# Understanding delinquent development from childhood into early adulthood in early onset offenders

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# 4 | Using risk profiles to differentiate between offending trajectories of early onset offenders

ABSTRACT

Taxonomic theories suggest that risk exposure across life domains influences offending behavior throughout the lifespan. However, empirical knowledge on whether functioning across life domains can help explain heterogeneity in offending trajectories is scarce, especially in childhood. By combining rich survey and official crime data on 348 childhood onset offenders from the *Dutch Childhood Arrestees Study*, we examine associations between risk profiles and offending trajectories from age 12 to 20. Next to an a-priori defined group of non-recidivists (55%), group-based trajectory modeling identified four offending trajectories: low-rate desisting (14%), low-rate persisting (18%), high-rate desisting (5%), and high-rate persisting (8%). Latent profile analysis further identified three risk profiles based on individual, familial, peer, school, and neighborhood characteristics: a low-problem/impulsive (31%), cognitive- and neighborhood-problem (48%), and multi-problem group (21%). Multinomial regression analysis showed that low-problem children were least likely to persist in offending during follow-up. Compared to low-problem children, multi-problem children were at increased risk of following the low-rate persistent trajectory, while children with both cognitive and neighborhood problems were at increased risk of following the high-rate persistent trajectory. Results offer implications for research on the development of offending, and for crime control policies and interventions for child delinquents.

*Key words*
Early onset offenders, offending trajectories, risk profiles

## 4.1    INTRODUCTION

A rich line of research has revealed heterogeneity in the development of offending by identifying distinct offending trajectories (for reviews see Jennings & Reingle, 2012; Piquero, 2008). With the aim of providing extensive insight into longitudinal patterns of offending, trajectory-based studies categorize individuals into trajectory subgroups displaying distinct offending patterns across age (see Nagin, 2005). Grouping individuals with homogeneous offending patterns allows researchers to explore the development of and persistence in offending in a given sample. Overall, this body of literature has shown that distinct offending trajectories can be identified, differing in offending rates, trajectory length, and peak age of offending.

The identification of distinct offending trajectories has triggered large research efforts aimed at characterizing offenders following distinct trajectories, mainly by studying differences in exposure to singular risk factors of offending from the individual, familial, peer, school, and neighborhood life domains (e.g. Chung et al., 2002; Ward et al., 2010; Wiesner & Capaldi, 2003). This work offers considerable insight into risk factors differentiating trajectory subgroups (mostly the high-rate chronic trajectory subgroup) from non-offenders. Unfortunately, scholars conclude that singular risk factors are less helpful in differentiating between offenders populating distinct offending trajectories (Day et al., 2012; Laub et al., 1998; Mulvey et al., 2010; Sampson & Laub, 2003), as offenders in all derived trajectory subgroups are exposed to some level of risk in several life domains (e.g. Assink et al., 2015; Day et al., 2012; Ferrante, 2013; Jolliffe et al., 2017; Ward et al., 2010). As a result, there is a lack of scientific knowledge on which offenders follow which offending trajectory. Prospectively explaining heterogeneity in offending trajectories is particularly challenging among early onset offenders, as singular risk factors identified in childhood differentiate even less between offending trajectories than risk factors identified in adolescence (Day et al., 2012; Ward et al., 2010). It is important to increase our insight into the etiology of distinct offending trajectories within the high-risk offender population of early starters (Moffitt et al., 1996), as this increases our understanding of why some trajectories progress while others discontinue. This is of great importance for policy and intervention efforts, as judicial interventions have been found to reduce crime among high-risk youth, while increasing re-offense rates among low-risk youth (see Lowenkamp & Latessa, 2002). With more detailed knowledge, the match between children's needs and criminal justice interventions can be improved, leading to less crime in society.

Instead of focusing on singular risk factors, recent research in a variety of disciplines has greatly progressed insight into heterogeneity in outcomes (e.g., youth depression, internet addiction, adolescent substance use, and adolescent internalizing symptoms) by focusing on differences in exposure to combinations of risk through the identification of risk profiles (J. R. Cohen

et al., 2015; Li et al., 2017; Simpson, Vannucci, & Ohannessian, 2018). Rather than estimating associations between singular risk factors and outcome measures, individuals are assigned to mutually exclusive subgroups exposed to similar combinations of risk. This approach allows researchers to adopt a holistic approach to risk exposure by simultaneously examining numerous types of risk, while accounting for possible confounding of singular risk factors. Together, this line of literature highlights the utility of risk profiles, as it reveals that distinct patterns of risk are differentially associated with a variety of outcome measures (e.g., J. R. Cohen et al., 2015; Li et al., 2017; Simpson et al., 2018).

The identification of risk profiles may also provide additional insight into the etiology of offending trajectories, as it is widely assumed that risk factors of offending do not operate in isolation, but rather co-occur and are often mutually reinforcing (e.g. Farrington & Welsh, 2008; Moffitt, 1993; van Haze-broek, Wermink, et al., 2019). Theory (Moffitt, 1993, 2006) and prior work (Assink et al., 2015; Jolliffe et al., 2017; Mulvey et al., 2010) suggest that we might increase our ability to differentiate between subgroups of offenders by adopting a holistic view on risk exposure, and study how distinct combinations of risk may differentially impact offending across age. However, research has not yet examined this possibility directly.

The current study therefore attempts to expand our understanding of heterogeneity in the development of offending by exploring whether and to what extent variation in exposure to risk across life domains can help explain heterogeneity in offending trajectories among early onset offenders. Specifically, we study the extent to which distinct offending trajectories and risk profiles can be identified in a group of early onset offenders. These trajectories and risk profiles are subsequently used to study whether children assigned to specific risk profiles in childhood are at increased risk of following specific offending trajectories. By addressing this issues, the current study intends to advance what is known about the etiology of patterns of offending across the lifespan.

## 4.1.1   Theoretical framework

Much research on offending trajectories has been guided by Moffitt's (1993, 1997) developmental taxonomy, arguing that distinct offending trajectories can be identified in the general population that differ in frequency and longitudinal pattern of offending. Building on a large body of literature, Moffitt (1993) hypothesized that the population of offenders can be divided into two subgroups, labeled adolescence-limited and life-course-persistent or *high-level chronic* offenders. Adolescence-limited offenders are theorized to engage in low-rate offending during adolescence. As such, adolescence-limited offenders are thought to abstain from offending in childhood, and desists from crime

before reaching adulthood. In contrast, life-course-persistent offenders are assumed to start offending in childhood and commit crimes at a high rate into adulthood. Based on additional empirical research testing for possible offender types (Moffitt et al., 1996; Nagin et al., 1995; Raine et al., 2005), Moffitt (2006) later added a third subgroup with an onset in childhood and persistent yet low offending rates during adolescence, labeled *low-level chronic* offenders.

Moffitt (1993, 2006) assumes that differences in offending trajectories result from varying etiological underpinnings of offending across offender subgroups (Moffitt, 1993, 2006). Adolescence-limited offenders are theorized to be affected by peer-related risk factors (Moffitt, 1993), as they mimic delinquent peers to demonstrate autonomy while experiencing a gap between biological and social maturity. They are expected to desist from crime when adult roles become available (Moffitt, 1993). In contrast, life-course-persistent or high-level chronic offenders are assumed to experience problems in multiple life domains. Biological deficits – caused by peri/prenatal problems such as maternal drug use or birth complications – are thought to manifest as cognitive deficits, impulsivity, and hyperactivity. Biological vulnerability is assumed to co-occur with familial disadvantage, and their combination is thought to place children at risk of offending. While individual and familial risk factors are predicted to remain relatively stable and influence behavior throughout the life-course (i.e., contemporary continuity), tendencies towards offending are assumed to escalate (i.e., cumulative disadvantage) as children are introduced to peer-, school-, and neighborhood-related risk (Moffitt, 1993, 1997). Low-level chronic offenders are theorized to share many individual (e.g., low intelligence), and familial (e.g., family adversity, and parental psychopathology) risk factors with the life-course-persistent group (Moffitt, 2006). However, Moffitt (2006) argues that low-level chronics are more likely to suffer from isolating individual characteristics (e.g., depression and anxiety) than their high-level counterparts. As a result, low-level chronic offenders are excluded from deviant social peer groups, and display low offending rates during adolescence.

In sum, Moffitt (1993, 2006) emphasizes the importance of exposure to distinct combinations of risk factors when studying heterogeneity in long-term offending behavior (Moffitt, 2006). As specific theoretical assumptions postulated by Moffitt (1993, 2006) can be extended based on prior empirical work (see Jennings & Reingle, 2012; van Domburgh, Vermeiren, et al., 2009), we first discuss prior studies focused on identifying offending trajectories and risk profiles in offender samples, before offering expectations on offending trajectories, risk profiles, and their association.

## 4.1.2   Prior research

By far, most trajectory-based studies have been conducted among general population and general offender samples, and identified between two and

seven trajectory subgroups, with three or four being the most common (for reviews see Jennings & Reingle, 2012; Piquero, 2008). In accordance with theory, the majority of trajectory-based studies identified (1) a very low/non-offending group (i.e., near-zero in offender samples); (2) an adolescence-peaked group, whose offending peaks at age 16 and then declines to zero in early adulthood; and (3) one or more persistent offending groups, that may differ in peak age yet have higher offending rates than all other groups at every age. A theoretically unanticipated group of late onset offenders – starting in adolescence and persisting into early adulthood – has also been identified.

The few prior studies that were able to explore which trajectories were populated by early onset offenders confirmed theoretical expectations, by showing that early onset offenders generally populate the most chronic trajectory subgroup (Allard et al., 2017; Broidy et al., 2015; Day et al., 2012). Despite the manifest theoretical and practical importance of identifying distinct re-offense patterns among child delinquents, studies on trajectories among early onset offenders are scarce (but see van Domburgh, Vermeiren, et al., 2009). Importantly, and in contrast to theory (Moffitt, 1993, 2006), prior work showed that even among child delinquents various offending trajectories can be identified, ranging from low- to high-level re-offending trajectory subgroups (van Domburgh, Vermeiren, et al., 2009).

