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

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Studying the effects of social bonds on offending behavior varied by biological vulnerability in early onset offenders

ABSTRACT

Applying sociological and developmental perspectives on offending, the current study assesses the within-individual associations between changes in social bonds and offending over time in early onset offenders, as well as the moderating influence of biological vulnerability. Longitudinal data from the *Dutch Childhood Arrestees Study* was analyzed using random effects models in order to examine the effects of changes in bonds with parents, peers, and school, as well as the interactions between biological vulnerability and social bonds, on offense rates from childhood into adolescence. While we found no evidence for main effects of changes in bonds with parents and school on offense rates, results revealed that an increase in affiliation with delinquent peers acted in the expected offending-inducing direction. Furthermore, the effect of bonds with school on offense frequency depended on participants' biological vulnerability, as only biologically vulnerable children were found to show higher offense rates in the years they skipped class. Current findings reveal that dynamic processes are important in understanding delinquent development in early onset offenders. Furthermore, the current study highlights the importance of including interactions between biological vulnerability for delinquent development and time-varying social factors when studying variability in offending over time.

Key Words

Early onset offenders, social bonds, biological vulnerability, within-individual methodology

5.1 INTRODUCTION

Both criminological theory and empirical research suggests that within delinquent populations individual offense frequency varies considerably across the life-course (Jennings & Reingle, 2012; Moffitt, 1993). While some delinquents display either a stable-low or stable-high pattern of offending, others show either increasing or decreasing rates of offending with age (Lynne-Landsman et al., 2011; Odgers et al., 2008). Moreover, a substantial portion of former delinquents desists from committing delinquent acts during the early adult years (Sampson & Laub, 2003).

The developmental literature suggests that understanding variability in offending across the life-course requires a dynamic approach to the influence of key social risk factors of offending (Childs, Sullivan, & Gullede, 2010; Paternoster & Brame, 1997), by allowing changes in life circumstances to affect individual criminal activity (Piquero, Brame, Mazerolle, & Haapanen, 2002). For instance, criminological theory states that social control originating from conventional social bonds is a key factor influencing delinquency and crime. Importantly, social bonds are hypothesized to change in response to changing life circumstances, and these changes in social bonds are assumed to be of primary importance to understand changes in offending over time (Moffitt, 1993; Sampson & Laub, 1993).

While research adopting a dynamic approach to key social risk factors has mainly focused on changes in offending during the transition from adolescence into early adulthood (see Averdijk, Elffers, & Ruiter, 2012; Kazemian & Farrington, 2015), studies addressing the question whether changes in social bonds may help explain variability in delinquency during the transition from childhood into early adolescence are scarce. Research on the transition into adulthood has for instance shown that marriage, being in a relationship, employment, and spending time in adult-like roles function as a positive source of change for offenders (Blokland & Nieuwbeerta, 2005; J. M. Hill, Blokland, & van der Geest, 2016; Horney, Osgood, & Marshall, 1995; Verbruggen, Blokland, & van der Geest, 2012), while divorce has been found to contribute to an increase in offending behavior (Bersani & Doherty, 2013). Transitioning into adolescence however is also accompanied by important changes in the social environment, involving changes in the importance of relationships with parents, peer networks, and school (Berndt, 1982; Larson & Richards, 1991). Whether or not individuals successfully navigate through changes in their social environment may result in a decrease or increase of offending behavior. It is especially relevant to study the effect of changes in social bonds on offending in an early onset offender population, as they are particularly crime-prone, yet also show substantial variability in offending during the transition from childhood into early adolescence (van Domburgh, Loeber, et al., 2009; van Hazebroek, Blokland, et al., 2019).

Importantly, both developmental (Moffitt, 1993), and biosocial (Monroe & Simons, 1991; Zuckerman, 1999) criminological theories argue that specific, relatively stable, individual characteristics developed early in the life-course (i.e., antisocial dispositions) may render individuals either less susceptible to changes in their social environment (Moffitt, 1997), or less equipped to benefit and more likely to suffer damage from these changes (Monroe & Simons, 1991; Zuckerman, 1999). For instance, antisocial dispositions resulting from peri/prenatal complications, neuropsychological problems, and impaired intelligence have been argued to affect both offending behavior as well as the extent to which individuals successfully navigate changes in social bonds (Moffitt, 1993). If we want to improve our efforts to support children experiencing difficulty in turning away from delinquent activities upon entering adolescence, it is therefore important to include antisocial dispositions and their interaction with the social environment, and social bonds in particular, in studies focused on variability in offending (Boman & Mowen, 2018; Moffitt, 1993). In the current study, we focus on biological vulnerability resulting from peri/prenatal complications, because theory (Moffitt, 1993) and prior research (for a review see van Hazebroek, Wermink, et al., 2019) have identified peri/prenatal problems as an important indicator of biological vulnerability interacting with social risk.

