Computers in Human Behavior Reports 8 (2022) 100249

Contents lists available at ScienceDirect

Computers in Human Behavior Reports

journal homepage: www.sciencedirect.com/journal/computers-in-human-behavior-reports

# Familial concentration of crime in a digital era: Criminal behavior among family members of cyber offenders

Steve G.A. van de Weijer [a,*], Asier Moneva [a,b]

[a] Netherlands Institute for the Study of Crime and Law Enforcement, PO Box 71304, 1008 BH, Amsterdam, the Netherlands
[b] Center of Expertise Cyber Security, The Hague University of Applied Sciences, Johanna Westerdijkplein 75, 2521 EN, The Hague, the Netherlands

ARTICLE INFO

*Keywords:*
Cybercrime
Hacker
Intergenerational
Family
Life-course

ABSTRACT

A vast and growing body of research has shown that crime tends to run in families. However, previous studies focused only on traditional crimes and research on familial risk factors for cyber offending is very scarce. To address this gap in the literature, the present study examines the criminal behavior of the family members of a sample of cyber offenders prosecuted in the Netherlands. The sample consists of 979 cyber offenders prosecuted for computer trespassing between 2001 and 2018, and two matched groups of 979 traditional offenders and 979 non-offenders. Judicial information and kinship data from Dutch Statistics were used to measure criminal behavior among family members. Both traditional offenders and cyber offenders were found to be more likely to have criminal fathers, mothers, and siblings than non-offenders. Additional analyses, however, showed different patterns between cyber offenders who were only prosecuted for cyber offenses and those who also committed traditional crimes. While the former group of cyber offenders were similar to non-offenders in terms of family offending, the latter group of cyber offenders were more similar to traditional offenders. Overall, these results suggest that the traditional mechanisms of intergenerational transmission of crime can only partially explain cybercrime involvement.

## 1. Introduction

Society has rapidly digitized over the past two decades, which has opened up new opportunities for offenders to commit cybercrimes. It is widely accepted that, on the one hand, there are cyber-enabled crimes, which are traditional offenses that can now be committed online, such as harassment and fraud (McGuire & Dowling, 2013). And, on the other hand, there are cyber-dependent crimes, which include new types of offenses such as hacking and malware infection which are aimed at, and committed through, Information Technology (IT) (Holt & Bossler, 2014; McGuire & Dowling, 2013; for a review see Maimon & Louderback, 2019). Recent figures testify to the importance of tackling both types of cybercrime. Official statistics and victimization surveys show that the most prevalent cyber-enabled crime—online fraud—increased in several European countries during this century (Kemp et al., 2020). Other cybercrimes have also been found to be highly prevalent across various European victimization surveys (Reep-van den Bergh & Junger, 2018). In the Netherlands, the country on which the current study focuses, hacking has even become the crime that is most often reported in victim surveys (Statistics Netherlands, 2020b).

These developments have raised important questions for criminologists, some of which remain unanswered despite the profound debate. Should we consider cybercrime as a new type of crime or as "old wine in new bottles" (Grabosky, 2001, p. 243)? Are existing criminological theories, and findings on the causes and correlates of traditional crimes, generalizable to cybercrime, or do we need new theories for this new type of crime (Holt & Bossler, 2016)? From a theoretical angle, previous criminological research mainly focused on applying the Routine Activity Approach (e.g., Holt et al., 2020; Leukfeldt & Yar, 2016; Yar, 2005) and Self-Control Theory to cybercrime (e.g., Holt et al., 2012; Marcum et al., 2014). In recent overviews of the cybercrime literature, however, it has been concluded that the vast majority of these existing studies only offer limited contributions to contemporary theoretical traditions as they have serious data limitations, such as small samples, student samples and cross-sectional study designs (Leukfeldt, 2017; Maimon & Louderback, 2019). Consequently, it remains largely unknown to what extent results from studies on traditional crime are generalizable to cybercrime.

One topic that has particularly received little attention is the extent to which familial risk factors for traditional offending are also risk

* Corresponding author.
*E-mail addresses:* svandeweijer@nscr.nl (S.G.A. van de Weijer), amoneva@nscr.nl (A. Moneva).

https://doi.org/10.1016/j.chbr.2022.100249
Received 8 August 2022; Received in revised form 12 November 2022; Accepted 16 November 2022
Available online 21 November 2022

factors for cyber offending. As previous studies on cyber offenders almost exclusively focused on risk factors at the individual level, our current knowledge about potential familial influences on their criminal behavior is virtually non-existent. This is an important gap in knowledge as a vast and growing body of research has shown that there are various characteristics and behaviors of family members that predict, and possibly cause, criminal behavior (for an overview see e.g., Ellis et al., 2019; Farrington, 2011). One of the most consistently found familial risk factor for criminal offending is the criminal behavior of family members. Over the last decades a large number of studies have shown that crime tends to run in families (e.g., Beaver, 2013; Farrington et al., 1996; Junger et al., 2013), and is transmitted from parent to child (e.g., Besemer et al., 2017; Eichelsheim & van de Weijer, 2018) and between siblings (e.g., Beijers et al., 2017; Mikkonen et al., 2020). To what extent the criminal behavior of family members also is a risk factor for cyber offending remains unknown. To shed light on this issue, this study examines whether the criminal behavior of fathers, mothers, and siblings is also associated with cybercrime perpetration. This provides us with important insights in whether cyber offenders and traditional offenders come from similar family backgrounds and, thus, whether theoretical mechanisms behind the concentration of crime within families are also applicable to cyber offenders or whether new theories are necessary to explain their behaviors.

After reviewing the main mechanisms that explain the concentration of traditional crime within families and elaborating on their possible application to cybercrime in the following section, the next presents the methodology of the study. This section describes the data used to compare family member offending, in two matched samples of traditional offenders and non-offenders, among all individuals in the Netherlands who were prosecuted for computer trespassing between 2001 and 2018. In the results section, bivariate and regression analyses are presented, followed by a discussion and conclusions.

## 2. Mechanisms of concentration of (Cyber)Crime within families

Various studies have shown that crime concentrates within families. Van de Weijer and colleagues (2014) showed that, within a Dutch sample of high-risk families, approximately 10% of the families were responsible for about 65% of all offenses, and that 80% of all offenses were committed by 20% of the families. Similar degrees of concentration were found in the Cambridge Study in Delinquent Development (Farrington et al., 1996) and the Pittsburgh Youth Study (Farrington et al., 2001). Beaver (2013) found an even stronger concentration of criminal arrests within families in the Add Health data: 10% of the families were responsible for 79% of all arrests, while 25% of the most criminal families accounted for all arrests.

Given this strong concentration of crime within families it is not surprising that several studies have found that parents and their children show similarities in their criminal behavior (Farrington et al., 2009; Thornberry et al., 2003; van de Rakt et al., 2010; van de Weijer et al., 2017). A meta-analysis conducted by Besemer et al. (2017) across 23 studies from 8 countries, showed that children with a criminal parent are 2.4 times more likely to offend than their peers without criminal parents. Other studies also found that specific crimes, such as violent crime (Frisell et al., 2011; van de Weijer et al., 2014), property crime (Farrington et al., 2017; Kendler et al., 2015), white collar crime (Kendler et al., 2015), and organized crime (van Dijk et al., 2019) concentrate within families and are transmitted from one generation to the next. To the authors' knowledge, however, no previous study has examined whether the offending behavior of family members is also a risk factor for cyber offending.