In various samples, several singular risk factors have been associated with trajectory subgroup membership, but these factors mostly differentiated between offenders in the high-rate chronic trajectory and non- or sporadic offenders. Studies conducted among juveniles from offender and at-risk samples, as well as the limited work on early onset offender samples, revealed that offenders in high-rate/chronic offending trajectories can be differentiated from non-offenders based on heightened exposure to risk in several life domains. Risk factors characterizing high-level trajectories include increased levels of impulsivity (Baglivio et al., 2015), attention problems (Wiesner & Capaldi, 2003), substance use (versatility) (Corrado, McCuish, Hart, & DeLisi, 2015), and sensation seeking/'being adventurous' (Jennings et al., 2019; Laub et al., 1998). In addition, offenders in high-rate trajectory subgroups have been found to suffer from inconsistent parenting (Wiesner & Capaldi, 2003), low parental supervision/neglectful parenting (Hoeve et al., 2008; Monahan & Piquero, 2009; Wiesner & Capaldi, 2003), parental delinquency (van der Geest et al., 2009), deviant peers (Baglivio et al., 2015; Chung et al., 2002; Monahan & Piquero, 2009; van der Geest et al., 2009), and neighborhood disadvantage (van Hazebroek, Blokland, et al., 2019).

While offenders in high-rate trajectory subgroups are generally exposed to highest levels of risk, many other trajectory subgroups are – to some extent – characterized by exposure to similar types of risk. This is evidenced by studies reporting that many risk factors (i.e., impulsivity/hyperactivity, low intelligence/school success, antisocial family members, poor parental supervision, and neighborhood disadvantage) characterized offenders assigned to various

trajectory subgroups (e.g. Assink et al., 2015; Baglivio et al., 2015; Day et al., 2012; Jennings et al., 2019; Jolliffe et al., 2017; Wiesner & Capaldi, 2003). As a result, many other studies failed to differentiate between offending trajectories based on theoretically relevant risk factors (e.g., low IQ, substance use, depressive symptoms, neighborhood conditions, parental criminality, parental supervision, childrearing practices, proportion of arrested friends) (e.g., Laub et al., 1998; Sampson & Laub, 2003).

One limitation of this line of research however, is that the influence of risk factors on offending is studied in isolation, making it impossible to include information on functioning across life domains. While studying singular risk factors allows researchers to assess their relative impact on outcome measures, it fails to account for possible additive and interactive effects among multiple risk factors. As a result, it remains unclear whether exposure to specific combinations of risk might especially increase the odds of prolonged delinquent involvement.

In order to integrate influences from multiple life domains, a growing body of research focused on a variety of adverse psychosocial outcomes has identified naturally occurring subgroups of individuals based on similar experiences across life domains (e.g., Dunn et al., 2011; Li et al., 2017; Simpson et al., 2018). This integrated approach allows researchers to study the collective impact of (the absence of) risk in several life domains. As such, it represents an important departure from studies that simultaneously examine relationships between singular factors and outcomes that inevitably weigh relationships against each other. The body of evidence surrounding the identification of risk profiles supports the assumptions that there are subgroups of individuals exposed to distinct patterns of risk. While the number of identified subgroups differs across studies, most studies identified a group characterized by limited exposure to all risk factors, and a group with relatively high scores on all risk factors. In general, studies showed that individuals in the low-risk group have better adjustment outcomes than individuals in the high-risk group. Importantly, prior work highlights the utility of risk profile identification as they provided complementary information to more traditional models by revealing associations between specific patterns of risk and variation in outcome measures (e.g., J. R. Cohen et al., 2015; Dunn et al., 2011; Li et al., 2017).

To date, few studies have aimed to identify risk profiles within offender populations. These studies revealed heterogeneity in patterns of risk across populations of early onset (Geluk et al., 2014), adolescent (e.g., T. Brennan, Breitenbach, & Dieterich, 2008; Dembo et al., 2008; Hilterman, Vermunt, Nicholls, Bongers, & van Nieuwenhuizen, 2019; Lopez-Romero et al., 2019; Schwalbe et al., 2008), and adult offenders (Taxman & Caudy, 2015). Risk profiles of offenders could be distinguished based on differences in levels of risk (i.e., quantitative differences in risk exposure), differentiating between low-, moderate-, and high-risk subgroups (Dembo et al., 2008; Hilterman et al., 2019), as well as differences in exposure to specific combinations of risk

factors (i.e., qualitative differences in risk exposure), differentiating between subgroups exposed to similar levels yet distinctive combinations of risk (e.g. T. Brennan et al., 2008; Lopez-Romero et al., 2019; Mulder, Brand, Bullens, & van Marle, 2010; Onifade et al., 2008; Schwalbe et al., 2008; Taxman & Caudy, 2015).

Importantly, studies showed that quantitative as well as qualitative differences in patterns of risk help explain heterogeneity in offending. For instance, studies showed that high risk groups are most likely to re-offend (Campbell et al., 2019; Hilterman et al., 2019; Taxman & Caudy, 2015), and that they tend to commit more future crimes (Lopez-Romero et al., 2019). Additionally, studies showed that youth that share cumulative risk levels yet differ in their patterns of risk exposure can differ in their re-offending rates (Onifade et al., 2008). As such, the identification of risk profiles has proved superior to original coding schemes focused only on overall level differences in risk exposure, and improved our ability to predict future offending (Campbell et al., 2019; Onifade et al., 2008).

While studies that identified risk profiles of offenders have progressed our understanding of variability in offending, the majority of these studies covered short (i.e., at the most two years) follow-up periods (Campbell et al., 2019; Dembo et al., 2008; Lopez-Romero et al., 2019; Onifade et al., 2008; Schwalbe et al., 2008; Taxman & Caudy, 2015; van Domburgh, Geluk, Jansen, Vermeiren, & Doreleijers, 2016). Moreover, by estimating offending as a dichotomous or continuous measure, none of the previous studies captured differences in persistence and desistance in offending over time. Lastly, prior work did not account for incarceration time, and might have therefore underestimated offending rates, especially among frequent offenders (Piquero et al., 2001). Up to date, it therefore remains unclear if, and to what extent, risk profiles can be used to explain heterogeneity in the development in offending across the lifespan.

### 4.1.3    The current study

The goal of the current study was to synthesize the interrelated lines of research on the identification of offending trajectories on the one hand and risk profiles on the other hand. In doing so, the current study aims to overcome some of the limitations of prior work. First, by studying associations between assignment to risk profiles and offending trajectory subgroups, we characterize offenders populating distinct trajectories based on exposure to combinations of risk rather than singular factors. Theory and converging lines of research suggest that such a holistic view of risk exposure is important in trying to characterize offenders following distinct offending trajectories. We explore this line of reasoning by combining the identification of risk profiles and offending trajectories, allowing us to account for functioning across life

domains, while avoiding overestimations of associations between singular risk factors and offending-related outcomes. Second, we identify risk profiles based on a large array of risk factors associated with offending behavior from all life domains, by utilizing unique data from the *Dutch Childhood Arrestees Study* on children registered by the police for committing an offense before the age of twelve. These data include information on theoretically important risk factors from individual (e.g., prenatal problems, intelligence, hyperactivity), familial (e.g., poor parental supervision, parental mental health problems, familial delinquency), peer (e.g., peer rejection, affiliation with deviant peers), school (e.g., poor school achievement) and neighborhood (e.g., low socio-economic status) domains. Third, as data on offending behavior covers a lengthier follow-up period, we are able to estimate the development of offending behavior across a longer period of the lifespan than all of the previous studies. As a result, we are better able to study desistence and persistence in offending. In estimating offending trajectories, we control for decreased exposure time caused by spells of incarceration, thereby avoiding underestimations of offending frequency.

Based on the Moffitt-taxonomy (Moffitt, 1993, 2006), and studies on offending trajectories and risk profiles of offenders, expectations can be formulated regarding the shape of trajectories, the content of risk profiles, and their association. First, Moffitt (1993, 2006) expects early onset offenders to continuously engage in offending behavior, displaying either low (low-level chronic trajectory) or high (high-level chronic trajectory) offending rates during adolescence. Regarding risk exposure, Moffitt (2006) expects that early onset offenders suffer from increased risk in multiple life domains due to adverse individual, familial, peer, school, and neighborhood characteristics. While Moffitt (2006) would not expect differences in levels of risk in early onset offenders, heterogeneity in combinations of risk factors is expected. Specifically, Moffitt (2006) distinguishes between a group of early starters experiencing heightened depression and anxiety and consequently social isolation, while a second group of early starters would be less characterized by these isolating features. The group experiencing isolating individual characteristics is expected to display lower offending rates, resulting in a low-level chronic trajectory. Children suffering from fewer isolating features are expected to demonstrate a high-level chronic offending trajectory. Based on prior work however – revealing quantitative in addition to qualitative differences in risk exposure (Lopez-Romero et al., 2019; Onifade et al., 2008; Schwalbe et al., 2008), as well as a group of early onset offenders who did not or only sporadically reoffended during follow-up (see van Domburgh, Vermeiren, et al., 2009) – we additionally expected to identify a group of early onset offenders exposed to relatively low levels of risk, re-offending at a decreasing rate with age.

## 4.2     METHOD

### 4.2.1     Participants and procedures

The data used in the current study originate from the *Dutch Childhood Arrestees Study*, a larger study focused on children registered by the police for committing a first offense prior to the age of 12. While offenses committed prior to the age of 12 (i.e., the age of criminal responsibility in the Netherlands) are not registered in national crime statistics, they are documented in local police registration systems. These registration systems were used to select children registered for displaying behavior that could have been prosecuted or fined if displayed by someone older than 12 years. Detailed descriptions of this study have been published previously (see Geluk et al., 2014; van Domburgh, Vermeiren, et al., 2009). The current study was based on children who were followed up in order to gather information on risk exposure ($N = 348$). The sample is largely male ($n = 302$), and about half of the participants ($n = 184$) is of non-Dutch origin. Participants were registered by the police between 2003 and 2005 ($M_{age} = 9.78$, $SD = 1.44$), for committing vandalism (58.7%, $n = 178$), property crime (27.4%, $n = 83$), and violent offenses (13.9%, $n = 42$).

The current analysis used data collected during the first measurement wave of the study, when children were between 5 and 13 years old ($M = 10.10$, $SD = 1.51$, *Median* = 11). In order to gather information on a range of risk factors from multiple life domains, questionnaires and interviews were administered to the children and their primary caretakers (hereafter referred to as 'parents') at participants' homes. For the aim of the current study, we linked data from several sources to the Childhood Arrestees data. Data from the Dutch police registration system Herkennings Dienst Systeem (HKS) was used to measure offending over a 3 to 11-year follow-up period, from February 2004 (when the oldest participants turned 12) until February 2015. Additionally, information on mortality and criminal sanctions were collected from the Research and Policy Database Judicial Documentation ('Onderzoek- en Beleidsdatabase Justitiële Documentatie', OBJD) of the Research and Documentation Centre of the Ministry of Justice (WODC) to obtain information on exposure time or 'street time' (i.e., the amount of time participants were free to engage in offending) (see Piquero et al., 2001).

