on a server. This can either be done by renting storage space with a server provider, or by hosting the server from an offender's home. And a forum needs to be built in a certain format, for which software (for example phpBB) might be used. Legal platforms providing technical support can also be explored by CSAM offenders in order to increase their

knowledge about building and facilitating a forum. Chapter 3 found evidence that administrators and moderators use Clearnet websites to learn about such technical prerequisites to build a forum. Evidence for connections to other Clearnet platforms only indirectly related to the criminal activities, such as hardware-, software-, video editing- and gaming platforms, was also found. The evidence thus suggests that offenders interested in CSAM do not operate in silos, but they will use digital platforms and other technical tools to their convenience.

To conclude, the criminal process of Darkweb CSAM fora clearly extends the forum environment itself. Moreover, the criminal process exceeds individual offending, and can instead be described by large groups of offenders engaged in social communities who increasingly cooperate in an organized way and to whom technical security and support and forum management are essential. The exchange of CSAM on the Darkweb thus does not occur in isolation. This dynamic has resulted in the professionalization and better organization of (Darkweb) CSAM offending. This conclusion directly leads to the second research question: how organized is the crime of CSAM on the Darkweb?

8.1.2 How organized is the crime of CSAM on the Darkweb?

Because of the increasing professionalization and technical sophistication of Darkweb CSAM offending found in Chapter 2, some professionals from law enforcement and academics as well as the media have begun to label Darkweb CSAM offending as organized crime (OC). In order to provide a theoretical exploration of the level and nature of the organization of CSAM on the Darkweb, this dissertation and Chapter 3 more specifically, uses the flexible conception of OC from Von Lampe (2016). When studying criminal processes and phenomena, Von Lampe (2016) argues to reframe the question and ask not whether certain criminal processes are OC or not in a dichotomous way, but rather seek to understand to what extent and in what ways the particular crime is organized. Von Lampe (2016) introduces and distinguishes three types of social structures – entrepreneurial, associational and illegal governance structures – that may influence organized criminal activity. In Chapter 3, six police investigation case files were analyzed using the methodology of the Dutch Organized Crime Monitor (Kruisbergen et al., 2018), accompanied by analyses of interviews with the police officers and public prosecutors involved. The results of this chapter lead to the following description of the organization of Darkweb CSAM offending along the lines of Von Lampe's (2016) three constructs of social structures.

Darkweb CSAM fora can firstly be characterized as digital marketplaces, or entrepreneurial structures, in which illegal goods in the form of CSAM are voluntarily exchanged and where there is overlap between suppliers and demanders. Like for actors in other

criminal markets, there is a risk of exposure by law enforcement, and the need for security leads offenders to screen and get familiar with their co-offenders. In this insecure environment, some level of illegal governance, or enforcement of forum rules and regulations and the resolution of (internal) conflicts, is imposed by forum administrators. In 'business meetings' between forum administrators, decisions about such rules and responses to conflicts are being made. Another important task for forum administrators is to decide about arrangements between forum members served to protect them from threats such as government involvement or other outside attacks to the forum. Darkweb CSAM offending is further embedded in the social network between offenders, or the associational structure, provided by the forum environment (extensively discussed in Chapter 2). The shared sexual interest in children is the social tie that binds forum members, leading to an identification with the community, to unwritten internal social rules of conduct (for example those of politeness and generosity) and to the use of 'slang'. Entrepreneurial structures, illegal governance as well as associational structures can thus clearly be identified within the criminal process of Darkweb CSAM offending.

Additional to the present findings, recent law enforcement reports indicate that the CSAM Darkweb landscape is in continuous movement. It is common for fora to be taken down by law enforcement (Europol, 2016; Europol, 2017; Raven et al., 2021). However, they can also be taken down by administrators for security reasons, for example because of forum members leaking information or illegal material, members compromising the forum, or because of a suspicion of law enforcement intervention. Public information from law enforcement further indicates that fora are expanding, and that they may overlap since members are typically active on various fora throughout time (Europol, 2016; Europol, 2017; Goodman, 2015; Zulkarnine et al., 2016). This means that in the recent past there has been a great number of fora online, with an overlap of forum members, and with members constantly relocating from forum to forum (Boerman et al., 2017; Frank et al., 2010; Goodman, 2015; Westlake et al., 2011; Zulkarnine et al., 2016).

When interpreting this organization and evolution, it can be concluded that Von Lampe's (2016) flexible conception of OC offered new insights into the organization of the criminal process of Darkweb CSAM offending. Although monetary profit, physical violence and the desire to monopolize the market (some traditional characteristics of OC) are largely absent, it can be concluded that the criminal process of Darkweb CSAM offending as well as the offenders involved in it show clear signs of entrepreneurial and social organization. In a criminal landscape that is in continuous movement, cooperation is being established in trust based social networks (further explored in Chapter 7 of this dissertation), overseen by keyplayers who are able to exert some internal governance.

