



# The developmental sequences of events underlying persistence in criminal convictions during adulthood

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## ABSTRACT

The relationship between multiple vulnerabilities experienced and accumulated during development, and later life-course persistent offending trajectories is well-established. However, no studies have yet systematically examined how the sequences in which these vulnerabilities are experienced may influence the persistence of criminal behaviour into adulthood. Therefore, this work investigated how the sequences in which risk factors were experienced may contribute to accruing adult criminal convictions among males with justice involvement during adolescence. To this end, we employed the rich and detailed Cambridge Study in Delinquent Development, a longitudinal study that followed 411 boys from South London from age 8 to age 61. Using an innovative methodological approach, the sequences of risk factors experienced at ages 8–10, 12–14, and 16–18 were mapped and analysed as predictors of adult convictions. Childhood vulnerabilities such as parenting-related problems, low attainment, and risk-taking behaviour at ages 8–10 emerged as key starting points for the developmental sequences leading to adult convictions. At ages 12–14, hyperactivity and low IQ were identified as significant risk factors, followed by school failure and sexual promiscuity at ages 16–18. A very small number of prevalent sequences of risk factors appeared to promote the continuity of convictions from adolescence into adulthood. Our findings suggest that enhancing parenting strategies and fostering school success may prevent the cascade of risk factors promoting life-course persistent offending trajectories. At the transition to adulthood, the most common risk factors and crime-predictive sequences seem to undermine key opportunities for earlier crime desistance.

## 1. Introduction

The evidence from various prospective longitudinal studies (e.g., Farrington, Ttofi, & Coid, 2009; Loeber, 2018) and subsequent systematic reviews conducted over the past decades have identified a set of relevant social, family and socioeconomic risk factors for initiation, progression, and persistence of criminal careers (e.g., Jolliffe, Farrington, Piquero, Loeber, & Hill, 2017). In a recent systematic review, Basto-Pereira and Farrington (2022) mapped, reviewed, and ordered (by effect sizes) the results of all meta-analyses of longitudinal studies examining the predictors of offending and persistence in crime during adulthood. They found that the strongest predictors of general offending

were dimensions related to parenting dysfunctionality and child maltreatment, but justice-involved youth's persistence in crime tended to be preceded by several multisystemic vulnerabilities, including alcohol and drug addiction, family dysfunctionality, antisocial peers, and school/employment-related problems.

Indeed, numerous theoretical frameworks such as the Interactional Model (Thornberry & Krohn, 2005), Age-Graded Theory of Informal Social Control (Sampson & Laub, 2005), Integrated Cognitive Antisocial Potential Theory (Farrington & McGee, 2019), and Moffitt's Developmental Taxonomy of Antisocial Behaviour (Moffitt, 1993) suggest that early risk factors can modify and magnify the influence of later causal elements, thereby leading to distinct patterns of criminal behaviour (as

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discussed by, e.g., [Farrington, 2020](#)). Therefore, these theoretical models propose that distinct offending trajectories are shaped not solely by the mere presence of risk factors in isolation, but by their interaction and progression across developmental stages.

For example, Terrie Moffitt's groundbreaking work on antisocial behaviour theorized two principal trajectories of offending, adolescence-limited and life-course persistent, and proposed a distinctive and sequential understanding of the developmental course of antisocial behaviour ([Moffitt, 1993, 2018](#)). The adolescence-limited trajectory of offending is proposed to result from the misalignment between biological and social maturity in contemporary Western societies, often referred to as the "maturity gap" ([Moffitt, 1993](#)). This trajectory both develops in the presence of antisocial peers and is reinforced by these peers, with the resulting antisocial behaviour providing a way for young people to demonstrate autonomy from their parents and embrace adult roles. Typically, the antisocial behaviour associated with this trajectory naturally diminishes over time and ends between the late adolescent years and the transition to adulthood ([Moffitt, 1993, 2018](#)). This coincides with the time period when most young people adopt adult roles, fulfilling the need for autonomy and where antisocial behaviour is no longer reinforced. Occasionally the consequences of these forms of antisocial behaviour (e.g., criminal justice involvement, addiction) may result in the adolescence-limited offending trajectory being extended into young adulthood ([Moffitt, 2018](#)).

In contrast, the life-course persistent trajectory is characterized by early manifestations of disruptive behaviour, evident during childhood, which tend to intensify and diversify into adolescence and adulthood. According to [Moffitt \(2018\)](#), this trajectory is initially triggered by minor neuropsychological variations, commonly the result of extremely impoverished or dysfunctional environments such as child maltreatment, poor child stimulation, maternal high-risk behaviours during pregnancy. These minor neuropsychological variations (e.g., emotion regulation problems, poor cognitive abilities, attention deficits, impulsivity) foster subsequent fractious and challenging interactions with parents and other caretakers in an environment that already has a higher likelihood of being underprivileged; this leads to a spiral of subsequent dysfunctional interactions that actively promote the development of an antisocial functioning pattern.

Contemporary and cumulative continuity processes are pivotal to understanding the lifelong nature of this trajectory. The contemporary continuity process refers to how the stable nature of some early risk factors, such as low intelligence, continue to be relevant across each life stage ([Moffitt, 1993, 2018](#)). The cumulative continuity process refers to the 'snowball effect' of specific risk factors. These risk factors have the ability to increase the likelihood of exposure to new risk factors, which, in turn, generate even more risk factors for offending ([Moffitt, 1993](#)). One example of this type of risk factor is low self-control; diminished self-control can hinder a youth's ability to study and to resist deviant peers' criminal incentives, which increases the possibility of early involvement with the justice system, thus creating more – and more active – risk factors across the lifespan. According to [Moffitt \(1993\)](#), these sequences of events will progressively diminish the opportunities to adopt a conventional lifestyle, thus increasing the likelihood of adopting a highly stable life-course persistent trajectory.

Also, the Integrated Cognitive Antisocial Potential theory (ICAP; [Farrington, 2020](#)) details how a sequence of risk factors and events can increase the likelihood of later antisocial behaviour. For instance, an individual's enduring propensity to be involved in antisocial behaviour, or their long-term antisocial potential, is the result of the accumulation and interaction of multiple developmental and life-course vulnerabilities (e.g., attachment and socialization problems, impulsiveness, presence of antisocial models during development). The highest levels of antisocial behaviour are likely related to a different set or sequence of risk factors experienced at different ages, as recently explained by David [Farrington \(2020, pp. 177\)](#):

"Since it might be expected that different factors would be important

at different ages or life stages, it seems likely that different models would be needed at different ages. Perhaps parents are more important in influencing children, peers are more important in influencing adolescents, and spouses and romantic partners are more important in influencing adults".

In other words, according to the ICAP, developmental sequences of different risk factors result in variations in long-term antisocial potentials and, consequently, different propensities for persistence in crime.

Therefore, according to multiple theoretical models, the presence and seriousness of antisocial behaviour is not merely a product of the importance of risk factors (e.g., environmental contexts, and traits) but develops and is maintained through an age-graded sequence of strengths and vulnerabilities. These sequences interact with, and in some cases promote or prevent, subsequent risk factors for offending, thereby shaping a probable trajectory of offending over time. In this context, [Le Blanc and Loeber \(1998, pp.182\)](#) were among the first researchers to make a compelling case for the importance of focusing on the developmental sequence of multisystemic factors that promote the development of criminal careers, according to these authors:

"we can no longer be satisfied with a myopic view of the causes of individual offending, rooted in a specific moment in time, all of which are assumed to be invariant with developmental stages; rather, there is a need to adopt a system view in which numerous facilitators operate and interact along the developmental timeline".