### 4.2.2     Measures

*Measures used for trajectory modeling*
Offending was defined as every entry in the Dutch police registration system HKS during follow-up. Frequency of offending across age was calculated using offender's date of birth and registration dates of offenses. The age at the end of follow-up ranged from 15 to 23 ($M = 20.28$, $SD = 1.57$), due to differences

in age at first arrest and year of inclusion. We limited the trajectories to ages for which data was available on at least 100 individuals, and therefore estimated offending trajectories up to age 20. When participants had not reached age 20 during follow-up, non-observed years were coded as missing to prevent contributions to trajectory estimations (see also van der Geest et al., 2009).[1] Between the age of 12 and 20, less than half (44.5%) of early onset offenders in the current sample was registered by the police for displaying offending behavior.

As there was no mortality during follow-up, we controlled for incarceration time by estimating the number of months individuals were not incarcerated within a year's time period. For example, individuals who had been incarcerated for 1 month at age 19, were coded 'free' for 11 months at that age (see also Piquero et al., 2001). We corrected for spells of incarceration by including exposure time (i.e., not incarcerated) as a time-varying covariate in the analysis (see also Mulvey et al., 2010; Piquero et al., 2001). About thirty percent of the recidivists had been incarcerated in the follow-up period (*n* = 46). The average incarceration time was 6.6 months, and none of the participants was incarcerated for the entire follow-up period.

*Measures used as profile indicators*
Information on risk factors from individual, familial, peer, school, and neighborhood domains was collected when children were between 5 and 13 years old (*M* = 10.10, *SD* = 1.51, *Median* = 11).[2] In order to facilitate the interpretation of risk profiles for different groups, levels of risk were determined based on norm scores whenever information on norm scores was available for a given questionnaire (see also Decuyper et al., 2013). When norm scores were unavailable, we calculated average scores for continuous profile indicators (see also T. Brennan et al., 2008; Geiser, Okun, & Grano, 2014). Higher scores on profile indicators are indicative of more problems in that specific area. The 21 profile indicators are described in Appendix A, including instruments, informants, sample items, response scales, internal consistency estimates, and final measurement levels of profile indicators. Information on measures per life domain and overall sample characteristics are provided below (see Appendix B for descriptive statistics).

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1   Of the 95 (27%) participants who did not reach the age of 20 during the observation period, 48 (13.8% of the total sample) participants reached the age of 19, and 73 (21.0% of the total sample) reached the age of 18 during follow-up. Assignment to trajectory subgroups did not differ between participants who did and did not turn 20 during follow-up, $\chi^2(4) = 7.57$, *p* = .11.

2   Because of potential problems with comprehensibility of the questionnaires, due to children being younger than eight years old or having below average verbal IQs (measured using the Wechsler Intelligence Scale for Children-Revised; Wechsler, 1974), self-report questionnaires from a total of 46 participants were coded as missing.

*Individual*

In the individual domain, we measured biological (indicators 1 and 2), cognitive (indicator 3), emotional (indicators 4 and 5), and behavioral (indicators 6 through 9) problems. Biological risk factors included whether children had suffered from *prenatal substance exposure*, and whether children's mothers had experienced *prenatal complications*. The cognitive indicator *intelligence* was categorized into seven categories using norm scores ranging from very high (IQ ≥ 130) to very low (IQ ≤ 69). Emotional risk factors encompassed a four-fold classification of *emotional problems* (i.e., close to average; slightly raised; high; very high), and a three-fold classification of *depression* (i.e., low; at risk; clinical range). Behavioral risk factors included a classification of levels of *hyperactivity/ inattention* (i.e., close to average; slightly raised; high; very high), the number of *substance types* the child had ever used, and mean scores signifying levels of *sensation seeking behavior*. Levels of *social understanding difficulties* were divided into seven categories using norm scores ranging from very low to very high. Emotional problems, depression, and social understanding difficulties can be argued to represent isolating individual characteristics. While descriptive statistics showed that overall levels of risk in the individual domain were slightly elevated, still a sizeable share of the current sample suffered from substantial problems. For instance, about a third of the sample had a very low (IQ = 79) to extremely low (IQ = 69) estimated IQ, a fourth of the sample experienced high to very high emotional problems, and 10.8% scored in the clinical range of depression.

*Familial*

We used *parenting characteristics* (indicators 10 through 13), *familial delinquency* (indicator 14), *parental mental health problems* (indicator 15), and *parenting stress* (indicator 16) as measures of risk in the family domain. Children's perception of parenting characteristics was determined by calculating mean scores on the following subscales: *parental neglect* (opposite of parental supervision), *inconsistent parenting*, *parental indifference* (opposite of parental warmth), and *uninvolved parenting* (opposite of parental involvement). We calculated norm scores on a scale from 0 (very low) to 6 (very high) to specify levels of parental mental health problems and parenting stress. Appendix B shows that children barely experienced adverse parenting, and that parents experienced below average to average levels of mental health problems and parenting stress. Still, a fourth of children's parents suffered from high to very high levels of mental health problems and parenting stress.

*Peers*

Peer relationship problems were measured as mean scores indicating levels of *bullying victimization* (indicator 17), and *affiliation with antisocial peers* (indicator 18). Descriptive statistics showed that children were sometimes bullied, and virtually had no antisocial friends.

*School*
*Poor school achievement* (indicator 19) was measured as failing a reading test. A child was assumed to have failed the reading test, when the number of words the child could read within one minute was one year behind their appropriate level (44% in the current sample).

*Neighborhood*
Postal codes were used as a proxy for *neighborhood levels of socio-economic status* (indicator 20) and *urbanization* (indicator 21). Information on both was available in quintiles, with highest scores indicating very low levels of socio-economic status (SES) and very high levels of urbanization respectively. As shown in Appendix B, about half of the sample grew up in neighborhoods with low to very low SES levels, and about 75% resided in highly urban areas.

### 4.2.3    Analytical approach

The first step in our analysis was to estimate group-based trajectory models using STATA Trajectory Procedure in STATA 13 (Jones & Nagin, 2013; Nagin, 2005). We fitted cubic shaped trajectories using a zero-inflated Poisson model, allowing us to account for the large number of zero offenses in the data (Lambert, 1992). In estimating offending trajectories, parameters defining the level and shape of offending trajectories were allowed to vary freely across groups. The trajectory model was solely based on participants with at least one police registration during the observation period (see also Broidy et al., 2015), as the risk of low-level recidivists being pulled into the non-recidivists group would have complicated comparisons between non- and low-rate recidivists. Wald ($\chi$2-based) tests were conducted to explore differences in intercepts and cubic slopes across trajectory subgroups.

Second, we conducted latent profile analyses (Collins & Lanza, 2013) in MPlus 8.1 (Muthén & Muthén, 1998-2010) to determine the optimal number of groups exposed to distinct combinations of profile indicators. We used the full maximum likelihood procedure, allowing for model estimates to be calculated based on information provided by participants with complete and partially complete data.[3] Differences in scores on profile indicators across risk profiles were examined through analysis of variance (ANOVA) and chi-square tests for continuous and dichotomous indicators respectively. Significant overall

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3    Of the 348 participants, 220 participants (63.2%) had missing data on at least one of the profile indicators, with 28% of the participants having missing data on one profile indicator and 80% of the participants having missing data on no more than four profile indicators. Whether or not participants had missing data, was not associated with eventual assignment to risk profiles, $\chi^2(2) = 3.41$, $p = .18$.

effects were followed by pairwise Bonferroni (equal variances assumed) or Tamhane (equal variances violated) post-hoc comparisons.

Third, participants were assigned to their most likely trajectory and risk profile – which is acceptable when assignment accuracy is above 80% (Clark & Muthén, 2009) – and both were used as observed variables in follow-up analyses. Assignment to trajectory subgroups across risk profiles (dummy-coded) was examined by using trajectory subgroup membership as a multiple nominal outcome in a series of multinomial logistic regression analyses.

### 4.2.4    Group assignment and diagnostics

In order to identify the optimal trajectory model, we estimated models with up to six groups and compared their fit (see upper half of Table 4.1). Model fit indices provided support for a four-group trajectory model, as the relative change in the Bayesian Information Criterion (BIC; Schwartz, 1978) decreased after the identification of the four-group model.[4] Additionally, average posterior probabilities (exceeding .80) and OCC values (exceeding 5.0) of the four-group model indicated adequate assignment accuracy (Nagin, 2005, 2010). A five-group solution was not preferred, as the fifth trajectory subgroup consisted of a very small share of participants (2.6%), who were conceptually embodied by a larger trajectory in the four-group model.

Next, fit indices for latent profile models with up to six groups were evaluated to identify the optimal risk profile solution (see bottom half of Table 4.1). The Lo-Mendell-Rubin likelihood-ratio test of model fit (LMR; Lo, Mendell, & Rubin, 2001) indicated that the model with three risk profiles was preferred, as adding a fourth group did not statistically improve model fit.[5] The three-group model also performed well on classification accuracy. The three-group model was therefore chosen for further analyses.

We will describe the four trajectory subgroups and three risk profiles among early onset offenders in the next section.

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4    The Bayesian Information Criterion (BIC; Schwartz, 1978), and the Akaike Information Criterion (AIC; Akaike, 1998) did not reach a minimum in the current study (see also Blokland et al., 2005), and therefore failed to clearly identify the best solution.

5    Nylund, Asparouhov, and Muthén (2007) suggest that a first non-significant LMR-test is a good indictor to stop increasing the number of groups. BIC values and the Bootstrap Likelihood Ratio Test (BLRT; McLachlan & Peel, 2000) failed to distinguish between the models identified in the current study, as they continued to prefer each model with an additional group (see also Geiser et al., 2014).

*Table 4.1: Fit statistics of risk profiles and offending trajectories*

| #TRAJ[1] | BIC | 2(ΔBIC)[2] | AIC | Lowest profile probability[3] | OCC[4] | Trajectory subgroup membership (n) |
|---|---|---|---|---|---|---|
| 1 | -1741.20 | | -1733.59 | 1 | - | 155 |
| 2 | -1547.66 | 387.08 | -1530.92 | .96 | 22; 54 | 111; 44 |
| 3 | -1534.44 | 26.44 | -1508.57 | .83 | 8; 13; 54 | 70; 43; 42 |
| **4** | **-1519.82** | **29.24** | **-1484.83** | **.83** | **9; 11; 40; 73** | **62; 47; 27; 19** |
| 5 | -1513.52 | 12.6 | -1469.39 | .79 | 6; 60; 21; 86; 565 | 82; 23; 23; 18; 9 |

| #LP[5] | BIC | 2(ΔBIC) | AIC | LMR (p value)[6] | BLRT (p value)[6] | Ent | Lowest profile probability[3] | Risk profile membership (n) |
|---|---|---|---|---|---|---|---|---|
| 1 | 14683.76 | | 14537.37 | - | - | - | 1 | 348 |
| 2 | 14296.83 | 773.86 | 14065.70 | .01 | <.001 | .89 | .91 | 268; 80 |
| **3** | **14231.89** | **129,88** | **13916.01** | **.01** | **<.001** | **.83** | **.92** | **167; 107; 74** |
| 4 | 14180.46 | 102,86 | 13779.83 | .45 | <.001 | .88 | .76 | 206; 60; 42; 40 |
| 5 | 13632.18 | 1096.56 | 13146.80 | .24 | <.001 | .90 | .91 | 134; 88; 61; 49; 16 |

*Note:* Bold text represents model fit indices for final group-model.