8.1.3 Which offender profiles and behavioral patterns can be distinguished on Darkweb CSAM fora?

While initial participation in a Darkweb CSAM forum requires some effort, and on the whole the exchange of CSAM on the forum shows clear signs of organization, this does not mean that every member joining such a forum will become an equally active participant in the online CSAM community. Several typologies of online CSAM offending have been developed (e.g. DeHart et al., 2017; Lanning, 2001; Tener et al., 2015), but so far, no empirical research explicitly examined whether and how CSAM offenders active on the Darkweb fit into those typologies. To answer the research question regarding offender profiles and behavioral patterns on Darkweb CSAM fora, Chapter 4 used a novel methodological approach to analyze forum members' posting behavior derived from criminal career research. Based on a unique dataset consisting of the digital forensic artifacts created by forum members, Chapter 5 examined the behavioral patterns of members who were not communicatively active in the public parts of the forum.

Using all communication data (over 400,000 posts) from four Darkweb CSAM fora and applying Group-Based Trajectory Modeling (GBTM) (Jones & Nagin, 2013; Nagin, 2005), using dimensions such as forum activity onset, posting frequency and posting duration, Chapter 4 distinguished multiple developmental pathways, or trajectories, based on members' posting history. Six trajectories, that can be interpreted as latent offender profiles, were distinguished:

1. The 'lurkers'. The largest group of forum members (58.8% of the sample) shows very little forum activity (a total of 2 posts per member on average). Members allocated to this trajectory enter the forum during its later stages and mostly refrain from posting shortly after entering.
2. The 'browsers'. This group (9.1% of the sample) also typically enters the forum in its later stages and portrays limited posting activity. Still, their average number of posts (n = 10.1) is almost five times higher than that of 'lurkers' and also includes posts under the 'Girls hardcore' forum environment category. Additional to their initial registration and application to the forum, it is likely that the majority of members belonging to this group have at least shown some forum browsing (yet non-communicating) activity for a relatively short period of time.
3. The 'CSAM interested'. This group (11.1% of the sample) has an average posting duration of six months and a total of 19 posts (on average) per member. The posting career of this group is more versatile in nature. Over two thirds of the members allocated to this trajectory post under the 'Girls hardcore' environment at least once, while nearly one third post at least once under the 'Boys hardcore' environment.

One in five members allocated to this trajectory also contribute to the 'General discussion' pages of the forum. Over half of the members in this category are registered as 'full member' by the forum administrators, suggesting that they contribute to the forum on a regular basis.

4. The 'escalators'. This group (15.8% of the sample) shows an increase in posting frequency the longer members are active on the forum. Given the timing of their last post, were the forum not taken offline, many members in this trajectory likely would have continued to contribute to the forum. One in ten of the members allocated to this group have a VIP status. As VIP status heavily depends on posting activity, the desire to reach VIP status may partially drive the escalating trajectory.
5. The 'vested members'. Members of this group (4.5% of the sample) first become active already during the early stages of the forum's evolution and have a total of 152 posts (on average) in various sections of the forum. Their posting behavior signals their affinity with the (social) community as a whole. The large majority of members allocated to this group enjoy a 'full member' status, and over one fifth even has a VIP status.
6. The 'managers'. This final group (0.8% of the sample) is characterized by a, compared to members from all other trajectories, high posting frequency (n = 1,636). Members of this group do not only post under the 'General discussion' topic; three quarters also post under the 'Information and technical safety' topic, indicating that they are involved in the management of the forum in some way. Members in this group show the longest posting career, and over half of them have an Administrator or VIP status.

Furthermore, from the data it becomes clear that most forum activity takes place in forum environments dedicated to CSAM of girls. That most of the CSAM shared contains illegal images and videos of girls, is also in line with previous research. Insoll et al. (2021) for example found that Darkweb CSAM offenders in their sample most often viewed CSAM related to girls in between the ages of 4 and 13 (45%); compared to 18% who viewed CSAM related to boys in the same age range. Previous studies confirm that most individuals with a sexual interest in children report fantasies about girls. For example, Dombert at al. (2016) report that 68.4% of their sample had an interest in girls, 13.1% in boys and 18.4% in boys as well as girls. Other studies focusing on online CSAM offenders specifically or comparing them to contact offenders, also indicate that a preference for girl victims is the most common (Elliott et al., 2012; Webb et al., 2007). Analyses of law enforcement image databases confirm these results. Interpol for example reports that 65% of the unidentified victims in the International Child Sexual Exploitation Image Database (ICSE), managed by Interpol, are girls (Interpol & ECPAT, 2018).

A study by Quayle and Jones (2011), who examined a sample of CSAM images in a database developed by the Child Exploitation and Online Protection (CEOP) Centre in the United Kingdom, even found that the sample contained four times more girls than boys. Finally, a study in cooperation with the National Center for Missing & Exploited Children (NCMEC) in the United States again confirms that girls are depicted in the majority of CSAM files stored in the NCMEC database (Seto et al., 2018).