Nonetheless, since [Le Blanc and Loeber's](#) assertion in 1998, studies examining the developmental sequences of multisystemic vulnerabilities related to later antisocial behaviour have remained exceptionally rare. This scarcity of studies can be attributed to the limited availability of long-term longitudinal studies capable of providing the requisite data (see [Basto-Pereira, Começanha, Ribeiro, & Maia, 2015](#)), as well as the substantial methodological challenges involved in examining multiple, temporally ordered risk factors. [Loeber \(2018: p. 162\)](#) perfectly described the magnitude of this endeavour:

"The identification of developmental pathways can become overwhelming when the possible developmental sequences linking dozens of problem behaviours are considered. For example, even with 20 different problem behaviours, the number of possible combinations of developmental sequences is  $2.43 \times 10^{18}$ ".

Indeed, to our knowledge only one study has systematically identified and mapped a complex chains of multisystemic risk factors that may contribute to adult criminal convictions. [Basto-Pereira, Farrington, and Maciel \(2024\)](#), used data from the Cambridge Study in Delinquent Development (CSDD) to introduce a new theoretical and methodological approach to the study of sequences increasing the likelihood of criminal behaviour. The authors identified 258 frequently occurring, temporally ordered sequences of risk factors associated with adult criminal convictions. As expected, the majority of these 258 crime-predictive developmental sequences exhibited effect sizes significantly larger than those of the most predictive risk factors within the CSDD dataset. At each developmental stage, particular risk factors were intricately intertwined, creating a chain of risks that cumulatively increased the prediction criminal convictions. This study showed that specific risk factors experienced during childhood, such as poverty, inadequate parenting, and predispositions towards risky behaviour, were at the root of crime-predictive developmental sequences. Typically, these initial factors were followed by lower cognitive performance and affiliation to delinquent peers during emerging adolescence, and challenges related to academic achievement, unstable employment, or substance abuse during late adolescence.

This approach drew attention to the significant shift required in developmental criminology, moving from studying the impact of risk factors in multivariate models to examining chains of risk factors. Specifically, [Basto-Pereira et al. \(2024\)](#) introduced concepts (along with a supportive methodology) to characterize the likelihood of a risk factor to attract other risk factors (magnetic risk factors) or be attracted to other risk factors (attracted risk factors) in a sequence of risk, as well as

evaluating the ability of each risk factor to influence the crime-predictive power of the sequences in which it is present (influential power). According to these authors, a magnetic factor is defined as a factor frequently observed at the onset of sequences predicting an assessed outcome. It has a high probability of being linked with several other factors in subsequent stages and creates multiple sequences that increase the likelihood of a certain outcome. In contrast, attracted factors are those influenced, predicted, or triggered by a variety of preceding factors, culminating at the end of multiple sequences that predict the targeted outcome (Basto-Pereira et al., 2024). Informed by knowledge, not just about the specific risk factor (i.e., low self-control), but also how this may fit in the risk factor sequence, interventions designed to prevent the onset or escalation of criminal and antisocial behaviour may be in a position to outperform previous approaches by effectively targeting and addressing the core risk factors enhancing this behaviour.

Nonetheless, the study of Basto-Pereira et al. (2024) focused on the developmental sequences predicting adult crime in a community sample. While the inclusive approach adopted by these authors enhanced the statistical power and represents a pioneering step through a novel methodology, it simultaneously limits the ability to examine whether there are key developmental sequences of risk factors that differentiate males on persistent offending trajectories from those on adolescent-limited trajectories.

## 2. Current study

To our knowledge, this is the first study to explore multiple sequences of a wide range of developmental risk factors that may lead to persistent criminal behaviour among justice-involved youths. As multiple studies have stressed over time (e.g., Basto-Pereira et al., 2015; Farrington et al., 2009), most chronic criminal careers involve justice-involved youths, but most justice-involved youths will not be convicted for crimes during adulthood. Thus, mapping the chain of multi-systemic factors underlying the persistence of antisocial behaviour is crucial for understanding why different justice-involved youths develop substantially different trajectories of offending. Second, and as highlighted by Basto-Pereira et al. (2024), robust evidence-based knowledge about sequences of developmental-graded risk factors is of foremost importance in informing interventions that consider past, present, and probable future high-risk criminogenic needs.

This study is also the first to explore more than one sequence of a wide range of developmental risk factors leading to persistent crime during adulthood among justice-involved youths. This study has two aims: first, to investigate the impact of sequences of risk factors from childhood (at ages 8–10) up to early adolescence (at ages 12–14) and late adolescence/young adulthood (16–18) on adult criminal convictions among justice-involved youths; and second, to examine the ability of each risk factor to be integrated in different crime-predictive sequences of risk factors: (a) predicting risk factors in subsequent developmental stages and (b) being predicted by risk factors in previous developmental stages.

## 3. Methods

### 3.1. Participants and procedures

The CSDD is an extensive prospective longitudinal study that followed-up 411 males from South London, from the age of 8–9 up to age 61 (Farrington, Piquero, Jennings, & Jolliffe, 2023). Initiated in 1962,

the study sought to investigate the development of antisocial and violent behaviour from childhood through to adulthood. The sample was the population of all boys who were attending six local state primary schools within a one-mile radius of the research office in South London. The majority of the CSDD cohort consisted of White British males (87 %) from two-parent working-class families, meaning the fathers were working as skilled, semi-skilled, or unskilled manual workers. Of the remaining 13 % (54 boys), 16 were Caucasian with one or both parents originally from another Western industrialized nation; 14 had at least one parent from Ireland; 12 had at least one parent being originally from Cyprus; and 12 were of African Caribbean origin. All the males were interviewed face to face multiple times (at ages 8, 10, 14, 16, 18, 32, and 48), with a subsample of these males being evaluated at ages 21 and 25 as well (Farrington, 2019). Across the study's duration, the retention rate was extraordinarily high, with 93 % of the males still alive being engaged at this study at age 48. Aside from face-to-face interviews, the boy's peers, parents, teachers, and later in life, partners, were also interviewed (e.g., Farrington et al., 2023; West & Farrington, 1973). As is detailed in the next subsections, school records during childhood and adolescence and criminal records across life were also searched.

Criminal convictions were searched and collected for all males from the age of 10 (the minimum age for criminal responsibility) up to the age of 61.99 (Farrington, 2019). The age at which each crime was committed was recorded for each male, initially from the Criminal Record Office and subsequently from the Police National Computer. All relatively serious offenses committed in Great Britain or Ireland, such as theft, burglary, robbery, murder, assault, or sex offenses, are registered in these records and were collected. Only minor convictions (e.g., motoring offenses, drunkenness) are not recorded in the Police National Computer and were therefore not included. The most recent search of the criminal records was conducted in April 2017 (Farrington, 2019). All registered convictions or cautions for crimes committed up to the age of 61 were collected for the CSDD study. By that age, 168 males who remained actively tracked in the study up to at least the age of 38 had been convicted, including those convicted during adolescence and adulthood.