#TRAJ = number of offending trajectories in estimated model; BIC = Bayesian Information Criterion; AIC = Akaike Information Criterion; #LP = number of risk profiles in estimated model; LMR = Lo-Mendell-Rubin Test; BLRT = bootstrap likelihood ratio test; Ent = Entropy.

[1] $N$ = 155: participants with a police registration during follow-up. Fit statistics for the one- through five-group models are reported, as proper solutions for models with (more than) six groups could not be obtained.

[2] ΔBIC indicates the relative change in BIC values

[3] Average posterior probabilities above .70 indicate satisfactory assignment accuracy (Nagin, 2010).

[4] OCC > 5.0 indicates high assignment accuracy (Nagin, 2005).

[5] $N$ = 348. Fit indices for models with up to five groups are displayed, as the six-group model failed to converge properly. We used a set of 600 random starting values to estimate each of the risk profile models (see also Mokros et al., 2015), and mean values were estimated independently within each profile.

[6] Significant LMR and BLRT tests indicate that the model with an additional subgroup (the $k$-group model) constitutes an important improvement over the $k - 1$ group model (Lo et al., 2001; Nylund et al., 2007; Vuong, 1989).

## 4.3   RESULTS

### 4.3.1   Offending trajectories

Figure 4.1 displays the offending trajectories of the trajectory subgroups that were identified in addition to the a-priori defined group of non-recidivists (NON) (55.5%, $n$ = 193): low-rate desisting (LR-D) (13.5%, $n$ = 47), low-rate persisting (LR-P) (17.8%, $n$ = 62), high-rate desisting (HR-D) (5.5%, $n$ = 19), and high-rate persisting (HR-P) (7.8%, $n$ = 27). Wald tests were non-significant (see Table 4.2), but the four offending trajectories clearly differed in offending rates, trajectory lengths, and peak age of offending (see Figure 4.1).[6]

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6   Furthermore, trajectory subgroups differed in exposure to combinations of childhood risk factors, as reported below, suggesting that these trajectories should not be combined (see also Hoeve et al., 2008).

*Figure 4.1: Longitudinal offending trajectories for the four-group model from age 12 to 20 corrected for time spent incarcerated*
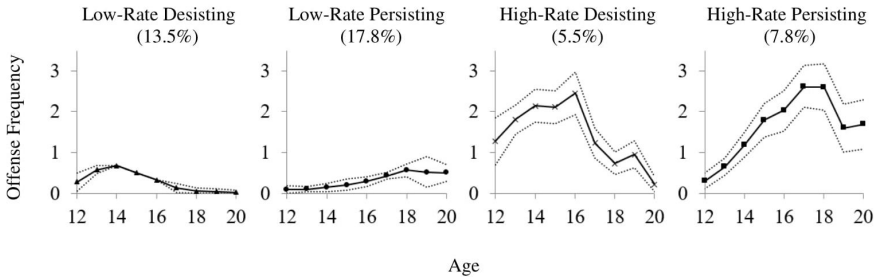


Mean offending rates were low in both the LR-D ($M$ = 0.29, $SD$ = 0.18) and LR-P ($M$ = 0.32, $SD$ = 0.20) subgroups, indicating that participants assigned to these trajectories committed one offense every three years. In contrast, average offending rates were high in both the HR-D ($M$ = 1.61, $SD$ = 0.74) and HR-P ($M$ = 1.58, $SD$ = 0.62) groups, demonstrating a level difference of 1.30 offenses per year between the low- and high-rate groups. Additionally, the desisting trajectories differed from their persisting equivalents in terms of development of offending. The LR-D group showed a rise and decline in offending rates with age, resembling the standard aggregated age-crime curve. As such, the LR-D group had the shortest offending trajectory, with a peak age of offending in early adolescence and declining offending rates towards abstinence around age 18. In contrast, the LR-P trajectory subgroup committed very few offenses until around age 15 and showed a (low) peak at age 18. Among the high-rate offenders, the HR-D group displayed high initial levels of offending that increased somewhat up to age 16, before steadily decreasing towards age 20. The HR-P group however, showed lower levels of offending at age 12, while offense rates rapidly increased, peaked around age 17-18, and persisted at a high rate into young adulthood.[7]

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7   Regarding crime mix, follow-up analysis showed that property crime was the most common offense type in all trajectory-subgroups (over 40% of all criminal law offenses). Vandalism made up a relatively large part of total crime in both desisting groups (about 30% as opposed to 20% in the persisting groups). The LR-D group committed a relatively large amount of violent and sexual offenses (25%) compared to the other trajectory-subgroups (14%), possibly because the LR-D group did not continue to commit drug, weapon, or traffic offenses. Traffic offenses are relatively common in the LR-P group (10%), compared to other trajectory-subgroups (less than 4%).

*Table 4.2: Wald tests testing differences between intercepts and cubic slopes across trajectory subgroups*

|            | LR-P vs. LR-D | HR-D vs. LR-D | HR-P vs. LR-D | HR-D vs. LR-P | HR-P vs. LR-P | HR-P vs. HR-D |
|------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Intercepts | 0.30 | 2.22 | 0.32 | 0.33 | 0.29 | 1.86 |
| Lineair slopes | 0.63 | 3.66 | 2.15 | 0.49 | 1.16 | 2.04 |
| Cubic slopes | 2.69 | 1.75 | 2.74[†] | 0.46 | 0.56 | 0.45 |

*Note:* Last group is reference category.
LR-D = low-rate desister ($n = 47$); LR-P = low-rate persister ($n = 62$); HR-D = high-rate desister ($n = 19$); HR-P = high-rate persister ($n = 27$).
[†]p < .10, *p < .05 **p < .01, ***p < .001.

### 4.3.2    Risk profiles

As previously described, three risk profiles were identified in our data. Based on post-hoc comparisons between profiles (see Table 4.3 and Figure 4.2), the risk profiles were labelled as follows: (1) low-problem/impulsive group (30.7%, $n = 107$), (2) cognitive- and neighborhood-problem group (48.0%, $n = 167$), and (3) multi-problem group (21.3%, $n = 74$).

Profile 1 consisted of children displaying overall lowest scores on profile indicators yet elevated levels of hyperactivity/inattention and sensation seeking, and was therefore labelled as *low-problem/impulsive group*. Specifically, low-problem children had average estimated IQs (IQ = 90-109), and close to average emotional problems. Additionally, children assigned to Profile 1 were not depressed, had not used substances before the age of 12, and experienced very low to low levels of social understanding difficulties. Regarding familial risk, results revealed that members of Profile 1 hardly ever experienced adverse parenting characteristics, and that parents experienced low to average mental health problems and parenting stress. Furthermore, low-problem children had no antisocial friends, and resided in neighborhoods with average to high SES and average urbanization levels. However, besides elevated levels of hyperactivity and sensation seeking, low-problem children scored close to overall sample estimates on prenatal substance exposure, prenatal complications, and school achievement. Lastly, levels of familial delinquency were low compared to Profile 2 and Profile 3, yet still 17% of low-problem children had a delinquent family member.

Profile 2 encompassed children with the lowest IQs, residing in the most disadvantaged neighborhoods, and was therefore labeled as *cognitive- and neighborhood-problem group*. Specifically, children assigned to Profile 2 had well below (IQ = 70-79) to below (IQ = 80-89) average estimated IQs, and resided in low to very low SES and highly urban neighborhoods. Besides intelligence and neighborhood characteristics, Profile 2 differed from Profile 1 in terms of lower scores on hyperactivity/inattention and sensation seeking, yet higher

*Table 4.3: Parameter estimates and prevalence rates for the total sample and across risk profiles*

| Risk Profile Indicator | Range | Sample | Risk Profiles | | | Profile Comparison | Post Hoc Comparison |
|---|---|---|---|---|---|---|---|
| | | | Profile 1 n (%) 107 (30.7) | Profile 2 n (%) 167 (48.0) | Profile 3 n (%) 74 (21.3) | | |
| 1 Prenatal Substance Exposure (%) | 0, 1 | 36.1 | 29.9 | 36.5 | 40.5 | $\chi^2(2) = 2.86$ | |
| 2 Prenatal Complications (%) | 0, 1 | 42.1 | 43.9 | 37.7 | 43.2 | $\chi^2(2) = 1.58$ | |
| 3 Low Intelligence (N) | 0-6 | 3.96 | 3.21 | **4.45** | *3.91* | $F = 41.19^{***}$ | 2 > 3 > 1 |
| 4 Emotional Problems (N) | 0-3 | 0.74 | 0.30 | 0.59 | **1.69** | $F = 52.68^{***}$ | 3 > 2 > 1 |
| 5 Depression (N) | 0-2 | 0.34 | 0.07 | 0.28 | **0.92** | $F = 24.24^{***}$ | 3 > 2 > 1 |
| 6 Hyperactivity/Inattention (N) | 0-3 | 0.91 | *0.77* | 0.44 | **2.21** | $F = 80.09^{***}$ | 3 > 1 > 2 |
| 7 Substance Use (M) | 0-3 | 0.27 | 0.28 | 0.20 | 0.43 | $F = 4.54^{*}$ | 3 > 2; 1 = 2, 3 |
| 8 Sensation Seeking (M) | 0-4 | 1.59 | *1.75* | 1.31 | 1.93 | $F = 16.65^{***}$ | 1, 3 > 2 |
| 9 Social Understanding Difficulties (N) | 0-6 | 1.40 | 0.64 | 0.75 | **3.81** | $F = 289.40^{***}$ | 3 > 1, 2 |
| 10 Parental Neglect (M) | 0-3 | 0.58 | 0.57 | 0.56 | 0.63 | $F = 0.55$ | |
| 11 Inconsistent Parenting (M) | 0-3 | 1.26 | 1.22 | 1.18 | *1.50* | $F = 7.19^{**}$ | 3 > 1, 2 |
| 12 Parental Indifference (M) | 0-3 | 0.32 | 0.30 | 0.26 | 0.47 | $F = 8.58^{***}$ | 3 > 1, 2 |
| 13 Uninvolved Parenting (M) | 0-3 | 0.95 | 0.93 | 0.91 | 1.07 | $F = 2.06$ | |
| 14 Familial Delinquency (%) | 0, 1 | 36.8 | 16.8 | **46.1** | **40.5** | $\chi^2(2) = 25.00^{***}$ | 2, 3 > 1 |
| 15 Parental Mental Health Problems (N) | 0-6 | 2.50 | 1.53 | 2.55 | **3.81** | $F = 28.07^{***}$ | 3 > 2 > 1 |
| 16 Parenting Stress (N) | 0-6 | 3.05 | 2.50 | 2.34 | **5.25** | $F = 97.31^{***}$ | 3 > 1, 2 |
| 17 Bullying victimization (M) | 0-3 | 0.77 | 0.71 | 0.70 | 1.00 | $F = 6.31^{**}$ | 3 > 1, 2 |
| 18 Antisocial Friends (M) | 0-3 | 0.38 | 0.34 | 0.35 | 0.48 | $F = 4.16^{*}$ | 3 > 1; 2 = 1, 3 |
| 19 Poor School Achievement (N) | 0, 1 | 43.9 | 41.1 | 40.1 | 37.8 | $\chi^2(2) = 0.10$ | |
| 20 Socio-economic status (M) | 0-4 | 2.64 | 1.47 | **3.37** | 2.69 | $F = 125.52^{***}$ | 2 > 3 > 1 |
| 21 Urbanization (M) | 0-4 | 3.07 | 1.99 | **3.77** | 3.13 | $F = 125.65^{***}$ | 2 > 3 > 1 |