From the latent offender profiles, it further becomes evident that a small minority of forum members is responsible for the vast majority of all public forum communication. In other words, a large majority of forum members can be characterized as 'lurkers'. Chapter 5 confirms these results, and finds that on the forum studied in this chapter (which was a different forum than the one studied in Chapter 4) only 3.4% of all forum members showed verbal forum activity. A caveat that needs mentioning however, is that the forum studied in Chapter 5 was an open forum that was considered more as a download platform, and where the risk of being caught was perceived to be high. This may have led to members of this particular forum being less likely to display verbal activity and to expose themselves more than strictly necessary. Despite potential differences in the nature of the fora studied in Chapters 4 and 5, results from both analyses support the notion of a division between highly active keyplayer forum members and far less active general members. Having access not only to the public communication data of a Darkweb CSAM forum, for the study discussed in Chapter 5 the authors also had access to a unique dataset of all members' movements (or clicks) behind the screen/keyboard on the website. Therefore, the behavioral patterns of all forum members, regardless of them being active communicators or not, could be established. As this meant that all forum members, including the 'true lurkers', could be included in the analysis, it was the first time that the behavior of the 'average forum member' could be established. Zooming in on lurking behavior, Chapter 5 finds evidence that the 96.6% of non-communicating members are still behaviorally active on the website. These 'lurking' forum members browse through the website and visit various forum environments.

Furthermore, the analysis in Chapter 5 shows that 93.6% of the forum members, of whom many 'lurking' members, actively download CSAM. On the forum investigated, members download 77 images or videos on average within a period of two weeks. So-called 'lurkers' therefore, although not actively communicating or uploading child abusive content to the forum, do engage with the forum's content in a manner that could encourage others to offend against children and produce new material. By their mere presence on the forum, 'lurkers' create and facilitate the demand and the market for CSAM. This may also mean that 'lurkers' still identify with the forum's predicated interests and experience a sense of belongingness by visiting the forum.

The skewed distributions in online behavior – posting, CSAM sharing as well as downloading – identified in this study corroborate findings from earlier studies examining the downloading and exchange of CSAM on Clearnet peer-to-peer networks, such as Gnutella, BitTorrent, eDonkey and GigaTribe. Wolak and colleagues (2014) for example, who measured a year of online CSAM activity on the Gnutella peer-to-peer network, found that less than 1% of the CSAM users on this peer-to-peer network accounted for a disproportionately high share of CSAM available on the network, each contributing 100 files or more. Over 80% of the CSAM downloaders shared very few CSAM files or were online for only a few days within the year of measurement. Jarlov and colleagues (2009) found similar results on the eDonkey network: most CSAM users contributed only a few files, whereas a very small number of CSAM users provided very large numbers (up to 3,000) of CSAM files (see also: Hughes et al., 2006; Steel, 2009).

To conclude, public opinion greatly condemns those who sexually offend against children. Within this climate, hardly any differentiation between different types of offenders and offenses is being made. The current dissertation ads some nuance to this stance, by establishing various offender profiles and behavioral patterns. Some individuals seem to enter CSAM Darkweb fora out of curiosity rather than out of a fully developed sexual interest in underaged children, which is reflected in their forum activity and behavioral patterns.

8.1.4 How can keyplayers in Darkweb CSAM fora be identified?

Chapter 6 builds on the notion that keyplayer forum members and general members can be distinguished, and explored alternative ways to automatically identify them from large datasets using various network science methods and techniques (Barabási, 2016).

Network metrics such as various centrality measures enabled to accurately identify keyplayers (such as administrators and moderators) as well as general forum members. The analyses furthermore revealed the more individualistic role of technical keyplayer members dealing with the forum's establishment, encryption and maintenance. It was found that larger forum topics were commented on by less active members, likely because these topics were more easily found and cover a more easily accessible subject. Topics with few comments were commented on by more active members, hinting at an elite of forum members contributing to more specialized (technical) discussions, consisting of keyplayers with roles important to the forum's very existence. Furthermore, the study illuminated the structural properties and distributions of the topics discussed in and members active on the fora. Insights in the forum's anti-lurker and anti-law enforcement policies and new member application guidelines could be deduced only by looking at the network structure of the data. The network data for instance revealed the forum's admission procedure in which members had to provide a post and content in order to gain access to the forum.

The study discussed in Chapter 6 portrayed the added value of multidisciplinary cooperation, with data scientists and criminologists collaborating on the same research problem. Having direct access to expertise within a specialized law enforcement unit, further enabled substantive interpretation of the results and hence, a deeper understanding of the data and the phenomenon under scrutiny. To conclude, distinguishing offender profiles and behavioral patterns (Chapter 4 and 5) and identifying keyplayers (Chapter 6) ultimately aids in the identification of the most active and dangerous Darkweb CSAM offenders, which gives direction to law enforcement's prioritization in CSAM crime investigations.

8.1.5 How is trust in Darkweb CSAM fora established?

Chapter 7 provided a systematic literature review from a criminological as well as psychological perspective linking individual offending motivation and behavior to the aggregation of the CSAM fora using the concept of trust. The reason for focusing on the concept of trust, is that results from Chapter 3 suggested that trust, originating from the associational structures underlying CSAM fora, is important and necessary for two or more offenders to be willing to cooperate (Von Lampe, 2016). Although the concept of trust is not equally important to all forum members, and likely has the greatest value in explaining the behavior of the most active forum members; it is an important concept to comprehend how and why forum members communicate about their deepest sexual feelings online.