Regarding ethical considerations, all the participants and their parents (when they were minors) consented to participate after being informed of the CSDD's objectives and potential implications. Confidentiality was assured and, at each face-to-face interview, informed consent was obtained and signed (e.g., Farrington et al., 2023; West & Farrington, 1973). The CSDD received various ethical approvals, including from the Home Office, the Cambridge Institute of Criminology Ethics Committee, and the Institute of Psychiatry, King's College London Ethics Committee. A detailed description of the CSDD study can be found in several books (e.g., Farrington et al., 2023; West, 1969; West & Farrington, 1973), as well as various articles and book chapters (e.g., Farrington, 2019; Farrington & Jolliffe, 2022; Farrington & West, 1981).

### 3.2. Risk factors for antisocial behaviour

Risk factors from socioeconomic, family, parental, attainment, personality, and behavioural/lifestyle domains were assessed across three key developmental periods: 8–10 years old (childhood), 12–14 years old (early adolescence), and 16–18 years old (late adolescence/teenage years).

#### 3.2.1. Childhood risk factors (8–10 years old)

Family domain: This domain was based on structured interviews

with the boy's parents by a psychiatric social worker and included harsh parental attitude and discipline (use of cruel or harsh parenting strategies); disrupted family (separation of the boy from the mother or the father in the first 10 years of life for reasons other than death or hospitalization); poor parental supervision (permissive parenting strategies and/or insufficient parental knowledge about what the boys were doing when they were outside the house); nervousness of father (this measure results from the combination of nervousness of the father and father currently under psychiatric treatment); and parental conflict (chronic tensions or persistent conflicts between the boy's parents).

Socioeconomic domain: Low socioeconomic status (SES; the primary provider, at that time usually the father, had an unskilled manual job); large family size (five or more children); high-delinquency-rate schools; low family income; and poor housing (degraded premises as rated by psychiatric social workers).

Parental domain: Low parental interest in the boy's education (parental knowledge about the child's school life, including school activities and problems); young mother (the boy's mother had her first child up to the age of 19) assessed through structured interviews with the boy's parents conducted by social workers; and depressed mother, assessed using a combination of measures, including social workers' interview ratings, to current involvement in psychiatric treatment, and score from the neuroticism dimension assessed using the Mother's Health Questionnaire. In addition, criminal records searches were conducted to assess if the boy's father or mother had a conviction.

Attainment domain: Information about verbal and non-verbal intelligence was assessed using, in the first case, verbal comprehension and vocabulary tests, and in the second case, using the Progressive Matrices Test. Scores were classified as low verbal or non-verbal IQ when the score was  $\leq 90$ . School attainment was assessed using the scores from a combination of English, arithmetic, and verbal reasoning tests.

Personality domain: Neuroticism and extroversion personality traits were assessed using the New Junior Maudsley Inventory. Popularity was measured using school peer ratings. To assess hyperactivity, the boy's teachers were questioned about restlessness and poor concentration during classes. High daring resulted from a combination of ratings by parents and peers that rated the boy's risk-taking behaviour (e.g., in traffic, exploring). Impulsivity was assessed through a combination of psychomotor tests of clumsiness, including the Spiral Maze, Porteus Maze, and Tapping tests. Lastly, difficult to discipline resulted from teacher's ratings about each boy.

### 3.2.2. Adolescent risk factors (12–14 years old)

Family/Parenting Domain: Parental conflict refers to chronic conflicts and divergences between parents; poor child rearing reflects a dysfunctional parenting style, which was characterized as being erratic, neglectful, or harsh. These dimensions were assessed by a social worker during interviews with the parents.

Socioeconomic domain: Low SES (as at ages 8–10, this indicator is based on the occupation of the breadwinner, typically the father); low family income (based on the breadwinner's income); poor housing (boy living in a house with deteriorated premises); and unemployed father (considered present if the father was unemployed in the previous two years).

Attainment domain: Standardized tests were used to measure low verbal IQ (Mill Hill Vocabulary test) and low non-verbal IQ (Progressive Matrices test). Scores of  $\leq 90$  were considered low. Frequent truancy and hyperactivity (indicating a lack of concentration and agitation in the classroom) were measured based on teachers' reports.

Personality domain: High daring was based on teacher reports at ages 12–14 regarding the boy's risk-taking behaviour (e.g., in traffic, exploring). Extroversion and neuroticism were measured using the New Junior Maudsley Inventory.

Behavioural/Peers domain: Early sex (had sex for the first time before 16) and association with delinquent friends were measured using self-report questionnaires.

### 3.2.3. Youth / teenage risk factors (at ages 16–18)

Parental/family domain: Poor relationship with the parents was measured through interviews with the boy at age 18.

Socioeconomic domain: Low SES based on the boy's occupation (considered present if the boy had an unskilled manual job); low take-home pay (based on the boy's salary); and unstable job record (characterized as being employed in various jobs over a short period).

Attainment domain: No examinations passed refers to not having taken or succeeded in any school exams by the age of 18.

Personality domain: High levels of extroversion and neuroticism were assessed based on the Eysenck Personality Inventory at age 16. High levels of impulsiveness were assessed at age 18 using the Attitude Questionnaire.

Behavioural/lifestyle domain: Habitual drug use (the boy assumed to have consumed illegal drugs five or more times); heavy gambling (considered present if large amounts of money were lost or won); binge drinking (self-report of drinking seven or more pints of beer on average per week or any other equivalent quantity of wine or spirits); heavy smoking (smoked 21 or more cigarettes per day); high debts (considerable level of debt at age 18, with the exception of mortgages); promiscuous sex (intercourse with more than two partners in the past half year); hanging about (refers to a constant presence of the boy on the streets); injured in fighting/road accident (only considered if required medical treatment); and antisocial group members (involved in fights, vandalism, or other forms of violence in a group of four or more males).

## 4. Analytic strategy

Our analytical strategy was divided into four parts. The first step involved selecting all males who were convicted at ages 10–20 and dividing them into two categories using the methodology outlined by [Farrington et al. \(2009\)](#): (a) males who were reconvicted at ages 21–61 and (b) males who were not convicted again after reaching the age of 21.<sup>2</sup>

We then examined the prevalence of each risk factor among the CSDD subsample of males convicted between the ages of 10 and 20 at the following ages: 8–10, 12–14, and 16–18; we displayed the prevalence of each risk factor in the persistent and adolescent-limited groups. Odds ratios (ORs) were calculated for each risk factor, at each age, to assess the risk for persistence in crime. Subsequently, we analysed sequences of three risk factors with at least one risk factor measured at each age (ages: 8–10, 12–14, and 16–18) in the aforementioned subsample. To identify sequences of risk factors that were both theoretically and practically relevant and that provided a sample size suitable for further statistical analysis, we tracked sequences with a prevalence of 10 % or higher [ $P(\text{Sequence } x) \geq 10\%$ ].