*Note:* Profile defining parameters are outlined, with elevated scores presented in italics and high scores presented in bold. Profile 1 = low-problem/impulsive group; Profile 2 = cognitive- and neighborhood-problem group; Profile 3 = multi-problem group. M = Mean; N = norm score.

scores on emotional problems, depression, and parental mental health problems. Results revealed that children assigned to Profile 2 suffered from elevated emotional problems, while growing up around delinquent family members (46%), and parents experiencing (below) average parental mental health problems. Profile 2 resembled Profile 1 in terms of prenatal problems, substance use, parenting and peer-related problems, and school achievement.

Profile 3 consisted of children experiencing overall highest levels of risk in individual, familial, and peer domains, and therefore received the label *multi-problem group*. Specifically, multi-problem children had slightly raised to high levels of emotional problems (versus close to average/slightly raised levels in Profiles 1 and 2), were at risk of developing clinical depression, and were highly hyperactive (versus close to average/slightly raised in the other two profiles). Also, children in Profile 3 had used none to 1 substance type prior to age 12, and experienced above average social understanding difficulties (as opposed to very low to low difficulties in Profiles 1 and 2).[8] Regarding familial problems, multi-problem children were exposed to slightly higher levels of inconsistent parenting and parental indifference than children populating Profile 1 and Profile 2. Additionally, 40.5% of children in Profile 3 had a delinquent family member. Furthermore, children's parents suffered from above average mental health problems (compared to low/below average problems in Profiles 1 and 2), and high parenting stress (compared to below average stress levels in Profiles 1 and 2). Indicators on peer-related risk revealed that children in Profile 3 were occasionally bullied, and had the most (i.e., none to a few) antisocial friends. Lastly, multi-problem children resided in neighborhoods with low to average SES and average urbanization levels, indicating that neighborhood-problems were less pronounced than in Profile 2, yet more prominent than in Profile 1.

### 4.3.3   Risk profiles and offending trajectories

Table 4.4 and Figure 4.3 illustrate that trajectory subgroup membership varied across risk profiles. Children in the low-problem/impulsive group were least likely to populate persisting offending trajectories. In comparison, children with cognitive- and neighborhood-problems (Profile 2) and children with multi-problems (Profile 3) were more likely to follow persistent trajectories. For instance, children assigned to the cognitive- and neighborhood-problem group

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8   Additional analysis revealed that the multi-problem group scored higher than Profile 1 and Profile 2 on all six subscales of the questionnaire on social understanding difficulties (Hartman, Luteijn, Serra, & Minderaa, 2006). As such, multi-problem children experienced (1) difficulty in tuning their behavior/emotions to the social situation, (2) reduced contact and social interests, (3) orientation problems in time, place, or activity, (4) difficulties in understanding social information, (5) fear of and resistance to change, and (6) displayed stereotyped behavior.

*Figure 4.2: Mean z scores on profile indicators for the three-group model*
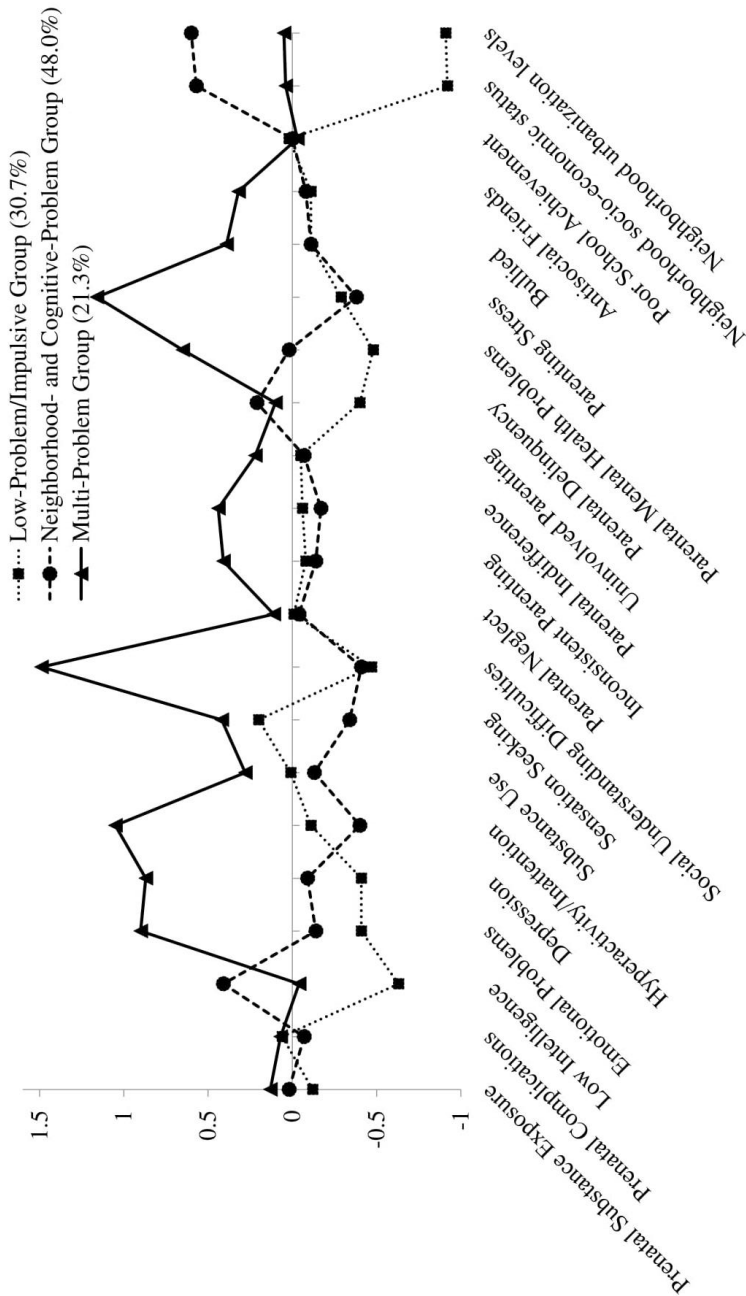


*Note*. As continuous profile indicators differ in range, we present standardized mean scores across risk profiles (see also Hall, Howerd, & McCabe, 2010).

were more likely to populate the HR-P trajectory subgroup than to abstain from crime (OR = 6.80), or follow the LR-D (OR = 4.29) or LR-P (OR = 3.83, *p* = .053) trajectory. Compared to the low-problem/impulsive group, multi-problem children were more likely to be assigned to the LR-P trajectory than to abstain from crime (OR = 2.42). Low- and multi-problem children were equally likely to follow one of the high-rate offending trajectories. Children populating the multi-problem group also differed in important ways from children assigned to the cognitive- and neighborhood-problem group. Multi-problem children were less likely to follow the HR-P trajectory over abstaining from crime (OR = 0.08), and they were less likely to populate the HR-P than the LR-P (OR = 0.06) or LR-D (OR = 0.14, *p* = .069) trajectory subgroups.

*Figure 4.3: Distribution of offending trajectories within risk profiles*
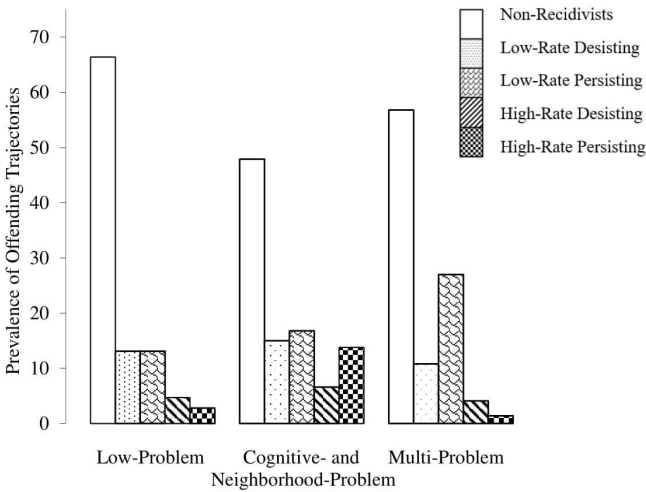


In sum, results revealed that the low-problem/impulsive group was least likely to display persistent offending behavior. In contrast, children assigned to both the cognitive- and neighborhood-problem group and the multi-problem group were at increased odds of displaying offending behavior into young adulthood. While the cognitive- and neighborhood-problem group was over-represented among high-rate persistent offenders, the multi-problem group was most likely to cluster in the low-rate persistent offending trajectory.[9]

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9   In accordance with our primary results, an additional chi square test with Bonferroni correction for multiple testing revealed that compared to low-problem children, children assigned to the cognitive- and neighborhood profile were at increased risk of following the high-rate persistent trajectory, while multi-problem children were at increased risk of following the low-rate persistent trajectory, $\chi^2(8) = 25.55$, *p* = .001.