Findings from the psychological literature confirm what was also found in the empirical studies of this dissertation: that for some forum members, the engagement in interpersonal communication with like-minded others on Darkweb CSAM fora serves various functions, including justification, normalization, and support, as well as access to expert advice, tutorials and information, and to CSAM itself. Criminological studies highlight that on Darkweb CSAM fora trust initially needs to be established under circumstances of anonymity, without knowing the true identity of one's co-offenders. Information about others and hence their level of trustworthiness is therefore limited. The process of trust establishment may be enhanced by creating a legitimate and reliable online identity. Previous research indicates that members share information about cybercriminal attributes, which then become a personal brand and as such lays the foundation for a reputation that is necessary for trust to be developed further (Lusthaus, 2012; Yip et al., 2013). Trust can be maintained by being visible and portraying oneself as an active member. This includes engaging in frequent online activity, involving posting messages, contributing to open discussions, exchanging valuable advice and by generally being helpful, as well as by mentoring and offering feedback to others. In addition, humor, playfulness, and sarcasm are frequently used to invoke trustworthiness.

To conclude, within the high-stake and high-risk environment of the Darkweb, where members have to manage a continuous flow of threats, such as attacks by hackers or apprehension by law enforcement, the associational structure of the fora lay an important foundation for trust to be established and maintained. It is the commitment and dedication members show to the community which leads to an informal interpretation of a member's forum behavior and to a mutual sense of belonging and trust. This is of social and technical relevance, as it forms the basis for offenders to be willing to cooperate in their criminal endeavors and to proceed in the exchange of CSAM.

8.2 Implications of the findings

To effectively tackle the problem of Darkweb CSAM and to be able to protect victims, it is imperative that strategies and policy are informed by empirical evidence. Up to this point, research specifically focusing on CSAM exchanged on the Darkweb is scarce, because of the Darkweb CSAM fora's illegal nature. Until recently, extant research into CSAM exchanged on other virtual platforms has been dominated by an individual perspective. This means that there is a substantive knowledge base on individual offending and motivation, leading to recommendations about effective therapeutical approaches or law enforcement offender interview strategies. However, there is yet a lot to learn about the structures of online CSAM fora, their hierarchies and role differentiations, and the positions of individual offenders within these fora. As a consequence, there exists a gap in our current knowledge on the cooperation between CSAM offenders, and the overall structure of the larger online CSAM offending landscape. This knowledge is however highly relevant, as it could lead to recommendations about how to strategically fight online CSAM offending, lay bare vulnerable points in the CSAM crime process suitable for intervention, and help identify keyplayer offenders without whom the CSAM forum structures would be greatly disrupted.

By taking an encompassing perspective, the current dissertation contributes to the current academic knowledge by providing detailed insights into the workings of fora where CSAM is exchanged on the Darkweb using multiple disciplinary and methodological perspectives. The criminological, psychological and data science perspective applied in this dissertation complement each other, and lead to the following implications.

8.2.1 Implications for law enforcement intervention

8.2.1.1 Implications from a network perspective

The first group of implications for law enforcement intervention results from the net-

work perspective taken in this dissertation. Although law enforcement agencies have successfully taken down large CSAM fora in the recent past, and have apprehended some of the keyplayers active on these fora, there are still improvements to be made (Bleakley, 2018; Raven et al., 2021). Historically, CSAM related crime was predominantly committed by individual offenders, and therefore an individual perspective was suitable for law enforcement to tackle this problem. The organized and professional ways in which CSAM related crime is now committed on fora on the Darkweb, asks for revised as well as new law enforcement perspectives.

Law enforcement interventions and techniques suitable to tackle Darkweb CSAM offending have to be intelligence-led (Von Lampe, 2016). Intelligence-led policing involves law enforcement to structurally collect and process information on Darkweb CSAM fora, on its infrastructure, on the individuals active within these fora, and on the nature and severity of the illegal material that is exchanged, for the purposes of intelligence gathering and for making informed decisions about actual criminal investigations. Research repeatedly points out that random attacks on targets in criminal networks are far less effective than informed and targeted ones directed towards keyplayers (Duijn et al., 2014; Frank et al., 2010; Joffres et al., 2011; Westlake et al., 2011; Westlake et al., 2015; Zulkarnine et al., 2016). This finding also applies to Darkweb CSAM fora: the findings of the current dissertation indicate that structurally analyzing these fora and prioritizing those keyplayers with specialized roles within the criminal network for law enforcement intervention, is likely to most effectively disrupt these fora.

More specifically, the organized and professional nature of Darkweb CSAM offending asks for law enforcement to proactively search for those investigations that will likely have the most impact. Wolak and colleagues (2014) for instance, estimated that if law enforcement agencies would arrest the high-contributors on peer-to-peer networks, the number of CSAM files available on the network could be reduced by as much as 30%. An example within the field of Darkweb CSAM offending concerns Darkweb undercover operations aiming to identify the most risky and dangerous keyplayer offenders. When proactively investigating on Darkweb CSAM fora, law enforcement has to deal with large amounts of data to analyze. Single suspects are sometimes responsible for years of communication, leading to datasets comprising of thousands of messages and images to be analyzed. It is not always possible anymore for analysts to physically read through all these data, so therefore advanced and automated analyses are needed (Wolak et al., 2014). This has to involve analysts and data scientists who are capable of conducting sophisticated technical analyses. Looking at the field of Darkweb CSAM from an organized crime perspective, tracking down and focusing on the most important forum members in an intelligence-led manner would professionalize the combat against this type of crime and maximize law enforcement efforts (Westlake et al., 2011).