In the CSDD sample most risk factors have an approximate prevalence of 25 %, as they represent the "worst" quartile of ordinal or continuous variables. However, in the CSDD sample of convicted youths (ages 10–20), these risk factors generally show a higher range and prevalence. Because we sought to identify developmental sequences of three risk factors that are more commonly associated among males than

<sup>2</sup> This decision to consider reconvictions between the ages of 21 and 61 was guided by findings from the CSDD study, which demonstrated a high degree of continuity in criminal convictions across the life course. In the CSDD, the average age of the first criminal conviction was 18.88, and the last was 28.10. However, among the 25 % of the CSDD sample who were convicted at some point in life, the last convictions occurred at age 37 or later ([Farrington et al., 2014](#)). In particular, among males convicted during adolescence (between the ages of 10 and 20), convictions, even much later in life, at ages 50 to 61, were significantly more likely, with odds ranging from 3.00 for those convicted at ages 10–13 to 8.50 for those convicted at ages 14–16, while those convicted at ages 17–20 had an OR of 5.7 for reconviction at ages 50–61 ([Farrington et al., 2023](#)).

would be expected by chance, we described the following indicators: (a) the expected prevalence of each sequence if the risk factors were not related (i.e., the multiplication of the probability of the risk factors contained in each sequence); (b) the actual sequence prevalence, and; (c) the  $z$  and the level of significance ( $* = p < .05$ ;  $** = p < .01$ ) for the one-directional binomial test for proportions. Sequences are presented as: Factor 1 (risk factor at ages 8–10) → Factor 2 (risk factor at ages 12–14) → Factor 3 (risk factor at ages 16–18).

All identified sequences of risk factors from age 8 to 18 were described and examined in relation to convictions between the ages of 21 and 61. ORs and confidence intervals for the likelihood of a sequence predicting a persistent group were calculated and displayed. The Haldane-Anscombe correction (Anscombe, 1956; Stevenson & Sergeant, 2024) was employed in the cases of cells with zero counts in contingency tables. Sequences were presented ranked by OR in descending order.

To guarantee a minimum period to evaluate adult reconvictions, participants without at least 17 years of continuously tracked data after 21 years of age (or 20 years after 18) were excluded from the analysis, which resulted in a sample of 121 males with adolescent criminal convictions (between 10 and 20 years of age). In addition, most of the risk factors in the CSDD had a residual number of missing cases (<5%), and only five risk factors (illnesses and accidents and authoritarian parents at ages 8–10, and unemployed father, low income, and parental conflict at ages 12–14) have more than 10% missing data. Following a strategy used in previous studies (e.g., Bergström & Farrington, 2021), these risk factors were excluded. In the remaining cases, for the few missing values across risk factors, the most frequent value imputation was implemented, because it is the only method available in the *TraMineR* package to missing replacement for sequences.

Finally, we conducted an analysis to identify magnetic, mixed, and attracted risk factors for the persistent group and their influential power (Basto-Pereira et al., 2024). The magnetic/mixed/attracted capability is the relative ability of a certain risk factor to be integrated in a sequence of risk factors predicting a certain outcome (in this case, adult persistence in crime). It is measured by the proportional representation of each risk factor at a certain age across all the sequences of risk factors predicting the targeted outcome. The influential power evaluates how each risk factor amplifies the risk for the targeted outcome within the sequences of risk factors where it is involved. This methodology was recently introduced by Basto-Pereira et al. (2024) and has the benefit of identifying risk factors highly likely to be followed (magnetic) or preceded (attracted) by several others risk factors, all of them creating age-graded chains of risk factors for a certain outcome – in this case, adult persistence in criminal convictions. In addition, the influential power is the information about the expected ability of a sequence containing a certain risk factor to predict the assessed outcome. The influential power was measured through the MOR [Median Odds Ratio], OR [Odds Ratio] Quartile 1 – Quartile 3, and the percentage of statistically significant sequences containing each risk factor (% Sig). The MOR was calculated using the odds for the predictive ability of sequences containing each risk factor at each age, regardless of whether those sequences are statistically significant. Compared to the study of Basto-Pereira et al. (2024), this work introduced the interquartile range for OR [Quartile 1 – Quartile 3]. The interquartile range for OR has previously been used to analyse sequencing data in the field of genetics (e.g., Ioannidis, Trikalinos, & Khoury, 2006).

The *TraMineR* and the *TraMineRextra* packages (R Software) were used to identify sequences of risk factors (Gabadinho, Studer, Muller,

Buerger, & Ritschard, 2016; R Core Team, 2005). The binomial test for proportions, OR, and other calculations were performed using Excel 2016 and IBM SPSS Statistics v.29.0 software.

## 5. Results

### 5.1. Risk factors predicting adult criminal convictions

Table 1 presents the prevalence of risk factors measured at ages 8–10, 12–14, and 16–18. Each of these risk factors was assessed among males with youth convictions in terms of (a) total prevalence; (b) prevalence among males with and without adult convictions (ages: 21–61); and (c) their predictive ability (OR) for adult convictions. Ten risk factors measured at different ages predicted persistence in criminal convictions between the ages of 21 and 61 years among males with youth criminal convictions. The risk factors that exhibited the greatest predictive ability for reconvictions between the ages of 21 and 61 years were parental conflict (OR = 3.85), hyperactivity (OR = 3.64), truancy (OR = 3.06), and unemployed father (OR = 2.84) at ages 12–14; unpopular (OR = 3.20) and poor supervision (OR = 2.68) at ages 8–10; and binge drinking (OR = 2.83) and sexual promiscuity (OR = 2.54) at ages 16–18. All of these risk factors were statistically significant ( $p < .05$ ).

### 5.2. Sequences of three risk factors predicting adult criminal convictions

Table 2 shows the sequences of risk factors measured between the ages of 8 and 18, with at least one risk factor measured at ages 8–10, 12–14, and 16–18 that best predicted persistence among males with criminal convictions during adolescence. All the prevalent sequences of risk factors ( $\geq 10\%$ ) that were associated across justice-involved males to a degree greater than that expected by chance were mapped. In total, 23 sequences of risk factors were identified, and all sequences increased the risk for an adult criminal conviction among justice-involved youths.

The sequence of risk factors that exhibited the strongest ability to predict criminal recidivism consisted of unpopular among peers at ages 8–10, followed by hyperactivity at ages 12–14, and sexual promiscuity at age 16–18 (OR = 20.09; % convicted males = 17.33% versus % non-convicted males = 0%). This specific sequence of risk factors was not observed in justice-involved males with adolescent-limited criminal convictions. In contrast, among those with criminal convictions in adulthood, approximately one in six males exhibited this sequence. At each developmental stage, the most common risk factors observed among all of these sequences were poor supervision at ages 8–10, hyperactivity at ages 12–14, and no exams passed at ages 16–18.