*Table 4.4: Odds ratios and confidence intervals from multinomial regression analysis: Risk profile membership on offending trajectory membership*

| Risk Profiles | LR-D vs. NON | LR-P vs. NON | HR-D vs. NON | HR-P vs. NON | LR-P vs. LR-D | HR-D vs. LR-D | HR-P vs. LR-D | HR-D vs. LR-P | HR-P vs. LR-P | HR-P vs. HR-D |
|---|---|---|---|---|---|---|---|---|---|---|
| Mod.1 P1 (*ref.*) | | | | | | | | | | |
| P2 | 1.16 [0.77-3.28] | 1.78 [0.87-3.64] | 1.95 [0.65-5.89] | 6.80** [1.96-23.63] | 1.12 [0.45-2.80] | 1.23 [0.36-4.27] | 4.29* [1.09-16.89] | 1.10 [0.32-3.79] | 3.83† [0.98-14.99] | 3.49 [0.70-17.29] |
| P3 | 0.94 [0.37-2.50] | 2.42* [1.10-5.28] | 1.01 [0.23-4.46] | 0.56 [0.06-5.59] | 2.50 [0.83-7.55] | 1.05 [0.20-5.60] | 0.58 [0.05-6.59] | 0.42 [0.09-2.05] | 0.23 [0.02-2.48] | 0.56 [0.04-8.09] |
| Mod.2 P1 | 0.63 [0.31-1.31] | 0.56 [0.28-1.15] | 0.51 [0.17-1.55] | 0.15** [0.04-0.51] | 0.89 [0.36-2.23] | 0.81 [0.23-2.81] | 0.23* [0.06-0.92] | 0.91 [0.26-3.13] | 0.26† [0.07-1.02] | 0.29 [0.06-1.42] |
| P2 (*ref.*) | | | | | | | | | | |
| P3 | 0.61 [0.25-1.47] | 1.36 [0.69-2.70] | 0.52 [0.14-1.96] | 0.08* [0.01-0.64] | 2.23 [0.84-5.96] | 0.85 [0.19-3.84] | 0.14† [0.02-1.17] | 0.38 [0.09-1.55] | 0.06** [0.01-0.49] | 0.16 [0.02-1.71] |

*Note:* $N = 348$. $R^2 = .07$ (Cox & Snell), .08 (Nagelkerke). Model $\chi^2(8) = 26.88$**. Lower group is reference category. Odds ratios greater than 1.00 indicate increased probability of group membership. Profile 1 = low-problem/impulsive group ($n = 107$); Profile 2 = cognitive- and neighborhood-problem group ($n = 167$); Profile 3 = multi-problem group ($n = 74$).
NON = non-recidivists ($n = 193$); LR-D = low-rate desisting ($n = 47$); LR-P = low-rate persisting ($n = 62$); HR-D = high-rate desisting ($n = 19$); HR-P = high-rate persisting ($n = 27$).
†$p < .10$, *$p < .05$ **$p < .01$, ***$p < .001$.

### 4.3.4    Sensitivity analyses

Two types of sensitivity analyses were conducted to determine whether similar results could be obtained for the multinomial logistic regression analyses when accounting for uncertainties in assignments to risk profiles and offending trajectories. First, we repeated the analyses among participants who were assigned to both risk profiles and offending trajectories with a probability of at least 70% (see also Diestelkamp et al., 2015). These analyses were based on 84% ($n = 293$) of the total sample, pointing out the high assignment accuracy in the current study. Second, the analyses were repeated among the entire sample while weighing for participant's posterior probabilities of belonging to each risk profile. Both sensitivity analyses confirmed our primary findings, producing similar directions, significance levels, and largely comparable odds ratios. Hence, the low-problem group was least likely to persist in offending. Also, associations between the cognitive- and neighborhood-problem profile (Profile 2) and the HR-P trajectory, and the multi-problem profile (Profile 3) and the LR-P trajectory remained significant. Thus, these additional analyses seem to strengthen the reliability of our main findings because uncertainty in group assignment did not appear to influence associations between risk profiles and offending trajectories.

In addition to testing the robustness of our findings, we performed two additional analyses to reflect on our methods of data-reduction, by alternatively defining risk and offender groups based on a count score of risk and overall frequency of offending, and revealing their association. First, associations between risk profiles and subgroups based on offense frequency were studied.[10] Multinomial regression analyses showed that children assigned to the cognitive- and neighborhood-problem groups were more likely to be classified as high-level recidivists than non-recidivists than the low-problem group (OR = 4.14, *p* < .01) and the multi-problem group (OR = 2.45, *p* = .03). Unfortunately, the increased risk of following low-rate persistent trajectories amongst children classified to the multi-problem profile could not be revealed when defining offender groups based on overall offense frequency, as the extent to which individuals display offending behavior over an extended period of time is lost when offending behavior is defined as merely the overall frequency of offending. Second, in order to study differences in mean counts of risk across offending trajectories, we created a sum score of risk exposure based on the presence of risk per life domain (i.e., individual, familial, peer, school, and neighborhood).[11] As a result, the count score of risk exposure ranged from 0 (no risk exposure in any of the life domains) to 5 (risk exposure in all five life domains). Descriptive statistics indicated that trajectory sub-groups were exposed to risk in an equal number of life domains, as evidenced by the limited differences in mean scores of risk across trajectory-subgroups, ranging from 3.23 in the non-recidivist group to 3.65 in the high-rate desisting group.[12] These additional findings thus highlight the importance of taking specific patterns of risk into account when studying variation in long-term offending behavior.

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10   Offender subgroups were defined as follows: (1) non-recidivists (i.e., participants without an additional police registration during follow-up), (2) sporadic recidivists (i.e., participants with one of two additional police registrations), (3) low-level recidivists (i.e., participants with three of four additional police registrations), and (4) high-level recidivists (i.e., particip-ants with more than 4 additional police registrations).

11   As calculating a sum score of all 21 profile indicators would require participants to have a valid score on all profile indicators – which was the case for 128 participants – the count score of risk exposure was calculated based on the absence (0) or presence (1) of risk exposure per life domain – requiring a valid score on at least half of the indicators per life domain – before being summed into a measure of risk exposure across life domains.

12   When the sum score of risk exposure was measured as the sum of risk exposure on all 21 profile indicators – ranging from 0 (i.e., no risk exposure on any of the 21 profile indicators) to 21 (i.e., risk exposure on all of the 21 profile indicators) – mean scores of risk exposure across trajectory subgroups were still fairly similar; ranging from 6.01 in the non-recidivist group to 8.60 in the high-rate desisting group.

## 4.4    DISCUSSION

The current study examined the extent to which exposure to distinct combinations of risk factors in childhood are associated with long-term re-offense patterns among early onset offenders. The reliance on registered data with a lengthy follow-up period, information on problems in various life domains, and the novel combination of risk profiles and offending trajectories enabled us to improve our knowledge on associations between childhood risks and long-term offending behavior.

Results showed that delinquent development in the current sample of early onset offenders was highly heterogeneous. In addition to an a-priori defined group of non-recidivists, the trajectory analysis yielded a model with four trajectories: two low-rate and two high-rate offending trajectories, with offending rates peaking either in adolescence or early adulthood. The finding that 55% of participants was assigned to the non-recidivist group diverges from theoretical expectations (Moffitt, 1993, 2006), as well as prior work on early onset offenders included in the Pittsburgh Youth Study, showing that only 20% desisted offending between ages 14 and 19 (van Domburgh, Loeber, et al., 2009). While not all early onset offenders in the current study continued to display offending behavior, the current sample can still be considered at increased risk of displaying offending behavior at the ages of criminal responsibility compared to national and cross-national general population samples (Blokland et al., 2010; Broidy et al., 2015). For instance, prevalence of offending in the current sample was three times higher than that of the general Dutch population, as only 14% of a Dutch birth cohort was registered by the police between 12 and 22 years old (Blokland et al., 2010).

The finding that both low- and high-rate recidivists were distributed across two offending trajectories resonates with findings from previous trajectory-based studies among adolescent and adult offender populations (Baglivio et al., 2015; Broidy et al., 2015; Day et al., 2012; Hoeve et al., 2008; Ward et al., 2010; Wiesner & Capaldi, 2003). As such, current empirical findings provide support for the robustness of trajectories repeatedly found in prior work, in that we found that both low- and high-rate offenders display either declining rates before reaching the mid-teens, or show rising offense rates into late adolescence that persist into adulthood. The fact that these trajectory shapes have been found repeatedly, despite studies varying in follow-up, provides support for the suggestion that trajectory modeling can be used to reveal variation in delinquent development that is not overly dependent upon specific study designs. We do however believe that it is important to consider that trajectory modeling is essentially exploratory in nature, and will extract a number of distinct trajectories in most datasets (Morizot, 2019; Sher, Jackson, & Steinley, 2011). Alternatively, trajectory modeling can be used to supplement or validate theoretically derived trajectories (Nagin & Tremblay, 2005; Sher, Gotham, & Watson, 2004) and provide insight into the extent to which theoret-

ical assumptions on delinquent development deviate from patterns of delinquency found in longitudinal data.

Results further revealed that three distinct profiles of childhood risk factors could be distinguished in our data. The latent profile analysis identified a low-problem/impulsive group (i.e., overall low levels of problems yet elevated hyperactivity/inattention and sensation seeking), a cognitive- and neighborhood-problem group (i.e., low intelligence levels and high neighborhood disadvantage), and a multi-problem group (i.e., high levels of individual, familial, and peer-related problems). As such, current profiles were characterized by overall level differences in risk exposure (quantitative differences) as well as exposure to specific combinations of risk (qualitative differences). While the low-problem group experienced overall low levels of risk exposure, the multi-problem group suffered from substantial problems in most life domains. Characteristics of the low- and multi-problem groups therefore support the assumption that problems in distinct life-domains – as well as internalizing and externalizing problems – are likely to co-occur (Caspi et al., 2014; Moffitt, 1993; Stouthamer-Loeber, Loeber, Wei, Farrington, & Wikström, 2002). However, problems in one life domain did not necessarily co-occur with problems in other life domains, as is evidenced by the cognitive- and neighborhood-problem group, in which familial problems were largely lacking. It would be interesting to explore whether this group might be characterized by impaired parental cognitive abilities, which could explain the cognitive problems in children (see Plomin & Spinath, 2004).