8.2.1.2 Implications from a criminal career perspective

In order to be able to work according to the way proposed, law enforcement has to know the offender group they are dealing with, and the characteristics of the most suitable targets for prioritization (Woodhams et al., 2021). Taking a criminal career perspective, the current dissertation points towards various groups suitable for law enforcement prioritization.

A first obvious group of desirable targets for law enforcement intervention are the administrators and other high-status and highly-active members of Darkweb CSAM fora, who can be seen as forum managers with an active role in facilitating and promoting a social environment in which forum members can exchange CSAM and communicate. While administrators may not always account for a disproportionate share in the exchange of CSAM on their forum, they do play an important role in the establishment and maintenance of the forum. By safeguarding the forum's workings and continuity and by exerting internal governance, administrators and other high-status members are essential in the criminal process and organization. Therefore, a way to disturb a Darkweb CSAM forum is to identify and eliminate the administrators and other keyplayers.

Among this group, the most suitable targets for law enforcement intervention are those members providing the technical development, support, and security to the fora. Without technical support, shielding, and problem solving, the fora would be much more vulnerable to law enforcement detection and would not be able to exist in a professional manner and for long periods of time. Most likely, there will not be dozens of offenders with a sexual interest in children, who also have the technically sophisticated skills to provide this support. Therefore, as the technically sophisticated skills necessary to run a large-scale forum are likely to be reserved to only a minority of CSAM offenders, targeting these offenders is expected to have the greatest impact.

Moreover, not only should law enforcement focus on the current administrators and technical keyplayer members; also the so-called escalators, or potential future keyplayer technical or managerial forum members are worth looking out for, as identifying and arresting them could prevent future crimes from occurring. The current dissertation finds that the group of escalators entails only a small proportion of all Darkweb CSAM forum members, yet their risk for future offending may be significantly elevated, as their online behavior seems to escalate. Escalation in their level of online communication may signal forum members belonging to this group gradually spending more time on the forum, them downloading increasingly severe material, or them increasingly joining conversations about offline abuse. Proactively targeting this offender group before true escalation takes place may be important to prevent future offending, and with that to prevent future victimization of children.

A further offender group suitable for law enforcement intervention, are those forum members active in the very early stages of a forum's existence, regardless of their formal forum status or managerial or technical expertise. These 'vested members' portray behavior that signals their affinity with the community as a whole. Chapter 5 found that the number of members registering during the very early days of a forum's existence is limited and that the number of registered members tends to increase quickly once a forum has been online for some time and becomes known in the wider Darkweb CSAM network. This implies that those members that register in the first week a forum becomes public are potentially interesting targets for law enforcement. Their familiarity with the new forum likely indicates that they have relevant ties to the broader CSAM network, and that they may fulfill a key role in the forum's future development.

Until now, only actively communicating forum members are considered as suitable targets for law enforcement prioritization and intervention. The potential risk of those members that are not active communicators should however not be underestimated. The current dissertation gives evidence that the large majority of forum members, including lurkers, download CSAM and consume the content related to those topics that interest them. It is therefore very likely that lurkers still identify with the forum's predicated interests and even experience a sense of belongingness. Moreover, lurkers on one platform may actually be active participators on other locations and may have important ties with influential fellow forum members or with the larger CSAM network (Cranefield et al., 2015; Tagarelli & Interdonato, 2013). Therefore, there may be value in also detecting lurkers with a high level of forum involvement, indicated by high volumes of (attempted) download- and movement activity (clicks) on the forum. To the extent that downloading CSAM affects attitudes and future behavior, all forum members, including lurkers, may develop toward becoming high-risk offenders, and may become a risk to children in the physical world (Insoll et al., 2021).

It is pivotal to further refine the existing typologies of online CSAM offenders, in order to be able to accurately perform risk assessments to identify the most risky targets on Darkweb CSAM fora. Quantitatively outlining the behaviors of Darkweb CSAM offenders can assist law enforcement in targeting specific fora or specific (groups of) forum members for further (qualitative) assessment and intervention. A more detailed understanding of member profiles and the most risky targets for prioritization is not only useful for the purpose of early detection, but it has further operational advantage when law enforcement professionals are interacting with CSAM offenders online in undercover operations. Studying the language and behavior within online interactions and conversations between prioritized individuals, gives an indication of their social involvement, and may aid in preparing for such operations (Woodhams et al., 2021) and in mirroring offenders' language and behavior to achieve a trusted posi-

tion within the forum (Yip et al., 2013). Law enforcement would benefit from a more established evidence base regarding the type of offender they are dealing with. On a broader level, knowledge resulting from this dissertation as well as related findings could be incorporated in relevant law enforcement training (Woodhams et al., 2021; Martellozzo, 2015).

8.2.2 Further implications

The current dissertation also has implications for professionals other than law enforcement. First of all, as Darkweb CSAM offending is becoming more common (Europol, 2016; Owen & Savage, 2015; Van der Bruggen, 2018; Woodhams et al., 2021), it is only logical that offenders who have been active on the Darkweb will gradually be entering correctional and rehabilitative services. This means that the caseload of forensic psychologists and other practitioners will increasingly consist of Darkweb CSAM offenders (Woodhams et al., 2021). The current dissertation aids these professionals with understanding the Darkweb as an offending platform, not only enabling offenders to collect and exchange CSAM but also providing a social community of like-minded individuals. A more detailed understanding of the different types of offenders active on the Darkweb with varying motivations will help forensic professionals in correctional and rehabilitative services tailoring their services to the type of offender they are dealing with.