Specific transmission of cyber offending (i.e., when both parent and child engage in cybercrime) might be rare as a consequence of differences in internet use and IT skills between generations, and because the number of people who are arrested and prosecuted for cybercrimes is still low. However, based on some of the mechanisms that are often used to explain intergenerational transmission of criminal behavior (Farrington, 2011), it can be expected that children of traditional offenders are more likely to become cyber offenders, compared to those without criminal parents.

A first mechanism that is often used to explain intergenerational similarities is social learning. According to social learning theories (Akers, 2009; Bandura, 1977) children might learn criminal behavior when they observe and imitate it from their parents. Learning might not only involve the skills or methods to perform criminal acts, but could also include attitudes towards criminal behavior or motivations to be involved in crime. As a consequence, children of traditional offenders are expected to have more positive attitudes and motivations towards criminal behavior. This might not only be reflected in their delinquent and criminal behavior in the physical world but could also increase their risk for committing crime in cyberspace.

Second, Farrington (2011) argued that risk factors for criminal behavior could have an important role in the intergenerational transmission of crime in two different ways. One is that risk factors for criminal behavior, such as poverty, unemployment, teenage parenthood, can be transmitted from one generation to the next. This *cycle of deprivation* could then lead to the perpetuation of crime over multiple generations. This mechanism is also in line with Gottfredson and Hirschi's (1990) General Theory of Crime, in which they argue that inadequate parenting leads to a low level of self-control which in its turn is *the* cause of criminal behavior. As it is unlikely that parents with low self-control adequately supervise their children and recognize and consistently discipline their misbehavior, low levels of self-control are also transmitted from parent to child and may lead to criminal behavior in consecutive generations (Boutwell & Beaver, 2010).

Another way in which risk factors could play a role is by mediating the relationship between parental and offspring offending when the risk factors for the latter are caused by the criminal behavior of the former (Farrington, 2011). For example, parental crime could lead to parental divorce, which has been found to be related to an increased risk of offspring offending (Kroese et al., 2020). If such risk factors for criminal behavior also increase the risk for cybercriminal behavior, there could be a relationship between parental traditional crime and offspring cybercrime.

Third, genetic factors could explain the potential relationship between parental crime and offspring cybercrime. A meta-analysis of virtually all twin studies of the past fifty years showed that, overall, 49% of the variance in human traits is attributable to genetic influences, with the remaining 51% attributable to environmental ones (Polderman et al., 2015). Similar influences of genetic factors were found in meta-analyses that focus specifically on antisocial or criminal behavior (Ferguson, 2010; Rhee & Waldman, 2002). Molecular genetic studies, however, have not yet been successful in identifying the specific genetic variants that are related to antisocial behavior. Recent Genome-Wide Association Studies (GWAS) on antisocial behavior (Tielbeek et al., 2017) and childhood aggression (Ip et al., 2021) did not find any significant associations. And although the polygenic score (PGS) resulting from the latter study significantly predicted aggression later in life, it only explained less than 1% of the variance (van der Laan et al., 2021). These results, however, may be the consequence of the relatively small sample sizes of these GWAS (respectively, $N = 31,968$ and $N = 87,485$) in combination with the strict p-value of a GWAS ($p < 5 \times 10^{-8}$), after a Bonferroni correction of 1 million independent tests. A recent GWAS on educational attainment which used a sample of about 1.1 million individuals, was able to find more than 1200 significant genetic variants and led to a PGS which explained 11–13% of the variance (Lee et al., 2018). It is therefore expected that future GWAS on antisocial behavior with much larger sample sizes will be able to identify relevant genetic variants as well.

Relatively little is known about the genetic influences on online behavior, as twin studies on online behaviors are still very scarce. A few

have shown that genetic factors explain a considerable amount of the variance in, for example, problematic internet use (Li et al., 2014; Vink et al., 2016) and the frequency of social media use (York, 2017). This indicates that our online behavior is also influenced by our genes and therefore there might also be genetic influences on cybercrime. If the same genetic variants are associated with both offline and online crimes, it can be expected that those with criminal parents are more likely to be engaged in cybercrime.

Finally, it has been hypothesized that intergenerational transmission of criminal arrests and convictions is the consequence of an official bias towards known criminal families (Farrington, 2011). When law enforcement bodies are more intensively monitoring known criminal families, their children are more likely to get arrested and convicted when they commit a crime. Besemer et al. (2013) found evidence for this official bias as they found that children with criminal parents were more likely to get convicted than their peers with non-criminal parents who had equal levels of self-reported crime. However, it is doubtful whether this mechanism also applies to cybercrime. Since cybercrimes are committed in cyberspace, the intensive monitoring performed by the police in physical space might not increase the risk of detection for cyber offenders. Only when the police also follow family members who share social and computer networks, the official bias mechanism could also apply to cyber offending.

Based on most of the abovementioned mechanisms it can be expected that children of criminal parents are also more likely to be involved in cybercrime. Since siblings share 50% of their genes, may imitate and learn each other's behavior, and often live in the same household—and are thus exposed to similar risk factors—an association with sibling criminal behavior could also be expected. However, to the authors' knowledge, whether the criminal behavior of family members is related to cyber offending has never been studied before. To bridge this gap in the literature, the present study addresses the following research question: To what extent is having criminal family members associated with committing cybercrime? To answer this research question, the prevalence of criminal parents and siblings will be compared between cyber offenders, traditional offenders, and non-offenders in the Netherlands.

## 3. Methods

### 3.1. Sample

We used data from Statistics Netherlands, which includes information on all Dutch citizens from several sources. By linking data on criminal records and kinship through an anonymized identification number, we assembled a multigenerational dataset with information on criminal behavior of both parents and their children. The criminal records from Statistics Netherlands include all criminal cases registered by the Dutch public prosecutor's office between 2001 and 2018.

Within this period, 1161 persons were prosecuted at least once for computer trespassing. Computer trespassing is defined by the Dutch law as intruding intentionally and unlawfully into a computerized work or part thereof (article 138 ab of the Dutch Criminal Code), which may be achieved by breaching security, technical intervention, using false signals or keys, or assuming a false identity. The Dutch Criminal Code thus aligns with the generally accepted definition of computer hacking that includes social engineering techniques (for a review see Holt, 2020). The identity of one or both parents was unknown for 182 of these 1161 cyber offenders. As we, therefore, could not examine their parents' criminal behavior they were excluded from the analyses. Among the remaining 979 cyber offenders, there were 807 males (82.4%), 925 were born in the Netherlands (94.5%), and they were on average 35 years old in 2018.

In order to construct two comparable control groups of traditional offenders and non-offenders, the criminal behavior of all Dutch citizens with known identity of their parents was examined. Those who were prosecuted for at least one traditional offense (i.e., any offense except computer trespassing) between 2001 and 2018 were considered as traditional offenders, while those who were not prosecuted for any offense in this period were considered as non-offenders. Next, each cyber offender was randomly matched to one traditional offender and one non-offender with the same year of birth, sex and country of birth.[1] Consequently, the total sample included 979 cyber offenders, 979 traditional offenders and 979 non-offenders. By matching these three groups on their year of birth, sex and country of birth it was ensured that the groups were similar on these background factors.