### 5.3. Magnetic, mixed, and attracted risk factors in sequences leading to adult criminal convictions

Table 3 shows the contribution of each risk factor at ages 8–10, 12–14, and 16–18 to the development of sequences of risk factors leading to persistence in criminal convictions during adulthood among males with convictions during adolescence. In more than half of the sequences, 4 out of 24 risk factors measured at ages 8–10 were at the beginning of sequences predicting persistence of offending into adulthood. These risk factors were poor parental supervision (17.39%; MOR = 5.97 [5.73–7.27]), harsh discipline (13.04%; MOR = 8.57 [4.23–8.57]), low attainment (13.04%; MOR = 8.57 [8.57–8.57]), and high daring (13.04%; MOR = 5.50 [2.95–11.25]). Poor parental

**Table 1**  
Risk Factors at Ages 8–10, 12–14, and 16–18 Predicting Convictions Between 21 and 61 Years Old Among Males with Criminal Convictions Between 10 and 20 Years Old

	AL vs Pers.								AL vs Pers.								AL vs Pers.						
	Risk Factor		No		Yes		OR		Risk Factor		No		Yes		OR		Risk Factor		No		Yes		OR
	n	%	n	%	n	%			n	%	n	%	n	%			n	%	n	%	n	%	
8–10 years old								12–14 years old								16–18 years old							
Unpopular	42	36.52	9	20.93	33	45.83	<b>3.2</b>	Hyperactivity	51	42.15	11	23.91	40	53.33	<b>3.64</b>	Binge drinking	36	29.75	8	17.39	28	37.33	<b>2.83</b>
Poor supervision	33	29.73	8	18.18	25	37.31	<b>2.68</b>	Truancy	41	33.88	9	19.57	32	42.67	<b>3.06</b>	Sexual promiscuity	50	41.67	13	28.26	37	50	<b>2.54</b>
Harsh discipline	43	38.05	11	25	32	46.38	<b>2.59</b>	Delinquent friends	52	43.33	14	31.11	38	50.67	<b>2.27</b>	No exams passed	88	72.73	29	63.04	59	78.67	2.16
Low interest in education	28	25.23	7	15.91	21	31.34	2.41	Poor childrearing	44	38.6	12	27.27	32	45.71	2.25	Hangs about	32	26.45	9	19.57	23	30.67	1.82
Low SES	28	23.14	7	15.22	21	28	2.17	Low nonverbal IQ	52	43.33	15	33.33	37	49.33	1.95	Extraversion	33	27.5	10	21.74	23	31.08	1.62
Low verbal IQ	44	36.67	12	26.09	32	43.24	2.16	Daring	28	23.14	8	17.39	20	26.67	1.73	Habitual drug use	56	46.28	18	39.13	38	50.67	1.6
Low income	43	35.54	12	26.09	31	41.33	2	Lying	60	49.59	19	41.3	41	54.67	1.71	Heavy smoking	46	38.02	15	32.61	31	41.33	1.46
Hyperactivity	33	27.27	9	19.57	24	32	1.93	Low verbal IQ	43	35.83	14	31.11	29	38.67	1.4	Poor relation w/ parents	39	32.23	13	28.26	26	34.67	1.35
Young mother	36	29.75	10	21.74	26	34.67	1.91	Low SES	41	36.94	14	32.56	27	39.71	1.36	Heavy gambling	46	38.02	16	34.78	30	40	1.25
Large family size	45	37.19	13	28.26	32	42.67	1.89	Poor housing	29	24.58	10	22.73	19	25.68	1.17	Low SES	42	35	15	32.61	27	36.49	1.19
Difficult to discipline	42	34.71	12	26.09	30	40	1.89	Early sex	58	48.33	22	47.83	36	48.65	1.03	Unstable job record	51	42.5	18	40	33	44	1.18
Nervous father	24	22.02	7	15.91	17	26.15	1.87	Extraversion	36	30	14	31.11	22	29.33	0.92	High debts	36	29.75	13	28.26	23	30.67	1.12
Low attainment	43	37.72	13	29.55	30	42.86	1.79	Neuroticism	39	32.5	16	35.56	23	30.67	0.8	Group activity	39	32.23	15	32.61	24	32	0.97
High extraversion	41	35.65	13	28.26	28	40.58	1.73																
Nervous boy	20	18.02	6	13.64	14	20.9	1.67																
High delinq. School	36	31.86	11	25.58	25	35.71	1.62																
Parental conflict	36	34.62	13	30.95	23	37.1	1.32																
High daring	56	46.28	20	43.48	36	48	1.2																
Convicted father	47	39.17	17	36.96	30	40.54	1.16																
Depressed mother	45	40.18	16	38.1	29	41.43	1.15																
Disrupted family	41	33.88	15	32.61	26	34.67	1.1																
High impulsivity	40	33.06	15	32.61	25	33.33	1.03																
Low nonverbal IQ	42	34.71	16	34.78	26	34.67	0.99																
High neuroticism	41	35.65	17	36.96	24	34.78	0.91																
Convicted mother	21	17.36	10	21.74	11	14.67	0.62																
Poor housing	60	49.59	28	60.87	32	42.67	0.48																

Note. AL = Adolescent-limited = Criminal conviction/s at ages 10–20 and no convictions between 21 and 61 years old; Pers. = Criminal conviction/s at ages 10–20 and at least one criminal conviction at ages 21–61; % = males with this risk factors; No % and n = % and n of males without convictions between 21 and 61 years old with each risk factor; Yes % and n = % and n of males with convictions between 21 and 61 years old with each risk factor; OR = odds ratio; OR Bold values are statistically significant ( $p < .05$ ).

**Table 2**  
Sequences of Risk Factors at Ages 8–10, 12–14, and 16–18, Discriminating Between Adult Persistent Versus Adolescent Limited Convictions from Ages 21 to 61

Rk	Sequences	% RF Comb. Prob.	% Seq.	z	% RF	% C RF	% NC RF	OR	OR LB	OR UB
1	Unpopular 8 10y → Hyperactivity 12 14y → Sexual promiscuity 16 18y	6.05	10.74	-1.67*	13	17.33	0.00	20.09	1.16	346.63
2	High daring 8 10y → Hyperactivity 12 14y → Sexual promiscuity 16 18y	8.06	13.22	-1.68*	16	20.00	2.17	11.25	1.43	88.34
3	Low income 8 10y → Delinquent friends 12 14y → Unstable job record 16 18y	6.44	12.40	-1.99*	15	18.67	2.17	10.33	1.31	81.44
4	Convicted father 8 10y → Truancy 12 14y → Unstable job record 16 18y	5.55	11.57	-2.07*	14	17.33	2.17	9.44	1.19	74.77
5	Disrupted family 8 10y → Hyperactivity 12 14y → Sexual promiscuity 16 18y	5.90	10.74	-1.72*	13	16.00	2.17	8.57	1.08	68.31
6	Harsh discipline 8 10y → Low non-verbal IQ 12 14y → Poor relation w/parents 16 18y	4.92	10.74	-2.07*	13	16.00	2.17	8.57	1.08	68.31
7	Harsh discipline 8 10y → Truancy 12 14y → Poor relation w/parents 16 18y	3.88	10.74	-2.44**	13	16.00	2.17	8.57	1.08	68.31
8	High impulsivity 8 10y → Delinquent friends 12 14y → Sexual promiscuity 16 18y	5.87	10.74	-1.73*	13	16.00	2.17	8.57	1.08	68.31
9	Large family size 8 10y → Truancy 12 14y → Sexual promiscuity 16 18y	5.21	10.74	-1.97*	13	16.00	2.17	8.57	1.08	68.31
10	Low attainment 8 10y → Hyperactivity 12 14y → Binge drinking 16 18y	4.46	10.74	-2.23*	13	16.00	2.17	8.57	1.08	68.31
11	Low attainment 8 10y → Low non-verbal IQ 12 14y → Binge drinking 16 18y	4.54	10.74	-2.20*	13	16.00	2.17	8.57	1.08	68.31
12	Low attainment 8 10y → Low verbal IQ 12 14y → Sexual promiscuity 16 18y	5.22	10.74	-1.96*	13	16.00	2.17	8.57	1.08	68.31
13	Low non-verbal IQ 8 10y → Low non-verbal IQ 12 14y → Poor relation w/parents 16 18y	4.81	10.74	-2.11*	13	16.00	2.17	8.57	1.08	68.31
14	Poor supervision 8 10y → Truancy 12 14y → Sexual Promiscuity 16 18y	3.82	10.74	-2.46**	13	16.00	2.17	8.57	1.08	68.31
15	Poor supervision 8 10y → Delinquent friends 12 14y → No exams passed 16 18y	8.52	14.88	-1.96*	18	21.33	4.35	5.97	1.30	27.30
16	Poor supervision 8 10y → Poor child rearing 12 14y → No exams passed 16 18y	7.21	14.88	-2.37**	18	21.33	4.35	5.97	1.30	27.30
17	High daring 8 10y → Hyperactivity 12 14y → Low SES 16 18y	6.77	14.05	-2.30*	17	20.00	4.35	5.50	1.20	25.29
18	Poor supervision 8 10y → Low non-verbal IQ 12 14y → No exams passed 16 18y	8.52	14.05	-1.75*	17	20.00	4.35	5.50	1.20	25.29
19	Harsh discipline 8 10y → Poor child rearing 12 14y → No exams passed 16 18y	9.40	17.36	-2.31*	21	24.00	6.52	4.53	1.25	16.36
20	Large family size 8 10y → Delinquent friends 12 14y → No exams passed 16 18y	11.62	17.36	-1.66*	21	24.00	6.52	4.53	1.25	16.36
21	Low income 8 10y → Delinquent friends 12 14y → No exams passed 16 18y	11.11	19.01	-2.22*	23	25.33	8.70	3.56	1.13	11.25
22	Low verbal IQ 8 10y → Low non-verbal IQ 12 14y → No exams passed 16 18y	11.37	19.01	-2.14*	23	25.33	8.70	3.56	1.13	11.25
23	High daring 8 10y → Hyperactivity 12 14y → No exams passed 16 18y	14.19	23.97	-2.52**	29	30.67	13.04	2.95	1.10	7.92