This is useful, as different Darkweb forum members may also require different interventions to prevent them from future offending. Previous research has pointed out that treatment levels should be tailored to risk levels (Smid, 2014). As suggested based on the findings in Chapter 4, lower-risk, situationally motivated 'lurkers' and 'browsers' may be deterred from CSAM offending by increasing their perceived risk of exposure and prosecution. When these offenders are identified and sentenced, for this group low-level treatment for a short period of time or even self-help programs might suffice (Insoll et al., 2021). On the contrary, 'vested members' and 'managers' – given their vested interests in the CSAM community – likely are not, or to a much lesser extent, deterred from offending simply by an increased risk of exposure and prosecution. For this group, more intensive treatment might be necessary to decrease the likelihood of recidivism. This could be community-based group treatment, or high-intensity mandatory institutional treatment for the highest risk offenders (Smid, 2014; Yang et al., 2021). To conclude, when sufficiently replicated across different samples, typologies such as the ones discussed in this dissertation could be used by clinical forensic professionals and other professionals for specifically assessing Darkweb CSAM offenders for offering them the most effective treatment with the aim of reducing future offending.

Another group of professionals that may learn from the current dissertation are public prosecutors. The results discussed in Chapter 5 provide a summary of the behavior or 'general profile' of Darkweb forum members, based on their forum activity, regardless of them being active communicators or not. With these results, prosecutors will be able to assess the behavior of individual offenders, and compare this behavior to the 'general profile' of CSAM offenders. For example, prosecutors could exemplify that a certain offender deviates from the general profile regarding the number of visits, clicks, and downloads on a forum, and give an evidence-based judgement of the intensity and severity of an offender's offending. More specifically, the results may help prosecutors in explaining to the court that despite the suspect showing no verbal activity, this does not necessarily mean that he has not had an active role in facilitating the demand of CSAM by downloading illegal material and thus in the maintenance of the CSAM network as a whole.

Finally, and perhaps most importantly, the current dissertation has implications for prevention. Insoll and colleagues (2021) found that Darkweb CSAM offending often starts at a very young age. Of the Darkweb offenders in their study, 70% had a first time exposure when they were under the age of 18, and 39% was even under the age of 13. Many of them do not appear to be preferential offenders, and their first exposure seems to occur accidentally. For example, they expose themselves because of curiosity, or they have started with viewing legal pornography and have become desensitized. Although the focus of the current dissertation was different – studying offenders active on Darkweb CSAM fora involved with the social aspect of the CSAM community – parallels can still be drawn. The combined results of both studies lead to the hypothesis that the relatively young first-time offenders are most likely part of the category of 'lurkers'. Although this group may still show offending behavior in terms of browsing through the forum and downloading CSAM, their involvement and grade of activity is significantly lower compared to the groups of more active and dedicated forum members. Therefore, this particular offender group may be susceptible to prevention initiatives, helping them to desist from offending at an early stage, and to not develop into becoming part of the higher-risk groups of 'escalators', 'vested members' or 'managers'.

Because of the taboo that rests on sexual offending against children and CSAM, offenders may not very likely seek help from therapists and expose themselves. Therefore, accessible and low-key help is essential. With this in mind, in the Finnish Protect Children Program, the Darkweb survey was accompanied by an online self-help program: an anonymous program for individuals who view and distribute CSAM, based on their thoughts, feelings, and behaviors regarding their use of CSAM, with a goal to maintain behavioral change and stop viewing CSAM (Insoll et al., 2021). Although the

effectiveness of this program has not been tested yet, it is positive that targeted initiatives are being developed and implemented for this particular group of offenders. Other forms of prevention should start even before youngsters become active on the Darkweb, and should involve creating a broader awareness of the problem. As part of the general sexual education of children, they should learn about the risks of the internet and Darkweb for sexual offending, for example from their parents, at school and in treatment facilities (Yang et al., 2021).

8.3 Methodological strengths and limitations

The aim of this dissertation was to explore CSAM fora on the Darkweb using multiple methods. By using various qualitative as well as quantitative methods, new insights about the topic of interest were gained from various angles. As every chapter in this dissertation has its own section discussing the strengths and limitations of the particular method used, this final section only describes the overarching and most important strengths and limitations.

8.3.1 Strengths

The most important strength is that online activities and behavior leave many more traces than do offline activities and behavior, offering a wealth of new data to be studied by academics. This results in knowledge that could not – or at least not as reliably – be obtained without having access to these online data sources. Using Darkweb CSAM forum communication as a data source for this dissertation, enabled to study the hard-to-reach offenders that are scarcely caught by law enforcement. In this regard the current dissertation distinguishes itself from previous studies in this area, that mostly focused on offenders who were prosecuted (e.g. Owens et al., 2016; Shelton et al., 2016), on ex-offenders now receiving treatment (e.g. Seto & Ahmed, 2014), or on offenders active on peer-to-peer networks (e.g. Hughes et al., 2006; Steel, 2009). From a qualitative perspective, research into this hidden offender population through unobtrusive means enables studying the actual and 'natural' behavior of these offenders, thereby shedding unique light on concepts such as the criminal process, the criminal organization, offender motivation and trust establishment and maintenance.