While the finding that quantitative and qualitative differences characterized current risk profiles contradicts theoretical assumptions on delinquent development in early onset offenders (Moffitt, 1993), it corroborates findings from prior work on risk profiles in offender samples (e.g., T. Brennan et al., 2008; Lopez-Romero et al., 2019; Mulder et al., 2010; Schwalbe et al., 2008). It is challenging to compare our risk profiles to those found in previous studies in more detail, because of dissimilarities in profile indicators. However, some comparisons are worth highlighting. For example, the co-occurrence of impulsivity and sensation seeking is in accordance with findings from a study performed by Lopez-Romero et al. (2019) among adolescent and young adult offenders. However, these features characterized one of the two high-risk groups in their study, instead of the currently identified low-problem group. When comparing current findings to results reported by Schwalbe et al. (2008), it stands out that school problems as well as familial involvement in the justice system were distinguishing factors in their sample of juvenile court-involved youth. However, school problems characterized all three risk profiles identified in the current study, and familial delinquency was high in two of the three currently identified profiles. Overall, these comparisons seem to indicate that singular distinguishing risk factors are less common in the current sample of early onset offenders than in prior work identifying risk profiles among adolescent and young adult offenders.

Lastly, findings indicated that children assigned to risk profiles characterized by problems in multiple life domains were at increased risk of following persistent offending trajectories into young adulthood. On the one hand, findings showed that low-problem children were least likely to persist in offending during follow-up compared to the other two profiles. On the other hand, the specific combination of cognitive and neighborhood problems placed children at risk of displaying high-rate persistent offending, while multi-problem children were at increased risk of showing low-rate persistent offending. Besides supporting prior findings on IQ and offending (Farrington & Hawkins, 1991; Fergusson & Horwood, 2002), and neighborhood disadvantage and offending trajectories (Allard et al., 2017), current findings showed that – when considering influences from all life domains – the specific combination of both elevated the risk of following the most troublesome offending trajectory. Findings on associations between risk profiles and offending trajectories suggest that low estimated intelligence might increase children's susceptibility to criminogenic characteristics of disadvantaged environments (such as peer pressure), while residence in deprived neighborhoods might also result in under stimulation which may further worsen children's cognitive impairment.

Hence, results showed that accounting for functioning across life domains can help explain heterogeneity in longitudinal offending patterns among early onset offenders. We found significant associations between risk profiles and offending trajectories, even despite our relatively small and homogeneous sample. These findings highlight the potential of advancing the larger field of trajectory-based literature, by adopting a holistic view on risk exposure through the identification of risk profiles. By linking risk profiles to offending trajectories, we might drastically improve our insight into heterogeneity in longitudinal offense patterns.

A meaningful way to build on the current study would be to explore whether risk profiles can help explain heterogeneity in offending trajectories in general population and offender samples. Research on such samples will likely capture larger differences in levels of risk and trajectories of offending, enhancing the likelihood of detecting associations between risk profiles and offending trajectories and improving our understanding of the underlying causes of distinct offending trajectories.

Additionally, future research could strive to enlighten associations between risk profiles and other adverse adolescent and adult outcomes. According to theory (Moffitt, 1993) and prior research (Dembo et al., 2008; Espiritu, Huizinga, Crawford, & Loeber, 2001; Loeber & Farrington, 2000; Moffitt et al., 2002), an early onset of offending is associated with several adverse adult outcomes, such as drug and/or alcohol abuse, young parenthood, and unemployment. Even early onset offenders who do not engage in offending during adolescence are at increased risk of developing non-crime problems (Jennings et al., 2016; Moffitt et al., 2002). Knowledge on associations between risk profiles in childhood and poor adolescent and adult outcomes may (1) inform and further

justify paths of early intervention programs aimed at reducing offending, even for those children who desist from crime before reaching adolescence, while also (2) unveil characteristics of true recoveries.

Lastly, heterogeneity in trajectory subgroup membership within risk profiles raises important questions for future research. Findings showed that not all low-problem children desist from crime, nor did all children exposed to risk in multiple life domains follow persistent trajectories. It would be interesting to shed a light on the developmental process causing heterogeneity in long-term offending patterns within groups exposed to similar combinations of risk in childhood. According to Moffitt (1993), influences from different life domains are more or less important in different stages of the life-course, with familial influences decreasing during adolescence, while peer-influences increase. It would therefore be of theoretical importance to study the change in risk factors within individuals to be able to examine if, and how, this influences the development of offending behavior over the life-course.

## 4.4.1   Theoretical implications

The first finding of theoretical importance is that heterogeneity in offense patterns among child delinquents, while not completely unanticipated (Baglivio et al., 2015; van Domburgh, Vermeiren, et al., 2009; van Hazebroek, Blokland, et al., 2019), exceeds theoretical expectations. While Moffitt (1993) would expect all early onset offenders to continuously engage in crime during – at least – adolescence, current findings clearly indicate that this is not the case for a large part of the current sample. In fact, half of the sample desisted from crime before reaching adolescence (non-recidivist group), and therefore represents a substantial share of the *Childhood Arrestees Sample*. When comparing offense levels and trajectory shapes with Moffitt's early onset groups, the LR-P group – characterized by low yet persistent levels of offending during adolescence – mostly resembles the theoretically expected group of low-level chronic offenders. Our HR-P group – displaying continuously high offending rates – might be argued to represent Moffitt's high-level chronic offenders. On the other hand, we identified two additional offending trajectories that are not described in Moffitt's taxonomy. Both the HR-D and LR-D groups do not seem to resemble expected high- or low level chronic trajectories, as offending rates declined in both trajectory subgroups. Our findings therefore suggest that extant theory on the development of offending would have to allow for offending rates to decline with age (see for example Sampson & Laub, 1993), by for instance permitting developmental processes in the social environment to curb delinquent development, even in offenders with an onset in childhood.

Second, findings highlighted the high-risk nature of the current sample, as almost three in four participants (Profile 2 and Profile 3 combined) were characterized by problems in multiple life domains. Furthermore, all three

risk profiles were characterized by prenatal, cognitive, and school problems, supporting the assumption that biological risk and poor school achievement are associated with an early onset of offending (Moffitt, 1993). When considering profile-specific characteristics, the multi-problem profile exposed to a combination of individual (i.e., internalizing as well as externalizing), familial, and peer problems might be argued to resemble Moffitt's low-level chronic group in terms of risk exposure. The increased levels of emotional problems, depression, social understanding difficulties, and bullying victimization characterizing the multi-problem group could be interpreted as isolating individual characteristics, which further validates the argument that multi-problem children can be classified as Moffitt's (2006) low-level chronic group. In contrast, children populating the cognitive- and neighborhood-problem group experienced problems in multiple life domains yet fewer isolating features, and might therefore be argued to represent Moffitt's (1993) classic life-course-persistent group. However, levels of familial problems might be lower than what would be expected among the high-level chronic group. Lastly, the finding that low-problem children developed relatively well in most life domains is in contrast with Moffitt's (1993) assumption on heterotypic continuity in risk exposure, as biological vulnerability in these children did not elicit the process of cumulative disadvantage.

Third, associations between risk profiles and offending trajectories further justify the suggestion that the cognitive- and neighborhood-problem group resembles the theoretically expected group of high-level chronics, while the multi-problem group bears a resemblance to the low-level chronic group. In accordance with theory, the cognitive- and neighborhood-problem group experienced problems in multiple life domains yet low levels of internalizing problems, and displayed a high-rate chronic trajectory. In contrast, multi-problem children suffered from a combination of externalizing, internalizing, familial, and peer-related problems, and were at increased risk of following a low-rate chronic trajectory. Future studies including levels of anxiety are needed to further support or contradict hypotheses on differences in individual characteristics between low- and high-level chronic offenders.

### 4.4.2   Limitations and recommendations

Some limitations need to be considered alongside the interpretation of current findings. First, as the current study used data on a specific offender population (i.e., children with a police contact prior to age 12), findings may be due to specific characteristics of this sample. While we expected to include a group displaying stable patterns of disruptive behavior, the selection criteria of the current study may have also led to the inclusion of children whose registration was more or less coincidental. As Moffitt et al. (1996) defined an early onset as the manifestation of prolonged antisocial behavior at home and at school,

future research employing diverse definitions of an early onset could reveal the generalizability of our results. As non-criminal justice interventions may have influenced the shapes of the observed offending trajectories, generalizability of current findings could also be revealed by including information on parental, school, and professional intervention efforts in future studies. Second, current offending trajectories were based solely on overall frequency of police registrations. Prior work revealed a lack of overlap between officially registered and self-reported delinquent behavior (Feld & Bishop, 2012), and highlighted the importance of distinguishing between several types of crime when identifying trajectories (van Hazebroek, Blokland, et al., 2019). It would be interesting to see if current findings can be replicated when studies focus on self-reported delinquent acts, and differentiate between types of crime. Third, identified risk profiles and offending trajectories were used as observed variables in follow-up analyses. However, ways of incorporating (dichotomous and continuous) distal outcomes into mixture models are continuously being developed (Nylund-Gibson, Grimm, & Masyn, 2019). Future research focused on the likelihood or rates of offending could therefore account for uncertainty in group assignment in follow-up analyses.

### 4.4.3    Practical implications

Current findings have two important implications for prevention and intervention efforts. First, findings revealed that prevention and intervention efforts aimed at early onset offenders should be focused on a range of problems, as almost three in four children (70%) suffered from difficulties in multiple life domains. As such, findings suggest that the implementation of general intervention programs may be a promising avenue for risk reduction in childhood onset offenders. Second, intervening relatively early in the life course seems particularly relevant for the cognitive- and neighborhood problem group, as they are at increased risk of continuously engaging in crime at a high-rate. In contrast, the low-problem group might benefit most from being excluded from intervention programs and/or judicial interventions, as research has shown that interventions can be counterproductive and increase offending rates when implemented among low-risk youth (see Lowenkamp & Latessa, 2002). Further clinical implications for low-problem children await research on the developmental processes that cause some of these children to follow persistent offending trajectories.