Note. % = % justice-involved males with this sequence of Risk factors; % C = % of justice involved males convicted during adulthood with this sequence; % NC = % of justice involved males with adolescent-limited convictions with this sequence; y = years old; OR = odds ratio; Rk = odds-ratio effect size ranking.

\*  $p < .05$ ; \*\*  $p < .01$

**Table 3**  
Magnetic, Mixed and Attracted Risk Factors for Sequences of Risk Factors Predicting Persistence in Convictions During Adulthood (Ages 21–61)

Risk Factors	Magnetic/Attractiveness Ability			Influential Power			% Sig.
	n	% RF	% Cum	MOR	MOR – IQR		
					Q1	Q3	
<b>Magnetic Risk Factors</b>							
8–12 years old							
Poor supervision	4	17.39 %	17.39 %	5.97	5.73	7.27	100 %
Harsh discipline	3	13.04 %	30.43 %	8.57	4.23	8.57	100 %
Low attainment	3	13.04 %	43.48 %	8.57	8.57	8.57	100 %
High daring	3	13.04 %	56.52 %	5.5	4.23	8.38	100 %
Low income	2	8.70 %	65.22 %	6.95	3.56	10.33	100 %
Large family size	2	8.70 %	73.91 %	6.55	4.53	8.57	100 %
Unpopular	1	4.35 %	78.26 %	20.09	20.09	20.09	100 %
Convicted father	1	4.35 %	82.61 %	9.44	9.44	9.44	100 %
Disrupted family	1	4.35 %	86.96 %	8.57	8.57	8.57	100 %
High impulsivity	1	4.35 %	91.30 %	8.57	8.57	8.57	100 %
Low nonverbal IQ	1	4.35 %	95.65 %	8.57	8.57	8.57	100 %
Low verbal IQ	1	4.35 %	100.00 %	3.56	3.56	3.56	100 %
<b>Mixed Risk Factors</b>							
12–14 years old							
Hyperactivity	6	26.09 %	26.09 %	8.57	5.50	11.25	100 %
Low nonverbal IQ	5	21.74 %	69.57 %	8.57	4.53	9.45	100 %
Delinquent friends	5	21.74 %	69.57 %	5.97	4.05	9.45	100 %
Truancy	4	17.39 %	95.65 %	8.57	8.57	9.01	100 %
Poor childrearing	2	8.70 %	95.65 %	5.24	4.53	5.97	100 %
Low verbal IQ	1	4.35 %	100.00 %	8.57	8.57	8.57	100 %
<b>Attracted Risk Factors</b>							
16–18 years old							
No exams passed	8	34.78 %	34.78 %	4.53	3.56	5.96	100 %
Sexual promiscuity	7	30.43 %	65.22 %	8.57	8.57	11.25	100 %
Poor relation w/parents	3	13.04 %	78.26 %	8.57	8.57	8.57	100 %
Unstable job record	2	8.70 %	95.65 %	9.89	9.44	10.33	100 %
Binge drinking	2	8.70 %	95.65 %	8.57	8.57	8.57	100 %
Low SES	1	4.35 %	100.00 %	5.5	5.5	5.5	100 %

**Note.** Cum % = Cumulative %; MOR = median odds ratio; MOR IQR = median odds ratio – interquartile range [Quartile 1 to Quartile 3]; % Sig = percentage of statistically significance sequences including each risk factor.

supervision was the most magnetic risk factor, involved in one in five to six of the sequences predicting persistence into adulthood. Among risk factors present in more than two sequences, harsh discipline and low attainment display the second greatest magnetic capability and the largest influential power, with an MOR of 8.57 in both cases. In other words, over half of the sequences of risk including harsh discipline or low attainment predicted persistence into adulthood with an OR equal to or larger than 8.57.

At ages 12–14, 3 out of 20 risk factors appeared in more than 70 % of the sequences predicting persistence into adulthood – namely, hyperactivity (26.09 %, MOR = 8.57 [5.50–11.25]), low nonverbal IQ (21.74 %, MOR = 8.57 [5.50–8.57]), and delinquent friends (21.74 %, MOR = 5.97 [4.53–8.57]). These risk factors were in the middle of the sequences of risk factors at ages 8–18, leading to subsequent persistence in convictions up to the age of 61. Hyperactivity was the mixed risk factor involved in more sequences of risk factors predicting criminal convictions during adulthood, appearing in approximately one in each of four sequences predicting convictions during adulthood.

Regarding the attracted risk factors, at ages 16–18, no exams passed (34.78 %, MOR = 4.53 [3.56–5.96]) and sexual promiscuity (30.43 %, MOR = 8.57 [8.57–11.25]) were observed in approximately two-thirds of the sequences predicting criminal convictions during adulthood. In addition, the most influential risk factor was an unstable job record (MOR = 9.89).