Since 414 cyber offenders (42.3%) were also prosecuted for at least one traditional crime, we also made a distinction between 414 cyber offenders who were prosecuted for both cybercrimes and traditional crimes and the remaining 565 cyber offenders who were only prosecuted for cybercrimes.

### 3.2. Measurements

The main variables of interest in this study concern the criminal behavior of the sample members and their family members. The dependent variable is the categorical variable indicating whether a sample member is a cyber offender, traditional offender or a non-offender, and was constructed as explained above. The independent variables indicating the criminal behavior of family members are also based on the criminal cases that were registered by the Dutch public prosecutor's office between 2001 and 2018.[2] The variables on *paternal and maternal crime* indicate whether or not the father and mother of the sample members were prosecuted for at least one crime between 2001 and 2018. A third category was added for both variables to indicate when the father or mother had died before 2001, since data on prosecutions was only available from 2001 onwards and they could not have offended if they died before this period. By adding this third category, no individuals had to be excluded from the sample and the information on the criminal behavior of their other parent and siblings could still be analyzed. *Sibling offending* was measured as whether or not at least one full- or half-sibling of each sample member was prosecuted for at least one crime between 2001 and 2018. When sample members did not have any full- or half-siblings, they scored on a third category of "no siblings". Binary variables were used to measure the criminal behavior of fathers, mothers and siblings as the large majority of them were never prosecuted or only once.

We also controlled for several demographic and socio-economic variables that have been found to be associated with traditional types of criminal behavior (e.g., Ellis et al., 2019; Farrington, 2011) and often with cybercrime as well (e.g., Schiks et al., 2022; Weulen Kranenbarg et al., 2018, 2021). As discussed above, such risk factors are also transmitted across generations (i.e., the cycle of deprivation; Farrington, 2011) and, therefore, may be related to the criminal behavior of family members as well.

First, we measured *family size* as the number of full- and half-siblings of the sample members.

Next, the *educational level* of our sample was based on their highest completed education and, following the standard classification of Statistics Netherlands (2020a), divided in three categories: low (i.e., primary and lower secondary education), medium (i.e., higher secondary education), and high (i.e., tertiary education).

[1] In the few cases in which it was impossible to find an exact match on all three variables, the person with the same sex and country of birth who was most close in age to the cyber offender was selected.

[2] It is important to note that these data do not provide information about the outcome of the criminal cases and, therefore, the registered persons are officially only marked as a suspect of a crime. This means that the police has closed their investigation and found enough evidence to send the case to the Public Prosecutor. However, it is unknown whether the prosecuted persons also were convicted.

The *employment status* of our sample members was measured using five variables which indicate the percentage of months between January 2001 and December 2018 in which our sample members were employed, in school, pensioned, receiving social benefits, or without an official income (i.e., 'other'). For example, a sample member who was employed during half of this period and in school during the other half of the period, scores 0.5 on both 'employed' and 'in school' and 0 on the other three variables (i.e., pensioned, receiving social benefits and other).

The *household income* of sample members was indicated by the percentile rank of a household within the distribution of incomes of all Dutch households in 2018.

The *marital status* of the sample members was indicated by three categories: single, married (or in a registered relationship), and divorced or widowed. As the number of widowed sample members was very low, this group was combined with those who were divorced. And the *marital status of their parents* was indicated by three similar categories: never married, married (or in a registered relationship), divorced or widowed.

Finally, a binary variable indicating whether both parents were *born in the Netherlands*, or not, was added as a control variable.

The demographic variables on the sex, year of birth and country of birth of sample members were not included as control variables in the analyses since the three groups were matched on these characteristics and therefore, per definition, have the same scores on these variables.

### 3.3. Analyses

Bivariate analyses were carried out to show to what extent the prevalence of paternal, maternal, and sibling offending differed between the groups of cyber offenders, traditional offenders and non-offenders. Chi-squared tests were used to examine whether these differences were significant. Next, multinomial logistic regression analyses served to test whether the associations found in the bivariate analyses remained the same after including all the control variables. In additional analyses, chi-squared tests and multinomial logistic regression analyses were also used to compare the criminal behavior of family members between the group of versatile cyber offenders, who also committed traditional crimes, and specialized cyber offenders, who only committed cybercrimes. To interpret the effect sizes in the regression models, we translate the beta coefficients into Cohen's $d$ with the formula $d = \log OR \times \sqrt{3}/\pi$ (Cohen, 1988). According to this measure, $d = 0.20$ is considered a small effect, $d = 0.40$ a medium effect, and $d = 0.80$ a large one.

In all regression analyses, missing values on educational level (18.4%) and household income (8.5%) were handled using multiple imputation. The other variables in the regression models did not have any missing values.

## 4. Results

Table 1 shows the descriptive statistics of all the variables that were used in the analyses. These statistics show that 14.6% of the sample had a father who was prosecuted between 2001 and 2018, while 6.7% had a mother in the same situation. The prevalence of criminal siblings was even higher (28.2%), probably because the siblings are younger in age than the parents, and because sample members, on average, had 2.1 siblings ($SD = 1.65$). Almost half of the sample had a medium educational level, while about a quarter had a low level. The remaining quarter was highly educated. Most of the time between 2001 and 2018 the sample members were either employed (47% of the months) or in school (38%), and the average household income percentile was 59.50 ($SD = 28.27$). Table 1 further shows that the majority of the sample was single (64.7%), while about a quarter was married, and one in ten was divorced or widowed. Almost two thirds of the parents were married with each other, almost a quarter of the parents were divorced or widowed, and the remaining 8.5% of the parents had never been married with each other. Finally, the majority of the sample (78.6%) had parents who were both born in the Netherlands.

**Table 1**
Descriptive statistics of the sample.

| Variables | N | Percentage | Mean | Std. Dev. |
|---|---|---|---|---|
| Offender group | 2937 | | | |
| Non-offender | 979 | 33.3 | | |
| Traditional offender | 979 | 33.3 | | |
| Cyber offender | 979 | 33.3 | | |
| Paternal crime | 2937 | | | |
| No | 2395 | 81.5 | | |
| Yes | 430 | 14.6 | | |
| Father died | 112 | 3.8 | | |
| Maternal crime | 2937 | | | |
| No | 2688 | 91.5 | | |
| Yes | 196 | 6.7 | | |
| Mother died | 53 | 1.8 | | |
| Sibling crime | 2937 | | | |
| No | 1923 | 65.5 | | |
| Yes | 828 | 28.2 | | |
| No siblings | 186 | 6.3 | | |
| Family size (number of siblings) | 2937 | | 2.10 | 1.65 |
| Educational level | 2397 | | | |
| Low | 593 | 24.7 | | |
| Medium | 1161 | 48.4 | | |
| High | 643 | 26.8 | | |
| Employment status | | | | |
| Employed | 2937 | | 0.47 | 0.37 |
| Social support | 2937 | | 0.09 | 0.20 |
| Pension | 2937 | | 0.01 | 0.05 |
| In school | 2937 | | 0.38 | 0.38 |
| Other | 2937 | | 0.05 | 0.12 |
| Household income percentile | 2688 | | 59.50 | 28.27 |
| Marital status | 2937 | | | |
| Single | 1899 | 64.7 | | |
| Married | 737 | 25.1 | | |
| Divorced/widowed | 301 | 10.2 | | |
| Parental marital status | 2937 | | | |
| Never married | 250 | 8.5 | | |
| Married | 1961 | 66.8 | | |
| Divorced/widowed | 726 | 24.7 | | |
| Parents born in the Netherlands | 2937 | | | |
| No | 629 | 21.4 | | |
| Yes | 2308 | 78.6 | | |