## APPENDIX A: DESCRIPTION OF PROFILE INDICATORS

| Risk Profile Indicator | Instrument[1] | C/P[2] | Items | Alpha[3] | Description or Sample Item (Response options) | Final | Scale Risk Profile Indicator[4] |
|---|---|---|---|---|---|---|---|
| *Individual* | | | | | | | |
| 1 Prenatal Substance Exposure | - | P | 3 | - | Whether mother had used substances (cigarettes, alcohol, drugs) during pregnancy (0 = *no*, 1 = *yes*) | D | 0 = *no substance use*, 1 = *substance use* |
| 2 Prenatal Complications | - | P | 3 | - | Whether mother had experienced complications during pregnancy (e.g. blood loss or sickness) and/or childbirth (e.g. navel cord entanglement or induction of labor) (0 = *no*, 1 = *yes*) | D | 0 = *no complications*, 1 = *complications* |
| 3 Intelligence | WISC-III | C | - | - | Test score on vocabulary (i.e. verbal intelligence) and block design (i.e. performal intelligence) | N | 0 = *upper extreme* (IQ = 130), 6 = *lower extreme* (IQ = 69) |
| 4 Emotional Problems | SDQ | C+P | 5 | .64 | Often unhappy, down-hearted or tearful (0 = *not true*, 2 = *certainly true*) | N | 0 = *close to average*, 3 = *very high* |
| 5 Depression | KdvK | C | 9 | .79 | I've been feeling down lately (0 = *not true*, 2 = *certainly true*) | N | 0 = *not depressed*, 2 = *clinical depression* |
| 6 Hyperactivity / Inattention | SDQ | C+P | 5 | .65 | Restless, overactive, cannot stay still for long (0 = *not true*, 2 = *certainly true*) | N | 0 = *close to average*, 3 = *very high* |
| 7 Substance Use | OAB | C+P | 5 | - | Whether the child had ever used substances (i.e. alcohol, tobacco, and drugs) (0 = *no*, 1 = *yes*) | M | 0 = *0 types of substances*, 3 = *3 types of substances* |
| 8 Sensation Seeking | SAHA | C | 7 | .71 | I like trying new things, even when they are not allowed (0 = *strongly disagree*, 4 = *strongly agree*) | M | 0 = *strongly disagree*, 4 = *strongly agree* |
| 9 Social Understanding Difficulties[5] | CSBQ | P | 49 | .94 | Over-reacts to everything and everyone; Takes in information with difficulty (0 = *does not apply at all*, 3 = *applies very well*) | N | 0 = *very low*, 6 = *very high* |
| *Familial* | | | | | | | |
| 10 Parental Neglect | SAHA | C | 8 | .50 | My parents [do not] want to know who I am meeting up with (0 = *never*, 3 = *often*) | M | 0 = *never*, 3 = *often* |
| 11 Inconsistent Parenting | SAHA | C | 5 | .43 | My parents forget a rule that they've made themselves (0 = *never*, 3 = *often*) | M | 0 = *never*, 3 = *often* |
| 12 Parental Indifference | SAHA | C | 6 | .65 | My parents [do not] hug me (0 = *never*, 3 = *often*) | M | 0 = *never*, 3 = *often* |
| 13 Uninvolved Parenting | SAHA | C | 6 | .60 | My parents [do not] spend time with me (0 = *never*, 3 = *often*) | M | 0 = *never*, 3 = *often* |
| 14 Familial Delinquency | SAHA | P | 1 | - | Whether a family member had ever been in contact with the criminal justice system (0 = *no*, 1 = *yes*) | D | 0 = *no*, 1 = *yes* |
| 15 Parental Mental Health Problems | SCL-90 | P* | 90 | .97 | Headaches; Feelings of guilt; Being scared (0 = *not at all*, 4 = *very much*) | N | 0 = *very low*, 6 = *very high* |
| 16 Parenting Stress | NOSIK | P* | 17 | .95 | My child demands more attention from me than I can give (0 = *strongly disagree*, 3 = *strongly agree*) | N | 0 = *very low*, 6 = *very high* |
| *Peers* | | | | | | | |
| 17 Bullying victimization | SAHA | C | 9 | .82 | How often have children from school called you names (0 = *never*, 3 = *often*) | M | 0 = *never*, 3 = *often* |
| 18 Antisocial Friends | SAHA | C | 6 | .52 | How many of your friends have been arrested by the police (0 = *none*, 3 = *most or all*) | M | 0 = *none*, 3 = *most or all* |

| Risk Profile Indicator | Instrument[1] | C/P[2] | Items | Alpha[3] | Description or Sample Item (Response options) | Final Scale | Risk Profile Indicator[4] |
|---|---|---|---|---|---|---|---|
| *School* | | | | | | | |
| 19 Poor school achievement | OMRT | C | - | - | Whether test scores on one-minute reading test indicated insufficient reading abilities | N | 0 = *no*, 1 = *yes* |
| *Neighborhood* | | | | | | | |
| 20 Socio-economic status | - | SCP | - | - | Neighborhood mean income, unemployment, and education levels (0 = *very high*, 4 = *very low*) | M | 0 = *very high* , 4 = *very low* |
| 21 Urbanization | - | ST | - | - | Number of households per km² (0 = *very low: less than 500 households per km²*, 4 = *very high: 2.500 or home households per km²*) | M | 0 = *very low*, 4 = *very high* |

*Note:* [1] Instrument: WISC-III = Wechsler Intelligence Scale for Children-Revised – version III (Wechsler, 1974); SDQ = Strengths and Difficulties Questionnaire (Goodman, 1997; Muris, Meesters, & van den Berg, 2003; van Widenfelt, Goedhart, Treffers, & Goodman, 2003; for information on norm scores see Youth-in-Mind, 2012); KdvK = Short Form Depression Questionnaire for Children (Korte Depressievragenlijst voor Kinderen; de Wit, 1987); OAB = Observed Antisocial Behavior Questionnaire (Loeber, Stouthamer-Loeber, van Kammen, & Farrington, 1989); SAHA = Social and Health Assessment (Weissberg, Voyce, Kasprow, Arthur, & Shriver, 1991); CSBQ = Children's Behavior Questionnaire (Hartman, Luteijn, Serra, & Minderaa, 2006); SCL-90 = Symptom Checklist (Arrindel & Ettema, 1986; Derogatis, Lipman, & Covi, 1973); NOSIK = Nijmeegse Ouderlijke Stress Index (Abidin, 1983; de Brock, Vermulst, Gerris, & Abidin, 1992); OMRT = One-Minute Reading Test (Brus & Voeten, 1995; Evers, van Vliet-Mulder, & Groot, 2000).

[2] Informant: C = Child; P = Parent; SCP = Social and Cultural Planning Office of the Netherlands 2002; ST = Statistics Netherlands, 2006. C+P indicates that the final score was determined by the informant reporting the most problems. P* indicates that the final score was determined by the parent reporting the most problems.

[3] Some of the profile indicators display low internal reliability (e.g. emotional problems and hyperactivity/inattention) as they are aimed at screening the entire concept with a limited number of items.

[4] Scale: D = dichotomous; N = norm scores; M = mean scores.

[5] The CSBQ consists of six subscales. Sample items are subtracted from subscales with the highest correlation with the total score in the current sample.

## APPENDIX B: DESCRIPTIVE STATISTICS OF PROFILE INDICATORS

| Risk Profile Indicator[1] | N | Range | Mean / Proportion | SD[2] | Norms (valid %)[3] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 Prenatal Substance Exposure (D) | 341 | 0, 1 | 36.1 | | | | | | | | |
| 2 Prenatal Complications (D) | 337 | 0, 1 | 42.1 | | | | | | | | |
| 3 Low Intelligence (N) | 319 | 0-6 | 3.96 | 1.19 | 0 | 1.3 | 5.3 | 34.8 | 27.6 | 16.9 | 14.1 |
| 4 Emotional Problems (N) | 342 | 0-3 | 0.74 | 1.06 | 61.1 | 14.9 | 12.9 | 11.1 | | | |
| 5 Depression (N) | 203 | 0-2 | 0.34 | 0.67 | 76.8 | 12.3 | 10.8 | | | | |
| 6 Hyperactivity/Inattention (N) | 342 | 0-3 | 0.91 | 1.16 | 54.1 | 19.0 | 9.1 | 17.8 | | | |
| 7 Substance Use (M) | 347 | 0-3 | 0.27 | 0.56 | 77.8 | 17.6 | 4.0 | 0.6 | | | |
| 8 Sensation Seeking (M) | 285 | 0-4 | 1.59 | 0.82 | | | | | | | |
| 9 Social Understanding Difficulties (N) | 309 | 0-6 | 1.40 | 1.62 | 38.2 | 27.5 | 13.3 | 8.4 | 3.6 | 7.4 | 1.6 |
| 10 Parental Neglect (M) | 285 | 0-3 | 0.58 | 0.41 | | | | | | | |
| 11 Inconsistent Parenting (M) | 286 | 0-3 | 1.26 | 0.57 | | | | | | | |
| 12 Parental Indifference (M) | 286 | 0-3 | 0.32 | 0.34 | | | | | | | |
| 13 Uninvolved Parenting (M) | 286 | 0-3 | 0.95 | 0.54 | | | | | | | |
| 14 Familial Delinquency (D) | 340 | 0, 1 | 36.8 | | | | | | | | |
| 15 Parental Mental Health Problems (N) | 267 | 0-6 | 2.50 | 2.02 | 25.1 | 12.7 | 14.2 | 12.4 | 13.9 | 13.9 | 7.9 |
| 16 Parenting Stress (N) | 301 | 0-6 | 3.05 | 1.90 | 12.6 | 12.0 | 12.6 | 22.9 | 13.6 | 13.0 | 13.3 |
| 17 Bullying victimization (M) | 286 | 0-3 | 0.77 | 0.60 | | | | | | | |
| 18 Antisocial Friends (M) | 283 | 0-3 | 0.38 | 0.33 | | | | | | | |
| 19 Poor School Achievement (N) | 317 | 0, 1 | 43.8 | | | | | | | | |
| 20 Socio-economic status (M) | 348 | 0-4 | 2.54 | 1.27 | 5.7 | 12.9 | 31.6 | 11.2 | 38.5 | | |
| 21 Urbanization (M) | 331 | 0-4 | 3.07 | 1.18 | 4.5 | 9.1 | 11.5 | 25.1 | 49.8 | | |

*Note:* Valid percentage exclude missing data, and represent the share of the sample that was exposed to that specific risk factor. SD = Standard Deviations.
[1] Risk Profile Indicator: D = dichotomous; N = norm scores; M = mean scores.
[2] SD is not reported for dichotomous variables.
[3] Norms: *Intelligence, Social understanding difficulties, Parental mental health problems, Parenting stress*: 0 = very low, 1 = low, 2 = below average, 3 = average, 4 = above average, 5 = high, 6 = very high; *Emotional problems, Hyperactivity/Inattention*: 0 = close to average, 1 = slightly raised, 2 = high, 3 = very high; *Depression*: 0 = not depressed, 1 = at risk of depression, 2 = clinical depression; *Substance use*: 0 = 0 substance types, 1 = 1 substance type, 2 = 2 substance types, 3 = 3 substance types; *Socio-economic status*: 0 = very high, 1 = high, 2 = average, 3 = low, 4 = very low; *Urbanization*: 0 = very low, 1 = high, 2 = average, 3 = high, 4 = very high.