**6. Discussion**

This study investigated how age-graded risk factors were integrated into different predictive sequences which increased the likelihood of crime persistence. This innovative methodological approach contributes to advancing knowledge about the intricate developmental chains of vulnerabilities predicting persistence in crime among justice-involved

youths. Our results identified only 23 sequences (representing 0.4 % of the analysed sequences) that co-occurred more frequently than expected by chance across 5746 possible sequences of risk factors, and all 23 significantly predicted later adult criminal convictions. Surprisingly few sequences associated with offending were found to discriminate between trajectories of persistence versus desistance from crime. Therefore, the nuanced sequences of risk factors identified, which substantially increased the risk for trajectories of persistent offending, are an important contribution of this work. In a systematic review of longitudinal studies assessing long-term predictors of crime desistance, Basto-Pereira et al. (2015) concluded that the lack of discrimination between trajectories of persistence and desistance from crime was due to the presence of many of the same risk factors in adults with a juvenile history of crime, regardless of whether they reoffend during adulthood.

**6.1. Shared origins for chains of risk leading to persistence in crime**

During childhood, poor parental supervision and harsh parenting emerged as the most prevalent shared origin for sequences of risk factors predicting adult criminal convictions among justice-involved youths. Together, these magnetic risk factors appeared in approximately one-third of the sequences predicting persistence in crime. In particular, harsh discipline (MOR = 8.57), together with low attainment, displayed the largest influential power for predicting adult criminal convictions. In other words, half of the prevalent sequences of risk factors starting with one of these vulnerabilities displayed a risk of adult conviction with an OR of 8.57 or higher.

The lack of effective parental supervision, with a failure to provide sufficient informal social control and to establish a secure parent-child attachment, appears to create a constellation of risk across developmental stages (Sampson & Laub, 2005). Moreover, in our study, risk factors related to parenting were linked to subsequent poor school

achievement, poor cognitive stimulation, and deviant peer affiliation. Indeed, effective non-violent parenting greatly enhanced the development of lifelong competencies in children and adolescents, including self-regulating frustration, gravitating towards prosocial groups, and delaying gratification, which allows the satisfaction of desires within social norms (Chung & Steinberg, 2006; Farrington, 2020).

During childhood, low school attainment and high-risk taking were, respectively, the third and fourth most magnetic risk factors. A high level of risk-taking behaviour is directly linked to impulsivity and has high levels of stability (e.g., Moffitt, 1993). It is also directly linked to stimulation seeking, which is considered a relevant personality characteristic for explain increased antisocial behaviour (DeLisi, 2009). Its high level of stability maintains high daring as an active and magnetic risk factor for offending across different stages. In addition, impulsiveness-related variables (e.g., high risk taking, high sensation seeking) tend to be associated with a large number of risk factors, such as low academic competence (Tan et al., 2022), addiction (Waddell, Blake, & Chassin, 2021), and deviant peer affiliation (McGloin & Shermer, 2009), which may lead to a subsequent cascade of life-long consequences predicting antisocial trajectories.

Therefore, these magnetic risk factors are the perfect examples of contemporary and cumulative continuity processes, as defined by Moffitt's Developmental Taxonomy of Antisocial Behaviour (Moffitt, 1993). Due to their high level of stability across life-course development, and their ability to promote a 'snowball effect' of risk factors in subsequent developmental stages, these simultaneously narrow opportunities for desistance and increase the likelihood of criminal persistence. In particular, Moffitt, 1993, 2006) theoretical approach highlights the role of neuropsychological variations in shaping contemporary and cumulative continuity processes in life-course persistent trajectories. Indeed, some of the most magnetic risk factors at ages 8–10, such as high daring and poor school attainment, are potential indicators of neuropsychological variations. However, the extent to which these vulnerabilities stem from genetic factors versus environmental influences remains unclear.

In contrast to Moffitt (1993, 2006) predictions, impoverished settings did not appear, per se, to play a significant role in creating sequences of risk factors for life-course persistent trajectories among justice-involved youths. Interestingly, this also differs from the results of Basto-Pereira et al. (2024), who found that impoverished settings significantly contributed to sequences of risk factors that globally increase the likelihood of convictions at some point in adulthood regardless of whether convictions were present during adolescence. The combination of these findings suggests that childhood vulnerability to impoverished settings may be particularly relevant for late-onset convictions and therefore should be explored further in future research.

## 6.2. Complex interplay of multisystemic vulnerabilities from adolescence to the transition to adulthood

At the transition to adolescence, hyperactivity was the most common risk factor leading to persistence in crime. This risk factor appeared in more than one quarter of the predictive sequences. Hyperactivity played a substantially more important role in sequences predicting persistence in crime than adult criminal convictions in the community (e.g., Basto-Pereira et al., 2024). This may suggest that hyperactivity constitutes a particularly concerning risk factor when co-occurring with high antisocial potential. Dagistan, Gica, Aydin, and Cilli (2021) suggests that the symptoms caused by ADHD increase individuals' risk for a history of problems in interpersonal relationships, frequent occupational changes, and a criminal record. These difficulties delay opportunities for significant changes in life and thus increase the odds of persistent offending.

Analogous to hyperactivity, low IQ was a particularly relevant vulnerability for risk factor sequences. In our work, the impact of low IQ on persistence might be better understood as part of a larger constellation of multisystemic problems, such as poor parenting and school

stimulation (e.g., poor parental supervision at ages 8–10 → low non-verbal IQ at ages 12–14 → no exams passed at ages 16–18). Previous research has suggested that low IQ is partially explained by poor environmental stimulation (e.g., Walker, Chang, Vera-Hernández, & Grantham-McGregor, 2011). Therefore, similar to hyperactivity, low IQ appears to be a risk factor for a myriad of consequences that are future risk factors for persistence in crime (Duncan & Magnuson, 2011).

At the transition to adulthood, two thirds of the paths leading to persistence in crime appeared to pass through school failure and promiscuous sex. These risk factors could be conceptualized as simultaneously the result of a chain of cumulative vulnerabilities and also explanatory factors for delays at conceptualized turning points in desisting from crime. Acquiring foundational skills and knowledge at the appropriate developmental stages is a crucial predictor of academic success (Duncan et al., 2007). In turn, consistent low academic achievement is a risk factor for a chain of subsequent social problems, such as school disengagement, deviant peer affiliation, and unemployment (Hall, 2016). For youths with poor school attainment and high levels of antisocial behaviour, finding beneficial alternative ways to break trajectories of offending behaviour upon reaching adulthood may be considerably more challenging.

In addition, most of the sequences of risk factors leading to persistence in crime ended at ages 16–18, in sexual promiscuity. Whereas this pattern of behaviour is rarely addressed across theoretical models, some empirical work has focused on untangling the relationship between early sexual debut and multiple sex partners during adolescence and offending. For instance, the Seattle Social Development Project (Epstein, Bailey, Manhart, Hill, & Hawkins, 2014), a longitudinal study that followed 808 young people, found that behavioural disinhibition, directly linked sexual risky behaviour (SRB) was related to multiple risk factors for offending, such as affiliation with antisocial peers, poor school bonding, poor family management, and early alcohol abuse. The findings of that study also suggested that individuals with more SRB tended to go through a process of self-selection in which they affiliated with peers with similar levels of risk-taking behaviour. Indeed, almost all sequences including promiscuous sex also integrated other indicators of impulsive behaviour (e.g., high daring, hyperactivity) during childhood or adolescence.