From a quantitative perspective, using forum communication and forum member relationships as a data source in this dissertation, enabled to study all forum members active on a Darkweb CSAM forum at once. In this world of big data, with Darkweb CSAM fora sometimes consisting of hundred thousands of members, sophisticated quantitative analyses become a necessary tool to gain insight into the fora's structures

and to identify the most important forum members. Moreover, using methods like Group-Based Trajectory Modelling or methods from a network or data science perspective, has a number of advantages over content-based analysis of Darkweb forum data, as it only requires derived datasets representing the structure of the forum, and not its actual content. As such, researchers without clearance are also able to analyze these datasets, without committing a crime. Moreover, using derived datasets also allows to analyze encrypted posts and fora in foreign languages. Finally, the dataset studied in Chapter 5 even offered the opportunity to also study the downloading behavior of true lurkers who are not otherwise communicating on the forum. Therefore this study arguably is one of the first – if not the first – studying all forum members on a Darkweb CSAM forum at once.

8.3.2 Limitations

Despite their strengths, the studies included in this dissertation also have some limitations. A first set of limitations is related to the generalizability of the results. Though varied in size and structure, the fora used for the current analyses do not constitute a representative sample of all Darkweb CSAM fora in a statistical sense. It is very well possible that there are 'more inaccessible' fora online, presently outside the view of law enforcement surveillance. The fora covered in this dissertation are from 2010-2017, and thus relatively old. There have been many more fora online, and likely there will be many more in the future. Although there is no indication that any significant changes in the criminal process, governance structure or member profiles have occurred in recent years; technological developments are likely to result in minor developments and changes on Darkweb CSAM fora. It would therefore be sensible to replicate the current studies and develop new studies on more recent Darkweb CSAM fora. When not having access to the data through cooperation with a law enforcement agency, Darkweb crawling and classification methods developed by academics may aid in reliably analyzing more recent data (Dalins et al., 2018). Finally, in terms of generalizability, the findings in this dissertation likely do not apply to all individuals interested in CSAM, as the dissertation specifically zooms in on the group of offenders active on CSAM fora on the Darkweb. Although the ratio of offenders active on the Darkweb versus the offenders active on the Clearnet is not known, interviews and informal conversations with law enforcement personnel pointed out that, for example because of its speed compared to the Darkweb, the Clearnet is still often used by CSAM offenders.

The illegal nature of the material discussed and exchanged on CSAM fora on the Darkweb introduces another hurdle in the scientific analysis of these online communities. Due to its illegal nature, only researchers with special clearance are able to conduct these analyses – which in case of the studies included in this dissertation meant

that much of the data was reviewed and coded by the first author only, who, at the time of writing, was a sworn-in police officer at the National Police of the Netherlands. Only data relating to the frequency, timing, and structural dimensions of forum members' online communications could be shared with others involved in the project. This introduces the risk of single rater bias, especially when qualitatively analyzing the forum data. To mitigate this risk, during all stages of analysis, the coding and findings were discussed with specialized police personnel involved in the police investigations where the data originated from, such to safeguard correct interpretation of the fora's workings and the nature of the data gathered.

Moreover, although innovative, there are some limitations more specific to studies using Darkweb communication data. More specifically, some potential crucial data was excluded from the current studies. The data available only covered forum communication posted on the public areas of the fora. Therefore, there was no way of estimating the size and nature of the private communication going on between members. Because of its even more private nature, this communication will most likely contain the most sensitive topics, potentially discussed in more detail. Moreover, although general estimates of the type of CSAM exchanged on the various Darkweb fora under investigation were conducted, this dissertation did not include an assessment of the actual CSAM exchanged or collected through the fora and it did not use the material exchanged as unit of analysis.

These limitations touch on a larger debate. Although online activities and behavior leave many traces, and the accessibility of online data continues to grow, the possibilities to make this data available to researchers are still scant. This relates to challenges in making datasets containing material of an illegal nature available to researchers in a non-sensitive or derived way to allow them to study these data, as well as in challenges related to transform the often very large online datasets in analyzable formats. Most research projects in this area, including all studies included in this dissertation, therefore rely on intensive cooperation with law enforcement personnel who have access to the data and the clearance to view the actual material. The current research would simply have been impossible if such intensive cooperation could not be obtained. This observation leads to some suggestions for future research directions.

8.4 Future research directions

There are other and newer ways in which sensitive and illegal data, such as the data studied in this dissertation, could be made available to researchers. To learn about the organizational structures of Darkweb CSAM fora, research methods using these fora's

meta-data, may be of help here. Moreover, various researchers have begun to use technical tools that automatically make images and videos inaccessible, which eliminates the illegal forum content but leaves the structure of the forum intact for researchers to analyze without them being liable to prosecution (e.g. Web-IQ, 2018). Connecting hashes, or digital footprints, to the images and videos, would even enable researchers to describe the nature and severity of these images without having to be exposed to them. Working in this manner would not only solve the single coder bias resulting from the sensitive and illegal nature of the data specific to the current dissertation discussed in Chapter 2, but in a much broader way it would make data available and analyzable to many more researchers. Working in this way enables a number of quantitative research avenues to be explored further.