The results of the bivariate analyses are presented in Fig. 1. Fig. 1A shows that, among the cyber offenders, 17.6% (n = 166) had a criminal father, 8.3% (n = 80) had a criminal mother, and 34.7% (n = 314) had a criminal sibling. However, paternal (20%; n = 188), maternal (9.3%; n = 89), and sibling offending (38.8%; n = 358) were all most prevalent among traditional offenders, although the differences with cyber offenders were small and not significant. Among non-offenders, offending was relatively rare among fathers (8.1%; n = 76), mothers (2.8%; n = 27), and siblings (16.9%; n = 156) and significantly less prevalent than in the other two groups. Fig. 1B displays the differences in family offending between cyber offenders who were only prosecuted for cybercrimes and cyber offenders who were also prosecuted for traditional crimes. Among the latter group of cyber offenders, paternal (24.7%; n = 98), maternal (14.3%; n = 58) and sibling offending (45.6%; n = 177) is significantly more prevalent than among those who were only prosecuted for cyber offending (12.5%, n = 68; 3.9%, n = 22; 26.4%, n = 137, respectively). Family member offending is also more prevalent among cyber offenders who were also prosecuted for traditional offenses than among non-offenders and traditional offenders, although the difference with traditional offenders observed in paternal offending is not significant. The prevalence of offending among the families of those who were only prosecuted for cyber offenses is more similar to those of non-offenders (see Fig. 1A). Their fathers and siblings, however, are still significantly more likely to offend than the fathers and siblings of non-offenders. Traditional offenders, on the other hand, had criminal fathers, mothers, and siblings significantly more often than the

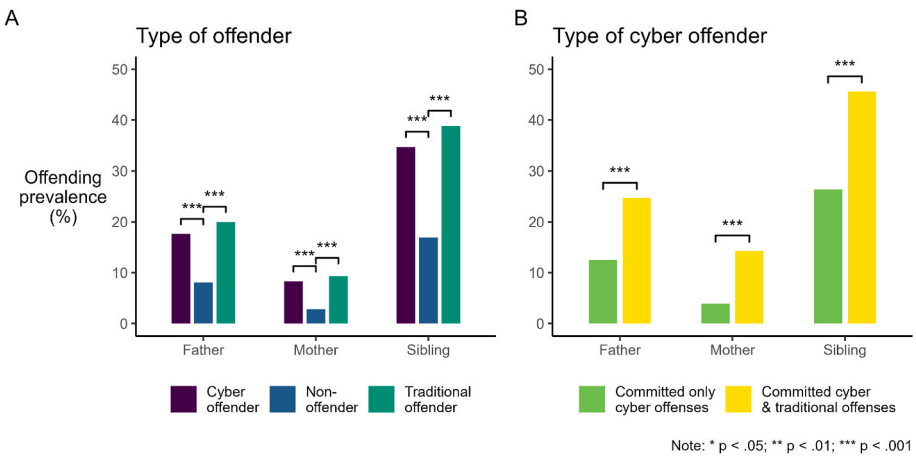


**Fig. 1.** *Differences in offending prevalence among family members by type of offender.*

group of cyber offenders who were only prosecuted for cybercrimes.

After controlling for several control variables, multivariate regression analyses were used to examine differences in family offending between traditional offenders, cyber offenders, and non-offenders. Model 1 of Table 2 shows the results of the comparison between traditional offenders and non-offenders. The prevalence of paternal ($OR = 1.782$; $d = 0.319$), maternal ($OR = 1.914$; $d = 0.358$), and sibling offending ($OR = 2.147$; $d = 0.421$) were all significantly higher among traditional offenders than among the non-offenders with small to medium effect sizes. This indicates that traditional offenders have, respectively, 78.2%, 91.4%, and 114.7% higher odds to have a criminal father, mother, and sibling than non-offenders.

Model 2 compares cyber offenders and non-offenders. Similar to the results in Model 1, having a criminal father ($OR = 1.557$; $d = 0.244$), mother ($OR = 1.772$; $d = 0.315$), and sibling ($OR = 1.866$; $d = 0.344$) was more common among cyber offenders than among the non-offenders with a small effect size. Thus, cyber offenders were, respectively, 55.7%, 77.2%, and 86.6% more likely to have a criminal father,

**Table 2**
Multinomial regression analyses for comparison between cyber offenders, traditional offenders, and non-offenders.

| Variables | Model 1: Non-offender (0) vs traditional offender (1) | | | | | Model 2: Non-offender (0) vs cyber offender (1) | | | | | Model 3: Cyber offender (0) vs traditional offender (1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | S.E. | OR | P | | B | S.E. | OR | P | | B | S.E. | OR | P | |
| Paternal crime | | | | | | | | | | | | | | | |
| No | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Yes | .578 | .158 | 1.782 | .000 | *** | .443 | .159 | 1.557 | .005 | ** | .135 | .128 | 1.145 | .290 | |
| Father died | .106 | .258 | 1.112 | .681 | | .025 | .259 | 1.025 | .925 | | .081 | .246 | 1.084 | .740 | |
| Maternal crime | | | | | | | | | | | | | | | |
| No | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Yes | .649 | .243 | 1.914 | .008 | ** | .572 | .244 | 1.772 | .019 | * | .078 | .173 | 1.081 | .654 | |
| Mother died | .560 | .395 | 1.751 | .156 | | .187 | .418 | 1.206 | .656 | | .373 | .337 | 1.452 | .269 | |
| Sibling crime | | | | | | | | | | | | | | | |
| No | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Yes | .764 | .124 | 2.147 | .000 | *** | .624 | .124 | 1.866 | .000 | *** | .139 | .107 | 1.149 | .193 | |
| No siblings | .270 | .215 | 1.310 | .209 | | .410 | .204 | 1.507 | .044 | * | −.140 | .198 | .869 | .478 | |
| Educational level | | | | | | | | | | | | | | | |
| Low | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Medium | −.605 | .142 | .546 | .000 | *** | −.321 | .147 | .725 | .029 | * | −.284 | .125 | .753 | .024 | * |
| High | −1.307 | .165 | .271 | .000 | *** | −.710 | .171 | .492 | .000 | *** | −.597 | .174 | .550 | .001 | *** |
| Employment status | | | | | | | | | | | | | | | |
| Employed | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Social support | 1.333 | .356 | 3.792 | .000 | *** | 1.502 | .359 | 4.491 | .000 | *** | −.169 | .251 | .845 | .500 | |
| Pension | −1.247 | .950 | .287 | .189 | | −1.214 | .975 | .297 | .213 | | −.033 | .975 | .968 | .973 | |
| In school | −0.647 | .172 | .524 | .000 | *** | −0.376 | .169 | .687 | .026 | * | −.271 | .165 | .763 | .102 | |
| Other | .513 | .517 | 1.670 | .322 | | 1.518 | .496 | 4.563 | .002 | ** | −1.005 | .373 | .366 | .007 | ** |
| Household income percentile | −.004 | .002 | .996 | .061 | | −.004 | .002 | .996 | .060 | | 0.000 | .002 | 1.000 | .973 | |
| Marital status | | | | | | | | | | | | | | | |
| Single | .194 | .135 | 1.214 | .152 | | .368 | .135 | 1.445 | .007 | ** | −.175 | .133 | .839 | .188 | |
| Married | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Divorced/widowed | .263 | .193 | 1.301 | .171 | | .596 | .189 | 1.815 | .002 | ** | −.333 | .172 | .717 | .053 | |
| Parental marital status | | | | | | | | | | | | | | | |
| Never married | .196 | .196 | 1.217 | .317 | | .406 | .188 | 1.501 | .031 | * | −.210 | .165 | .811 | .203 | |
| Married | (ref.) | | | | | (ref.) | | | | | (ref.) | | | | |
| Divorced/widowed | .295 | .123 | 1.343 | .016 | * | .196 | .123 | 1.217 | .112 | | .099 | .111 | 1.104 | .369 | |
| Parents born abroad | .279 | .132 | 1.322 | .034 | * | .429 | .128 | 1.536 | .001 | *** | −.149 | .115 | .862 | .193 | |
| Family size (number of siblings) | −.020 | .035 | .980 | .569 | | −.038 | .035 | .963 | .282 | | .018 | .031 | 1.018 | .560 | |
| MacFadden's pseudo $R^2$ | .080 | | | | | | | | | | | | | | |
| N | 2937 | | | | | | | | | | | | | | |