In addition, some crime-predictive sequences culminating in sexual promiscuity in our study align with the pathway of impersonal sex described in Malamuth's Confluence Model of sexual aggression (Malamuth & Hald, 2017). These sequences are associated with growing up in disrupted and violent environments and are further influenced by affiliation with deviant peers. According to these authors, when combined with hostile masculinity, such trajectories significantly elevate the risk of sexual aggression and are also linked to other forms of antisocial behaviour. Similarly, studies such as Lussier, Proulx, and Leblanc (2005) have suggested that high levels of sexualisation, both increase the risk of sexual aggression and also reflect a broader pattern of antisocial behaviour.

Furthermore, some studies have found that having a high number of previous sexual partners substantially reduces the likelihood of subsequent marriage (e.g., Christensen, 2004; Wolfinger & Perry, 2023). This suggests that sexual promiscuity may restrict the likelihood of establishing a stable, satisfactory romantic relationship in the near future. Therefore, one of the key hypotheses resulting from this work is the possibility that the most significant factors influencing persistence in crime among justice-involved youths are those experienced during critical points of development which reduce the likelihood of being able to take advantage of potential turning points for desistance from crime (Sampson & Laub, 2005). These include marriage, employment, or military service. In other words, many of the same risk factors identified in Moffitt, 1993, 2006) as active promoters of cumulative continuity processes may also limit or delay the access to the critical turning points outlined in Sampson and Laub's (2005) theory, thereby reducing the probability of increasing informal social control and establishing social

bonds—central factors in desistance from crime. However, further research is necessary to test this hypothesis and explore the extent to which these turning points can be promoted and these attracted risk factors can be prevented even in trajectories of cumulative disadvantage.

### 6.3. Strengths, limitations, and future directions

One of the key strengths of this study is the identification of predictive sequences of risk factors for persistence in crime. This study was also conducted using the CSDD, which constitutes another major strength of this work. The CSDD provides an impressive 53-year follow-up to evaluate the risk of persistent criminal behaviour throughout the life course, which allows for measuring the risk for persistence in criminal convictions throughout the lifespan. The CSDD dataset also includes a thorough assessment of a broad set of risk factors using multiple informant sources that are accurately measured even by current research standards (Farrington et al., 2023).

Nevertheless, this study has limitations that need to be acknowledged. First, this study relied on official records to assess persistence in crime. Although numerous studies have demonstrated that criminal convictions are a good indicator of criminal propensity (see Basto-Pereira & Farrington, 2020), comparisons between official convictions and self-reported delinquency also suggest that official records underrepresent the full scope of criminal behaviour (Farrington, Ttofi, Crago, & Coid, 2014).

Second, males from the CSDD sample lived in an economic and social environment that diverges in relevant ways from children born in the last decade. Indeed, South London in the 1960s and 70s was significantly less ethnically diverse, and societal views were far more conservative. These differences may have produced changes in the effect of some life events on subsequent offending. Concomitantly, it is important to stress that this is an intrinsic limitation of long-term longitudinal studies, and more contemporary longitudinal cohorts will result in a substantially reduced time to evaluate the risk for persistence in crime during adulthood. Nevertheless, future research will benefit from replicating our study and comparing our findings with more contemporary long-term longitudinal cohorts.

Third, although the risk factors assessed at that time remain scientifically central for understanding the development of offending behaviour, it is likewise true that more recent developments have highlighted new relevant explicative dimensions for offending, particularly from the biological domain, that are particularly relevant for understanding the development of antisocial behaviour and that were not assessed in the CSDD cohort. In the future, it would be important to understand how magnetic those risk factors are – or, in other words, how related they are to a cascade of subsequent multisystemic risk factors for antisocial behaviour.

Fourth, it is important to emphasize that the identified sequences of risk factors are exploratory in nature and should not be interpreted as causal. While these sequences highlight an underexplored phenomenon in the criminology field—the development of risk—they do not necessarily represent unique pathways to persistent offending. The findings are inherently shaped by the specific risk factors included in the study, the exclusion of unmeasured variables, and the characteristics of the sample itself. Additionally, no control variables were applied to assess whether these sequences would remain significant after accounting for other relevant predictors. Moreover, while the methodological approach allowed for the examination of numerous potential sequences, only a small subset met the criteria for significance, which increases the likelihood of associations arising by chance due to the multiple testing process. Despite these limitations, this exploratory approach offers valuable insights into the developmental patterns of risk factors, underscoring the need for further research to validate these pathways in diverse populations and contexts.

Finally, only three key assessment moments were considered, at ages

8–10, 12–14, and 16–18. Additionally, all the participants were males from working-class families, who, at that time, were responsible for most of the registered youth offending. Future research should replicate our study using more contemporary, gender, and ethnically diverse longitudinal datasets, and encompass shorter intervals to better capture the chain of life events interacting with developmental changes and leading to persistence in crime.

### 6.4. Implications and final recommendations

This work significantly enhances the understanding of how individual risk factors interacted with other risk factors in the developmental stages to narrow opportunities to desist from criminal careers during adulthood. According to this study, there were few, but extremely prevalent (ranging between 10.74 % and 23.97 %) and highly predictive (OR = 2.95–20.09) chains of risk factors that substantially undermined the opportunity for desistance from crime among youths with criminal convictions. During childhood, there are three crucial risk factors: dysfunctional parenting (in particular, poor parental supervision and harsh discipline), early school underachievement, and a high risk-taking propensity. These sequences were then intertwined with critical individual differences, such as suboptimal (and often under-stimulated) cognitive abilities and/or hyperactivity. Almost all of these sequences appeared to lead to obstacles experienced at the transition to adulthood, (e.g., no exams passed, sex promiscuity, binge drinking) which may have reduced opportunities for turning points, and therefore substantially increased the odds for later adult criminal convictions.

If replicated across other cohorts, these findings may have profound implications. In particular, these findings suggest that prioritizing early interventions to address the most critical magnetic risk factors for persistence in crime among children exhibiting disruptive behaviour—such as improving effective nonviolent parenting styles (e.g., Being a Parent Program; Day, Michelson, Thomson, Penney, & Draper, 2012; Maciel, Day, & Basto-Pereira, 2024) or targeting rule-breaking behaviours associated with deficits in children's self-control or emotional regulation (e.g., Stop Now and Plan program; Augimeri, Walsh, Donato, Blackman, & Piquero, 2018)—may play a crucial role in breaking the subsequent chains of developmental risk factors that lead to trajectories of life-course persistent offending.

Therefore, our work on magnetic risk factors suggests that improving parenting strategies, helping children reduce their lack of self-control and hyperactivity symptoms, and promoting school engagement and success may prevent an avalanche of other risk factors and thus result in the prevention of other psychosocial and educational problems which create the perfect conditions for persistence of offending into adulthood. Additionally, our findings also suggested that sequences of risk factors delaying well-known turning points leading to desistance from crime and assuming adult roles are linked to persistence in criminal behaviour. In other words, a new hypothesis emerges at late adolescence, which suggests that actively preventing risk factors (e.g., educational and vocational programmes, help justice-involved youths to establish life plans) in many of these developmental pathways will catalyse the emergence of pivotal turning points to promote informal social control, thus leading to an early change in offending trajectories.

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## Informed consent statement

Informed consent was obtained from all participants involved in this research.

## CRedit authorship contribution statement

**Miguel Basto-Pereira:** Writing – original draft, Software, Resources, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Darrick Jolliffe:** Writing – review & editing, Validation, Supervision, Funding acquisition, Formal analysis. **David P. Farrington:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare no conflict of interest.

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