The current study examines the extent to which changes in social bonds with parents, peers, and school are related to variability in offending in early onset offenders during the transition from childhood into adolescence, and whether these effects vary across children differing in biological vulnerability resulting from peri/prenatal complications. To address its aims, the current study uses three waves of panel data on a sample of Dutch delinquents with an onset below age 12 who were followed from childhood into adolescence (Geluk et al., 2014; van Domburgh, Vermeiren, et al., 2009).

5.1.1 Theoretical framework

A variety of sociological theories explains delinquency based on individuals' social environment, such as social control theory (Hirschi, 1969), differential association (Sutherland, 1947), and social learning theory (Akers, 1973). Control theory argues that delinquency emerges when bonds to society are weak or broken. During the transition from childhood into adolescence, changes in social bonds with parents (i.e., the amount of parental supervision, and the amount of time parents spend with their children), peers (i.e., time spent with conventional peers), and school (i.e., perceived importance of education, and attachment to teachers) are thought to alter the likelihood of criminal involvement (Hirschi, 1969). In addition, from learning (Akers, 1973) and socialization (Sutherland, 1947) theories it can be derived that the effects of social bonds with parents and peers on delinquency may depend on whether

or not parents and peer themselves display law-abiding or rather offending behavior. Specifically, learning and socialization theories state that delinquent behavior is learned through social interactions, and social bonds with delinquent others will therefore increase the likelihood of delinquent involvement (Akers, 1973; Akers & Jennings, 2016; Hoebe et al., 2016; Sutherland, 1947).

The developmental criminological literature has highlighted the importance of changes in key social influences upon entering adolescence, arguing that changes in the social environment from childhood into adolescence may result in changes in delinquent activity within individuals over time (Moffitt, 1993). While family is the most prominent factor in the development of conventional norms in childhood, it is normal for children to break away from their parents during adolescence, and in turn, spend more time with peers (Berndt, 1982; Larson & Richards, 1991; Moretti & Peled, 2004). Consequently, as the role of parents decreases, peers become increasingly important in influencing behavioral development during the transition from childhood into adolescence (Cooper & Ayers-Lopez, 1985; Haynie & Payne, 2006), including delinquent development (Moffitt, 1993; Simons, Whitbeck, Conger, & Conger, 1991).

Developmental taxonomic theory (Moffitt, 1993) and biosocial theory (Monroe & Simons, 1991; Zuckerman, 1999) combine ideas from sociological, psychological and developmental criminology, by acknowledging the importance of both (changes in) social bonds and antisocial dispositions. Traditionally, psychological criminology has explained offending behavior in terms of antisocial dispositions, that develop in childhood from both social and biological origins – such as low self-control (Wilson & Herrnstein, 1985) – and keep motivating delinquent behavior throughout the life-course.

Moffitt (1993) argues that children's antisocial disposition decreases the likelihood of experiencing prosocial interactions, as well as the ability to profit from these interactions. At the same time however, antisocial disposition increases the likelihood of experiencing antisocial interactions as well as the child's vulnerability to the negative effects of such interactions. Children displaying antisocial tendencies will therefore be more likely to bond with similarly antisocially inclined peers, as well as be more susceptible to their negative influences than are children without antisocial dispositions (Moffitt, 1993; Wright, Caspi, Moffitt, & Silva, 2001). However, when children with antisocial dispositions, despite them being unlikely to do so, do develop prosocial ties such as conventional bonds with parent or school, the effects of these bonds may appear larger than those in prosocial children (Wright et al., 2001). This is not because of antisocially inclined children are more receptive to the benefits of prosocial bonds – rather on the contrary –, but because prosocial children tend not to engage in delinquent behavior in the first place, leaving less room for behavioral improvement – a floor effect. Furthering this line of reasoning, one could expect the detrimental effects of antisocial bonds to be most outspoken for children without antisocial

dispositions, not because they are more vulnerable to these effect than children that do have antisocial dispositions – rather on the contrary – but because of ceiling effects.