Note: *p < .05; **p < .01; ***p < .001; Missing values on educational level and income percentile were imputed using multiple imputation.

mother, and sibling than the non-offenders. Remarkably, also those who had no siblings were more likely to become a cyber offender than those who had only non-criminal siblings with a small effect size ($OR = 1.507$; $d = 0.226$).

Model 3 shows the results of the comparison between traditional offenders and cyber offenders. None of the regression coefficients regarding family offending in this model were significant. This indicates, in line with the bivariate results presented in Fig. 1, that cyber offenders and traditional offenders do not differ significantly from each other in terms of criminal family members.

With respect to the control variables, the results in Table 2 show that those with a higher educational level are less likely to be a traditional or cyber offender than a non-offender, but also that cyber offenders tend to have a higher educational level than traditional offenders. Moreover, individuals who received social benefits were more likely to be engaged in traditional crime and cybercrime, while those in school were less likely to be convicted of either type of crime, compared to employed people. People who were not in school and had no official income (i.e., the "other" group) were found to be more likely to be a cyber offender than a traditional offender or a non-offender. Furthermore, cyber offenders were more likely to be divorced or single than to be married, compared to non-offenders. Parental divorce was more common among traditional offenders than non-offenders, while cyber offenders were more likely to have parents who had never been married than non-offenders. Finally, both traditional offenders and cyber offenders were more likely to have parents who were born abroad than non-offenders.

Additional multinomial regression analyses were performed to examine differences between cyber offenders who were only prosecuted for cybercrime and those who were prosecuted for both cybercrime and traditional offenses. Model 1 in Table 3 shows that those with criminal sibling(s) ($OR = 1.504$; $d = 0.225$), a criminal father ($OR = 1.537$; $d = 0.237$), and criminal mother ($OR = 2.743$; $d = 0.556$) were significantly more likely to be prosecuted for both cybercrime and traditional crime than only for cybercrime, although the effect size of the latter (medium) was much larger in comparison. The odds ratios indicate that cyber offenders who also commit traditional crime were, respectively, 53.7%, 174.3%, and 50.4% more likely to have a criminal father, mother, and sibling than those who only committed cybercrimes. In Models 2–5 these two groups of cyber offenders were also compared to the non-offenders and the traditional offenders. The results from Model 2 indicate that parental offending was not significantly associated with committing only cybercrimes, in comparison to non-offenders. The criminal behavior of siblings, however, was significantly more prevalent among this group of cyber offenders than among non-offenders. Model 3, on the other hand, shows that the criminal behavior of all family members was significantly related to being a cyber offender who also commits traditional offenses compared to a non-offender. Similarly, Model 4 shows that traditional offenders were significantly more likely to have a criminal father, mother, and sibling than those who only committed cyber offenses. Finally, Model 5 shows that no significant differences were found in the criminal behavior of family members, between traditional offenders and cyber offenders who were prosecuted for both traditional crime and cybercrime.

## 5. Discussion

The aim of this paper was to examine whether individual cybercrime perpetration was associated to the criminal behavior of fathers, mothers, and siblings—a question seldom studied in the field. To this end, all individuals in the Netherlands who were prosecuted for computer trespassing between 2001 and 2018, were compared with a matched sample of traditional offenders and non-offenders. As is often the case in cybercrime scholarship, the results showed partial support for the applicability of traditional criminological premises to cybercrime, in this occasion, those of the familial concentration of crime.

In line with the existing literature on the familial concentration of criminal behavior (e.g., Besemer et al., 2017; Eichelsheim & van de Weijer, 2018), this study showed that traditional offenders were more likely to have criminal family members than non-offenders. A novel contribution of this study is that these findings were not limited to traditional crimes, but also applied to cybercrime. Overall, the cyber offenders in this study were significantly more likely to have a criminal father, mother, and sibling than non-offenders, while no significant differences were found with traditional offenders. However, it is important to emphasize that the majority of both cyber and traditional offenders did not have a criminal father, mother or sibling. This is in line with previous studies on familial concentration of crime (e.g., Farrington et al., 2001; van de Weijer et al., 2014) and illustrates that, although having criminal family members is a risk factor for criminal offending, criminal behavior is in many cases the consequence of other factors. The relatively small effect sizes support this claim.

Moreover, it is important to note that additional analyses revealed that there is heterogeneity within the sample of cyber offenders. Cyber offenders who also committed traditional crimes were indeed very similar to traditional offenders as both groups often have criminal family members. However, it could be argued that this criminal behavior of family members of these cyber offenders is related to their involvement in traditional crimes rather than specifically to their cyber offending. In addition, as this group of cyber offenders per definition committed multiple offenses (i.e., at least one traditional and one cyber offense), it is possible that this group comprises the most serious offenders in the sample which could explain why they were most likely to have criminal

**Table 3**
Multinomial regression analyses for comparison between two groups of cyber offenders, traditional offenders, and non-offenders.

| Variables | Model 1 | | | | | Model 2 | | | | | Model 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Only cyber (0) vs Both cyber and traditional (1) | | | | | Non-offender (0) vs Only cyber (1) | | | | | Non-offender (0) vs Both cyber and traditional (1) | | | | |
| | B | S.E. | OR | P | | B | S.E. | OR | P | | B | S.E. | OR | P | |
| Paternal crime | .430 | .193 | 1.537 | .025 | * | .252 | .185 | 1.287 | .174 | | .683 | .189 | 1.980 | .000 | *** |
| Maternal crime | 1.009 | .281 | 2.743 | .000 | *** | .017 | .304 | 1.017 | .954 | | 1.027 | .269 | 2.793 | .000 | *** |
| Sibling crime | .408 | .161 | 1.504 | .011 | * | .451 | .142 | 1.570 | .002 | ** | .859 | .156 | 2.361 | .000 | *** |

| Variables | Model 4 | | | | | Model 5 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Only cyber (0) vs Traditional offender (1) | | | | | Both cyber and traditional (0) vs Traditional offender (1) | | | |
| | B | S.E. | OR | P | | B | S.E. | OR | P |
| Paternal crime | .344 | .169 | 1.411 | .037 | * | -.086 | .156 | .918 | .581 |
| Maternal crime | .691 | .258 | 1.996 | .007 | ** | -.318 | .198 | .728 | .108 |
| Sibling crime | .334 | .132 | 1.397 | .011 | * | -.073 | .137 | .930 | .592 |
| McFadden's pseudo $R^2$ | .099 | | | | | | | | |
| N | 2937 | | | | | | | | |

Note: *p < .05; **p < .01; ***p < .001; These regression models include the same control variables as in Table 2.

family members.