The Darkweb CSAM forum's underlying communication network, its structure, strengths, and weaknesses can be studied using mathematical concepts and techniques from the social network analysis (Morselli & Roy, 2008; Tompson & Chainey, 2011). Identifying keyplayers and brokerage positions, and seeking ways to optimally disrupt these fora so to prevent them from victimizing children remains an important topic of future study (Westlake et al., 2011). Taking a criminal career perspective, future research could assess the extent to which it is possible to predict members' future forum position, based on the development of their online communications. In this way, interventions could be aimed at curbing members' developmental pathway, preventing their online offending from spiraling out of control and them attaining central positions in the CSAM forum.

Moreover, the current dissertation points toward two types of data that could be included in future academic research. First, the most sensitive conversations will most likely occur in private messaging, therefore future network studies could compare the results of this dissertation with analyses conducted on these private messages. Secondly, the results of Chapter 5 imply that (attempts to) downloading CSAM is the main reason for many members to visit Darkweb CSAM fora. In order to explore downloading behavior in more detail, future studies should include the meta-data of the images themselves in their datasets.

Following another methodology, members' online behaviors can also be further explored by simply asking forum members about it. The study by Insoll and colleagues (2021) contained a first attempt of doing so. At the time of writing this conclusion, the survey developed by Insoll and colleagues (2021) was still accessible on the Darkweb, and had already received over 10,000 responses. Surveys such as these give novel and detailed insights originating directly from the offenders themselves, who remain anonymous and are as yet unknown to law enforcement, let alone to academics. The continuation of such studies is paramount to understand the CSAM landscape in all its breadth.

Finally, Darkweb offender communication also offers vast datasets to be further explored qualitatively. Following Chapter 7 of this dissertation, the process through which individuals seek to establish trust and develop relationships with other members on Darkweb CSAM fora could be examined in more depth when qualitatively studying the language of public and private messages exchanged by forum members. From this communication, researchers could for example deduce which aspects and features forum members take into consideration when making the decision of whether or not another member is trustworthy enough to initiate contact and develop a relationship with. In addition, it would be useful to explore in more detail how trust-based personal relationships between co-offenders may trigger the formation of smaller sub-networks, and how this may contribute to the progression and escalation of offending behavior. Besides trust, other relevant concepts to be explored qualitatively include behavioral differences between keyplayer and general forum members, factors that lead offenders to start communicating on a forum and rise in the forum's hierarchy, offending methods, techniques and cooperation, and the establishment of either friendship or competition. More generally, more in-depth analysis is needed to gain deeper insight into the thoughts, feelings, and behaviors of Darkweb CSAM offenders to protect children from future crimes (Insoll et al., 2021).

8.4.1 Bridging the gap between law enforcement and science

The current dissertation is one of the first exploring CSAM fora on the Darkweb. Only recently, research papers on this topic have started to emerge (e.g. Insoll et al., 2021, Kokolaki et al., 2020, Woodhams et al., 2021, Yang et al., 2021). In other words, the research in this area is still young. One of the explanations for this is the fact that this type of research needs in-depth knowledge about law enforcement and the offender community as well as knowledge about science and scientific research methods. This means that an open-minded and optimistic cooperation between law enforcement communities and academic communities needs to be continued and further developed (Baechler, 2019; Duijn & Klerks, 2014; Jarlov et al., 2009). Despite the growing number of instances in which such intensive collaboration is indeed achieved, some obstacles preventing cooperation also need mentioning. One important obstacle is the different pace of law enforcement and that of academic activities. Where policing is characterized by 'fast thinking' and often occurs in real time, academic thinking is often slow and prepares for the medium to long term (Baechler, 2019; Kahneman, 2011). Furthermore, law enforcement often expresses a need for concrete answers to specific cases or specific questions and for policies that can be implemented directly. Academic research on the contrary, is often focused on scientific problem-solving and draws conclusions about generalities that might not directly answer the concrete questions put forth by

law enforcement. This may result in difficulties in understanding each other's context and objectives (Baechler, 2019; Telep, 2017), which in its turn may obstruct a trustful and fruitful relationship in which possibilities to share knowledge and data within the boundaries of the law are continuously explored.

Striving for effective intelligence-led and evidence-based policing (Von Lampe, 2016), strong and fruitful relationships between law enforcement and academics can be built or maintained by the means of for example shared PhD-professional positions, mutual and continuous education and training courses, collaborative student projects, or community-building initiatives (Baechler, 2019). Working closely together in this regard will help smooth the translation and implementation of academic findings into practically applicable recommendations for professional practice. Moreover, the issues of confidentiality, privacy, and security when it comes to data-sharing from a governmental and law enforcement perspective can be more easily overcome.

Because of the public demand for such material, CSAM is – however unfortunate this may be – strongly embedded in our present day society (Von Lampe, 2016). The internet, and with it online (Darkweb) CSAM fora, has developed very rapidly and CSAM offenders continuously traverse to newer platforms in increasing anonymity. It is therefore essential that academic research stays up to date with the latest technological developments, and has the courage to explore new areas and platforms of research. The expertise, knowledge and input from law enforcement in this regard is pivotal. Intensive collaboration between researchers from different disciplines, and between academic, law enforcement, and private partners is therefore our best chance of effectively protecting children in the future.