Drawing from sociological and developmental criminology, we can sum up the following theoretical assumptions on associations between within-individual changes in social bonds and offending in early onset offenders. First, we expect that an increase in social bonds with conventional family members, peers, and school will result in a decrease in offending behavior. Second, we expect to observe an increase in offending behavior as a result of an increase in social bonds with criminal parents or delinquent peers. Third, the effects of within-individual changes in social bonds on delinquency are theorized to depend on biological vulnerability, with bonds with conventional others offering stronger protective effects against delinquent behavior in biologically vulnerable children, while bonds with delinquent others will have stronger offending-inducing effects in biologically nonvulnerable youth than among their biologically vulnerable counterparts.

5.1.2 Prior research

Two generations of longitudinal studies focusing on associations between social bonds with parents, peers, and school and delinquent behavior can be distinguished. The first generation of studies compared offenders and non-offenders on familial, peer, and school characteristics or studied the correlation of these characteristics with levels of delinquency (for a recent review, see Farrington, 2015). As such, these studies emphasized between-individual differences in social bonds and offending (Farrington et al., 2002; Flanagan, Auty, & Farrington, 2019). Such studies found that in the family domain, weak social bonds (e.g., poor parental supervision, low parental involvement) were associated with a higher probability of later offending (Derzon, 2010; Flanagan et al., 2019). In contrast, strong positive familial bonds were found to be associated with lower levels of offending behavior. In the peer domain, affiliation with delinquent peers was found to result in an increased risk of offending (Hemphill et al., 2009). Regarding bonds to school, prior work has shown low school commitment to be associated with a higher likelihood of offending behavior (Chung et al., 2002).

Prior work has also aimed to explain between-individual differences in offending by focusing on differences in antisocial dispositions, as well as by addressing the question whether the association between social bonds and offending varies by antisocial disposition (for a review, see Craig, Baglivio, Wolff, Piquero, & Epps, 2016; van Hazebroek, Wermink, et al., 2019). For example, studies have revealed associations between genetic (Rhee & Waldman, 2002), peri/prenatal (for a review see Wakschlag et al., 2002), and neuropsychological functioning (for a review see Ttofi et al., 2016) and antisocial develop-

ment. Furthermore, and in line with theoretical expectations, prior work has shown that the associations between social bonds and offending depend on individual differences in antisocial disposition (van Hazebroek, Wermink, et al., 2019; Wright et al., 2001). For instance, children exposed to peri/prenatal complications and adverse social circumstances have been found to display the highest levels of delinquent behaviors (van Hazebroek, Wermink, et al., 2019). On the other hand, strong social bonds have also been found to lower the likelihood of offending in children with low-self-control (Wright et al., 2001), as well as in children exposed to adverse childhood experiences (Craig et al., 2016).

While the first generation of studies provided consensus on between-individual differences in social bonds and delinquency, a second generation of studies was designed to increase our understanding of delinquent development by utilizing dynamic models that focus on developmental changes within individuals (Thornberry, 1996). This second generation of studies contributes to the literature on associations between social bonds and delinquency in two important ways. First, second generation-studies are better able to test developmental theories of offending, as they are focused on explaining changes in individual delinquent activity over time. Second, by focusing on within-individual changes in social bonds and offending, pre-existing differences between individuals are held constant and are therefore accounted for in second generation-studies (Allison, 2009). This is important, as there will always be pre-existing differences of interest – whether measured or not – that may affect changes in individual offending behavior (Farrington et al., 2002; Paternoster, Bushway, Apel, & Brame, 2003).

The few studies that have applied within-individual methodology to examine the effects of changes in social bonds with parents on offending behavior, have generated mixed findings. Some of the research on the impact of bonds with parents on offending showed that youths experiencing an increase in parental bonds over time – measured as parental attachment and parental supervision – displayed a decrease in their offending behavior (Childs et al., 2010; Craig, 2016; Peterson, Lee, Henninger, & Cubellis, 2016). Likewise, a decrease in parental bonds – operationalized and measured as low attachment, low parental involvement and poor parental supervision – was shown to be associated with an increase in subsequent offending behavior (Farrington et al., 2002; Hemphill et al., 2015). In contrast, other work (Beardslee et al., 2018; Childs et al., 2010) has shown that changes in parental supervision does not affect individuals' delinquent development.

A slightly larger body of literature examined the effects of social bonds with peers on offending, although in absolute numbers this type of study is also still rare. Most of this work suggests that peer delinquency is positively related to individuals' own engagement in offending behavior (i.e., Beardslee et al., 2018; Childs et al., 2010; Craig, 2016; Hemphill et al., 2015; Peterson et al., 2016; Unnever & Chouhy, 2019). In contrast, however, Farrington et al.

(2002) failed to find an association between changes in delinquent peers and individual's own future delinquent behavior.