On the other hand, the cyber offenders who only committed cybercrimes appeared to come from less delinquent families. In fact, they were found to be significantly less likely to have criminal parents and siblings compared to the traditional offenders and the group of cyber offenders who also committed traditional offenses. In terms of parental offending they were similar to the sample of non-offenders, although they were more likely to have criminal siblings compared to those who abstain from crime. Possibly, this correlation with sibling criminality was easier to detect than an association with parental offending as criminal behavior was only measured over 17 years, between 2001 and 2018. Criminal parents in this data would still have to be criminally active at relatively old age and therefore may constitute a group of more serious chronic offenders. Nevertheless, these results suggest that parental offending is not associated with an increased risk of offending for those who only commit cybercrime and that known parental risk factors for traditional offending may not be generalizable to this group.

The differences observed between these two groups of cyber offenders also illustrate how important it is to consider that the population of cyber offenders is heterogeneous. Future studies should therefore distinguish between these types of cyber offenders or control for involvement in traditional crime. Other sources of heterogeneity are the multiple forms of cybercrime and cyberdeviance that exist (Holt & Bossler, 2020). The modus operandi for computer trespassing might vary from methods that require no or little IT skills such as brute force attacks and social engineering techniques, to methods that are more complex and sophisticated such as malware infection and vulnerability exploitation. It is also possible that the family background of the cyber offenders that use more advanced hacking methods is different from that of the rest in the sense that it is more influenced by an IT education or job. Moreover, note that other types of cyber offenders such as harassers and fraudsters could not be identified in the data of Statistics Netherlands because they are prosecuted under articles of the criminal code for traditional offenses. A more sophisticated cybercrime recording system would allow for a finer granularity in the analysis, which would in turn let researchers examine the differences between different types of cyber offenders. The results of this study are therefore not generalizable to all cyber offenders. It could, however, be expected that online harassers and fraudsters are more similar to traditional offenders than the specialized cyber offenders identified in this study, since these crimes are traditional offenses that are committed online.

Although the application of the developmental and life-course paradigm to cybercrime is still in its infancy and more research on familial risk factors for cyber offending is necessary, the results of this study underline the potential of family based interventions to decrease involvement in cybercrime. Piquero et al. (2016) conducted a meta-analysis on early family training programs, and found that these are an effective evidence-based strategy for preventing antisocial behavior and delinquency. Our finding that cyber offenders who also commit traditional offenses have a similar family background as traditional offenders suggests that such family based interventions might also be effective to reduce antisocial behavior among this type of cyber offenders. However, since those who only commit cyber offenses usually live in non-delinquent families they are less likely to be subjected to such family training programs. In fact, it is questionable whether such programs would be effective for this group of cyber offenders since they seem to be living in less problematic families than traditional offenders. In any case, more research is necessary on the effectiveness of training programs, interventions, and treatments for cyber offenders.

Note that some limitations in the data should be considered when interpreting the results of this study. First, the well-known underreporting issues cause the dark figure of crime to be even greater for cybercrime (Kemp et al., 2020). Besides that, and due to the use of official judicial data, only cyber offenders who got arrested and prosecuted were included in the sample. It is likely that these offenders only constitute a small share of all cyber offenders in the Netherlands. This is illustrated by the fact that 5.5% of the Dutch citizens (i.e., approximately 950.000 people) fall victim to hacking annually (Statistics Netherlands, 2020b), but only 1161 individuals were prosecuted for computer trespassing between 2001 and 2018. So, in the most likely scenario in which this small group of prosecuted cyber offenders is not representative of the total population of cyber offenders, the results of this study would not be generalizable to them.

Another consequence of the low number of prosecuted cyber offenders is that nuclear families with multiple cyber offenders were virtually non-existent in this sample. It was therefore impossible to examine whether cybercrime concentrates within families as well. It is, however, very well possible that some of the family members of the cyber offenders also committed cybercrimes but were never prosecuted for this. We expect this to be more likely among siblings than among parent-child dyads, given intergenerational differences in internet use and IT skills. The development of IT was still in its infancy when the current generation of parents were in their youth. The limited spread of the internet would have affected the digital dependence of that generation and therefore also the abundance of criminal opportunities in cyberspace. We are still witnessing the growth of a whole generation of digital natives. The generation that is today less than 25 years old is the one that has really experienced the benefits of IT along with the risks that it entails. It is possible that a future replication of this study, focusing on self-reported cyber offending among two generations of digital natives finds evidence for intergenerational transmission of cybercrime. In that case, the differences in family offending observed between those who only committed cyber offenses and traditional offenders could smooth out.

Finally, our measurement of the criminal behavior of family members is limited by the fact that the data only includes crimes committed between 2001 and 2018. Given that the criminal behavior of most people peaks in adolescence and early adulthood, it is likely that our results underestimate such behavior—particularly in the case of the parents. We nevertheless mitigated this potential bias by matching the samples on birth year.

## 6. Conclusion

This paper addressed the understudied topic of crime concentration within families of cyber offenders prosecuted by computer trespassing. Using public databases from the Netherlands, this study selected a three-group sample (i.e., cyber offenders, traditional offenders, and non-offenders) to perform statistical comparisons between family offending rates across all three groups. The results show that the fathers, mothers, and siblings of cyber offenders and traditional offenders present similar levels of offending, as opposed to the lower levels exhibited by non-offenders. Among cyber offenders, it is those who also commit traditional offenses who share the most similarities with traditional offenders. In contrast, those who only commit cyber offenses seem to be more similar to non-offenders in terms of familial offending. Overall, these results suggest that the traditional mechanisms of intergenerational transmission of crime can only partially explain cybercrime involvement. Further research with future generations of cyber offenders—and different types of cybercrimes—is needed to contest these findings.

## Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The authors do not have permission to share data.

## Acknowledgements

Funding This work was supported by the Netherlands Organisation for Scientific Research (NWO) under project number 451–16-014.

## References

Akers, R. L. (2009). *Social learning and social structure: A general theory of crime and deviance*. Transaction Publishers.

Bandura, A. (1977). *Social learning theory*. Prentice-Hall.

Beaver, K. M. (2013). The familial concentration and transmission of crime. *Criminal Justice and Behavior, 40*(2), 139–155. https://doi.org/10.1177/0093854812449405

Beijers, J., Bijleveld, C. C. J. H., van de Weijer, S. G. A., & Liefbroer, A. (2017). All in the family?" The relationship between sibling offending and offending risk. *Journal of Developmental and Life-Course Criminology, 3*(1), 1–14. https://doi.org/10.1007/s40865-017-0053-x

Besemer, S., Ahmad, S. I., Hinshaw, S. P., & Farrington, D. P. (2017). A systematic review and meta-analysis of the intergenerational transmission of criminal behavior. *Aggression and Violent Behavior, 37*, 161–178. https://doi.org/10.1016/j.avb.2017.10.004

Besemer, S., Farrington, D. P., & Bijleveld, C. C. J. H. (2013). Official bias in intergenerational transmission of criminal behaviour. *British Journal of Criminology, 53*(3), 438–455. https://doi.org/10.1093/bjc/azt006

Boutwell, B. B., & Beaver, K. M. (2010). The intergenerational transmission of low self-control. *Journal of Research in Crime and Delinquency, 47*(2), 174–209. https://doi.org/10.1177/0022427809357715

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). L. Erlbaum Associates.

van Dijk, M., Kleemans, E. R., & Eichelsheim, V. I. (2019). Children of organized crime offenders: Like father, like child? An explorative and qualitative study into mechanisms of intergenerational (Dis)Continuity in organized crime families. *European Journal on Criminal Policy and Research, 25*(4), 345–363. https://doi.org/10.1007/s10610-018-9381-6

Eichelsheim, V. I., & van de Weijer, S. G. A. (Eds.). (2018). *Intergenerational continuity of criminal and antisocial behaviour: An international overview of studies*. Routledge, Taylor and Francis Group.

Ellis, L., Farrington, D. P., & Hoskin, A. W. (2019). *Handbook of crime correlates* (2nd ed.). Academic Press, an imprint of Elsevier.

Farrington, D. P. (2011). Families and crime. In J. Q. Wilson, & J. Petersilia (Eds.), *Crime and public policy* (2nd ed., pp. 130–157). Oxford University Press.

Farrington, D. P., Barnes, G. C., & Lambert, S. (1996). The concentration of offending in families. *Legal and Criminological Psychology, 1*(1), 47–63. https://doi.org/10.1111/j.2044-8333.1996.tb00306.x

Farrington, D. P., Coid, J. W., & Murray, J. (2009). Family factors in the intergenerational transmission of offending. *Criminal Behaviour and Mental Health, 19*(2), 109–124. https://doi.org/10.1002/cbm.717

Farrington, D. P., Jolliffe, D., Loeber, R., Stouthamer-Loeber, M., & Kalb, L. M. (2001). The concentration of offenders in families, and family criminality in the prediction of boys' delinquency. *Journal of Adolescence, 24*(5), 579–596. https://doi.org/10.1006/jado.2001.0424

Farrington, D. P., Ttofi, M. M., & Crago, R. V. (2017). Intergenerational transmission of convictions for different types of offenses. *Victims and Offenders, 12*(1), 1–20. https://doi.org/10.1080/15564886.2016.1187693

Ferguson, C. J. (2010). Genetic contributions to antisocial personality and behavior: A meta-analytic review from an evolutionary perspective. *The Journal of Social Psychology, 150*(2), 160–180. https://doi.org/10.1080/00224540903366503

Frisell, T., Lichtenstein, P., & Långström, N. (2011). Violent crime runs in families: A total population study of 12.5 million individuals. *Psychological Medicine, 41*(1), 97–105. https://doi.org/10.1017/S0033291710000462

Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford University Press.

Grabosky, P. N. (2001). Virtual criminality: Old wine in new bottles? *Social & Legal Studies, 10*(2), 243–249. https://doi.org/10.1177/a017405

Holt, T. J. (2020). Computer hacking and the hacker subculture. In T. J. Holt, & A. M. Bossler (Eds.), *The palgrave handbook of international cybercrime and cyberdeviance* (pp. 725–742). Springer International Publishing. https://doi.org/10.1007/978-3-319-78440-3_31.

Holt, T. J., & Bossler, A. M. (2014). An assessment of the current state of cybercrime scholarship. *Deviant Behavior, 35*(1), 20–40. https://doi.org/10.1080/01639625.2013.822209

Holt, T. J., & Bossler, A. M. (2016). *Cybercrime in progress: Theory and prevention of technology-enabled offenses* (1st ed.). Routledge.

Holt, T. J., & Bossler, A. M. (Eds.). (2020). *The palgrave handbook of international cybercrime and cyberdeviance*. Springer International Publishing. Imprint: Palgrave Macmillan https://link.springer.com/10.1007/978-3-319-90307-1.

Holt, T. J., Bossler, A. M., & May, D. C. (2012). Low self-control, deviant peer associations, and Juvenile cyberdeviance. *American Journal of Criminal Justice, 37*(3), 378–395. https://doi.org/10.1007/s12103-011-9117-3

Holt, T. J., van Wilsem, J., van de Weijer, S. G. A., & Leukfeldt, E. R. (2020). Testing an integrated self-control and routine activities framework to examine malware infection victimization. *Social Science Computer Review, 38*(2), 187–206. https://doi.org/10.1177/0894439318805067

Ip, H. F., van der Laan, C. M., Krapohl, E. M. L., Brikell, I., Sánchez-Mora, C., Nolte, I. M., St Pourcain, B., Bolhuis, K., Palviainen, T., Zafarmand, H., Colodro-Conde, L., Gordon, S., Zayats, T., Aliev, F., Jiang, C., Wang, C. A., Saunders, G., Karhunen, V., Hammerschlag, A. R., … Boomsma, D. I. (2021). Genetic association study of childhood aggression across raters, instruments, and age. *Translational Psychiatry, 11*(1), 413. https://doi.org/10.1038/s41398-021-01480-x

Junger, M., Greene, J., Schipper, R., Hesper, F., & Estourgie, V. (2013). Parental criminality, family violence and intergenerational transmission of crime within a birth cohort. *European Journal on Criminal Policy and Research, 19*(2), 117–133. https://doi.org/10.1007/s10610-012-9193-z

Kemp, S., Miró-Llinares, F., & Moneva, A. (2020). The dark figure and the cyber fraud rise in Europe: Evidence from Spain. *European Journal on Criminal Policy and Research*. https://doi.org/10.1007/s10610-020-09439-2

Kendler, K. S., Ohlsson, H., Morris, N. A., Sundquist, J., & Sundquist, K. (2015). A Swedish population-based study of the mechanisms of parent–offspring transmission of criminal behavior. *Psychological Medicine, 45*(5), 1093–1102. https://doi.org/10.1017/S0033291714002268

Kroese, J., Bernasco, W., Liefbroer, A. C., & Rouwendal, J. (2020). Growing up in single-parent families and the criminal involvement of adolescents: A systematic review. *Psychology, Crime and Law*, 1–15. https://doi.org/10.1080/1068316X.2020.1774589

van der Laan, C. M., Morosoli-García, J. J., van de Weijer, S. G. A., Colodro-Conde, L., the ACTION Consortium, Ip, H. F., van der Laan, C. M., Krapohl, E. M. L., Brikell, I., Sánchez-Mora, C., Nolte, I. M., Pourcain, B. S., Bolhuis, K., Palviainen, T., Zafarmand, H., Colodro-Conde, L., Gordon, S., Zayats, T., Aliev, F., … Boomsma, D. I. (2021). Continuity of genetic risk for aggressive behavior across the life-course. *Behavior Genetics, 51*(5), 592–606. https://doi.org/10.1007/s10519-021-10076-6

Lee, J. J., Wedow, R., Okbay, A., Kong, E., Maghzian, O., Zacher, M., Nguyen-Viet, T. A., Bowers, P., Sidorenko, J., Karlsson Linnér, R., Fontana, M. A., Kundu, T., Lee, C., Li, H., Li, R., Royer, R., Timshel, P. N., Walters, R. K., Willoughby, E. A., … Cesarini, D. (2018). Gene discovery and polygenic prediction from a genome-wide association study of educational attainment in 1.1 million individuals. *Nature Genetics, 50*(8), 1112–1121. https://doi.org/10.1038/s41588-018-0147-3

Leukfeldt, E. R. (Ed.). (2017). *The human factor in cybercrime and cybersecurity: Research agenda*. Eleven International Publishing. https://www.elevenpub.com/criminology/catalogus/research-agenda-the-human-factor-in-cybercrime-and-cybersecurity-1.