Only a few studies investigated how within-individual changes in bonds with school affect offending, and these findings too vary. Peterson et al. (2016) found that an increase in bonds to school over time – measured as both school commitment and school achievement – significantly reduced offending behavior. Additionally, Na (2017) showed that youth who dropped out of school were significantly more likely to experience an increase in subsequent arrests compared to youth who did not drop out. However, other studies have found no significant effects of changes in school bonds on delinquent behavior (Farrington et al., 2002; Unnever & Chouhy, 2019).

Although the above-mentioned research adopting within-individual designs has added greatly to our understanding of the effects of changes in social bonds with parents, peers, and school on changes in offending behavior over time, they have been limited in three important ways. First, except for the study conducted by Na (2017), studies on within-individual changes in offending were based on the general adolescent population and inner-city samples. It is therefore likely that not many early onset offenders were included in prior samples. Consequently, prior results might not apply to Moffitt's (1993) early onset offenders, who are deemed most at risk of displaying persistent offending behavior. Various scholars have therefore recommended that future studies apply within-individual models in longitudinal surveys of especially at risk populations (Farrington, Ttofi, & Piquero, 2016; Hemphill et al., 2015). Second, prior work did not examine whether the effects of social bonds depend on pre-existing individual differences in biological vulnerability to delinquent development. This is important, as assumptions on interaction effects between biological vulnerability and social influences are key in developmental criminological theory on early onset offenders (Moffitt, 1993). Third, unlike studies examining the effects of associations with delinquent peers, none of the prior studies on the effects of parental social bonds on offending across adolescence captured differences in parental law-abiding or criminal behavior. Up to date, it therefore remains unclear if, and to what extent, bonds with conventional versus criminal parents differentially affect within-individual changes in youth's delinquent involvement.

5.1.3 The current study

The current study aims to increase our understanding of variability in offending, as well as overcome some of the shortcomings hampering earlier research, (1) by studying the effects of within-individual changes in social bonds with family, peers, and school on offense frequency, (2) by doing this in a high-risk sample of early onset delinquents, and (3) by paying specific

attention to pre-existing individual differences in biological vulnerability. In addition, as the data provide us with information on social bonds and offense frequency during the transition from childhood into early adolescence, we are able to expand our knowledge on associations between within-individual changes in social bonds and variability in offending to this crucial transition in the life-course. Furthermore, by specifically distinguishing between law-abiding and criminal parents, we are able to study the potential differential effects of bonds with conventional versus criminal parents on changes in offending behavior over time.

5.2 METHOD

5.2.1 Participants and procedures

This study is based on data from the *Dutch Childhood Arrestees Project*, a prospective longitudinal study on early onset delinquents, conducted by the Department of Child and Adolescent Psychiatry of the Amsterdam University Medical Centers (VUmc) (Geluk et al., 2014; van Domburgh, Vermeiren, et al., 2009).¹ Children with a registered police contact prior to age 12 (i.e., the minimum age of criminal responsibility in the Netherlands) were selected from three municipal police registries in the Netherlands (i.e., Gelderland-Midden, Utrecht, and Rotterdam-Rijnmond). A total of 348 children (302 males; 184 of non-Dutch origin) participated in the first measurement occasion ($M_{age} = 10.63$, $SD = 1.48$), shortly after they were registered by the police between 2003 and 2005 ($M_{age} = 10.26$, $SD = 1.45$). These participants formed the base sample that has since been followed-up on three more occasions, after 1-year ($n = 295$, 85%, $M_{age} = 11.79$, $SD = 1.53$), 2-years ($n = 266$, 76%, $M_{age} = 12.85$, $SD = 1.54$), and 6.5-years ($n = 134$, 39%, $M_{age} = 17.61$, $SD = 1.50$).

The current analysis used data from the first (T1), second (T2) and third (T3) measurement waves of the study. At each assessment, questionnaires and interviews were administered to the children and their primary caretakers (hereafter referred to as 'parents'), covering offending behavior and a range of risk factors from multiple life domains. Comparing police records of the baseline sample to those of a Dutch birth cohort suggests that the study achieved its goal of including a high-risk sample of early onset delinquents, as 45 percent of the baseline sample had a police record from age 12 into early adulthood compared to 14 percent of the Dutch birth cohort (Blokland et al., 2010).