Leukfeldt, E. R., & Yar, M. (2016). Applying routine activity theory to cybercrime: A theoretical and empirical analysis. *Deviant Behavior, 37*(3), 263–280. https://doi.org/10.1080/01639625.2015.1012409

Li, M., Chen, J., Li, N., & Li, X. (2014). A twin study of problematic internet use: Its heritability and genetic association with effortful control. *Twin Research and Human Genetics, 17*(4), 279–287. https://doi.org/10.1017/thg.2014.32

Maimon, D., & Louderback, E. R. (2019). Cyber-dependent crimes: An interdisciplinary review. *Annual Review of Criminology, 2*(1), 191–216. https://doi.org/10.1146/annurev-criminol-032317-092057

Marcum, C. D., Higgins, G. E., Ricketts, M. L., & Wolfe, S. E. (2014). Hacking in high school: Cybercrime perpetration by Juveniles. *Deviant Behavior, 35*(7), 581–591. https://doi.org/10.1080/01639625.2013.867721

McGuire, M. R., & Dowling, S. (2013). *Cyber crime: A review of the evidence* (Vol. 75, pp. 1–128). Home Office https://www.gov.uk/government/publications/cyber-crime-a-review-of-the-evidence.

Mikkonen, J., Savolainen, J., Aaltonen, M., & Martikainen, P. (2020). Using age difference and sex similarity to detect evidence of sibling influence on criminal offending. *Psychological Medicine*, 1–9. https://doi.org/10.1017/S0033291720003724

Piquero, A. R., Jennings, W. G., Diamond, B., Farrington, D. P., Tremblay, R. E., Welsh, B. C., & Gonzalez, J. M. R. (2016). A meta-analysis update on the effects of early family/parent training programs on antisocial behavior and delinquency. *Journal of Experimental Criminology, 12*(2), 229–248. https://doi.org/10.1007/s11292-016-9256-0

Polderman, T. J. C., Benyamin, B., de Leeuw, C. A., Sullivan, P. F., van Bochoven, A., Visscher, P. M., & Posthuma, D. (2015). Meta-analysis of the heritability of human traits based on fifty years of twin studies. *Nature Genetics, 47*(7), 702–709. https://doi.org/10.1038/ng.3285

van de Rakt, M., Ruiter, S., de Graaf, N. D., & Nieuwbeerta, P. (2010). When does the apple fall from the tree? Static versus dynamic theories predicting intergenerational transmission of convictions. *Journal of Quantitative Criminology, 26*(3), 371–389. https://doi.org/10.1007/s10940-009-9089-3

Reep-van den Bergh, C. M. M., & Junger, M. (2018). Victims of cybercrime in Europe: A review of victim surveys. *Crime Science, 7*(5), 1–15. https://doi.org/10.1186/s40163-018-0079-3

Rhee, S. H., & Waldman, I. D. (2002). Genetic and environmental influences on antisocial behavior: A meta-analysis of twin and adoption studies. *Psychological Bulletin, 128*(3), 490–529.

Schiks, J. A. M., van de Weijer, S. G. A., & Leukfeldt, E. R. (2022). High tech crime, high intellectual crime? Comparing the intellectual capabilities of cybercriminals, traditional criminals and non-criminals. *Computers in Human Behavior, 126*, Article 106985. https://doi.org/10.1016/j.chb.2021.106985

Statistics Netherlands. (2020a). *Standaardonderwijsindeling 2016* (pp. 1–113). Statistics Netherlands: Editie 2019/'20. https://www.cbs.nl/-/media/_pdf/2020/25/pubsoi2016_ed1920.pdf.

Statistics Netherlands. (2020b). Veiligheidsmonitor, 2019 (pp. 1–113). Statistics Netherlands https://longreads.cbs.nl/veiligheidsmonitor-2019/.

Thornberry, T. P., Freeman-Gallant, A., Lizotte, A. J., Krohn, M. D., & Smith, C. A. (2003). Linked lives: The intergenerational transmission of antisocial behavior. *Journal of Abnormal Child Psychology, 31*(2), 171–184. https://doi.org/10.1023/a:1022574208366

Tielbeek, J. J., Johansson, A., Polderman, T. J. C., Rautiainen, M.-R., Jansen, P., Taylor, M., Tong, X., Lu, Q., Burt, A. S., Tiemeier, H., Viding, E., Plomin, R., Martin, N. G., Heath, A. C., Madden, P. A. F., Montgomery, G., Beaver, K. M., Waldman, I., Gelernter, J., … Posthuma, D. (2017). Genome-Wide association studies of a broad spectrum of antisocial behavior. *JAMA Psychiatry, 74*(12), 1242–1250. https://doi.org/10.1001/jamapsychiatry.2017.3069

Vink, J. M., Beijsterveldt, T. C. E. M., Huppertz, C., Bartels, M., & Boomsma, D. I. (2016). Heritability of compulsive Internet use in adolescents. *Addiction Biology, 21*(2), 460–468. https://doi.org/10.1111/adb.12218

van de Weijer, S. G. A., Besemer, S., & Augustyn, M. (2017). Intergenerational transmission of crime. In A. A. J. Blokland, & V. Van der Geest (Eds.), *The Routledge international handbook of life-course criminology* (pp. 279–297). Routledge/Taylor & Francis Group.

van de Weijer, S. G. A., Bijleveld, C. C. J. H., & Blokland, A. A. J. (2014). The intergenerational transmission of violent offending. *Journal of Family Violence, 29*(2), 109–118. https://doi.org/10.1007/s10896-013-9565-2

Weulen Kranenbarg, M., Ruiter, S., & Van Gelder, J.-L. (2021). Do cyber-birds flock together? Comparing deviance among social network members of cyber-dependent offenders and traditional offenders. *European Journal of Criminology, 18*(3), 386–406. https://doi.org/10.1177/1477370819849677

Weulen Kranenbarg, M., Ruiter, S., van Gelder, J.-L., & Bernasco, W. (2018). Cyber-offending and traditional offending over the life-course: An empirical comparison. *Journal of Developmental and Life-Course Criminology, 4*(3), 343–364. https://doi.org/10.1007/s40865-018-0087-8

Yar, M. (2005). The novelty of 'cybercrime': An assessment in light of routine activity theory. *European Journal of Criminology, 2*(4), 407–427. https://doi.org/10.1177/147737080556056

York, C. (2017). A regression approach to testing genetic influence on communication behavior: Social media use as an example. *Computers in Human Behavior, 73*, 100–109. https://doi.org/10.1016/j.chb.2017.03.029