We examined whether study members who completed all three waves differed from the baseline sample in terms of several background characteristics

1 This study was approved by the Dutch Ministry of Justice.

(see top half of Table 5.1 for demographic details of the sample across waves). Results revealed no differences in gender ($\chi^2(1) = .10, p = .75$), ethnicity ($\chi^2(1) = 2.72, p = .10$), or frequency of offending at wave 1 ($t(324) = -.68, p = .50$). In addition to missing data due to non-participation, we excluded self-report questionnaires of children younger than eight years old and children with below average verbal IQs at wave 1 (measured using the Wechsler Intelligence Scale for Children-Revised; Wechsler, 1974), because of potential problems with comprehensibility of the questionnaires. As a result, self-report questionnaires were excluded for 64 children at T1, 50 children at T2, and 48 children at T3. Children whose self-report questionnaires were and were not excluded did not differ in terms of gender or ethnicity. Besides the lack of bias in attrition resulting from differences in background characteristics, our choice of analyses – looking at within-individual change – further minimized bias resulting from loss of data, as each person serves as their own control by focusing on associations between change in each person's risk exposure and their offending behavior (Allison, 2009).

5.2.2 Measures

Offense frequency. Frequency of offending behavior was measured at all three waves using the child version of the Observed Antisocial Behavior Questionnaire (OAB: Vragenlijst Waargenomen AntiSociaal gedrag; Loeber, Stouthamer-Loeber, van Kammen, & Farrington, 1989; Slot, Orobio de Castro, & Duivenvoorden, 1998). Participants were asked whether they had committed any of 20 delinquent acts – over the past six months at baseline, and over subsequent intervals between waves (i.e., approximately 12 months in waves 2 and 3) – and if so, how many times they had committed these acts. The 20 items measuring offending behavior included: stealing outside the home (6 items), hitting or fighting outside the home (5 items), property damage and arson (5 items), rule breaking and fare dodging (3 items), and possession of a weapon (1 item).² Items on non-delinquent behaviors under Dutch law were not included in the scale. Across all waves, for only 4 out of 20 delinquent acts, over 5 percent of the sample reported to have committed the particular act 4 or more times. To prevent outliers in the frequency distribution, we therefore

2 The 20 items on delinquent behaviors under Dutch law included: (1) stealing a bicycle, (2) shoplifting, (3) stealing from school, (4) stealing from a car, (5) stealing from someone's pocket, coat, or bag, (6) burglary, (7) hitting a teacher, (8) hitting or kicking other children, (9) throwing stones or objects towards others, (10) taking part in a group fight, (11) threatening a child, (12) purposely damaging property at home, (13) purposely damaging school property, (14) purposely damaging property in other places, (15) making graffiti at public places, (16) arson, (17) fencing, (18) trespassing, (19) fare dodging, and (20) weapon possession.

capped reported frequency at 4 for all delinquent acts, and then summed the frequency of all items to create a count scale.^{3,4}

Social Bonds. Social bonds with family (i.e., parental supervision, and parental involvement), peers (i.e., affiliation with delinquent peers), and school (i.e., changes in schools, and skipping class) were measured using the Social and Health Assessment (Weissberg, Voyce, Kasprow, Arthur, & Shriver, 1991). Social bonds were measured as follows:

- 1) Parental supervision: average score on 8 items on children's perception of the degree of parental control over different aspects of their lives (e.g., 'My parents want to know who I am meeting up with', rated on a scale from 0 (*never*) to 3 (*often*) with higher scores indicating stronger bonds with family, $\alpha = .51$ at T1);⁵
- 2) Parental involvement: average score on 6 items on the extent to which children feel that their parents are involved in several areas of their lives (e.g., 'My parents spend time with me', rated on a scale from 0 (*never*) to 3 (*often*) with higher scores representing stronger bonds with family, $\alpha = .61$ at T1);
- 3) Affiliation with delinquent peers: 1 item asking how many of the child's friends have been arrested by the police, rated on a scale from 0 (*none*) to 3 (*most or all*) with higher scores indicating that a larger portion of the participant's friends consisted of delinquent peers;
- 4) Changing schools: 1 item asking how many times children had changed schools, rated on a scale from 0 (*0 times*) to 3 (*three or more times*) with higher scores representing weaker bonds with school;
- 5) Skipping class: 1 item asking whether or not the child had skipped class, rated on a scale from 0 (*no*) to 1 (*yes*) with higher scores representing weaker bonds with school.

Criminal Parents

In order to study whether parental bonds may have differential effects on offending when parents themselves are criminal or law-abiding, we constructed a dummy variable indicating whether the child's parents (i.e., biological parents or their current partners) had been in contact with the police across the three

3 The four delinquent acts that were committed four or more times by over 5 percent over the sample across waves included 'kicking or hitting other children', 'taking part in a group fight', 'trespassing' and 'fare dodging'.

4 Participants displaying the highest frequencies of offending according to the uncapped measure were also identified as frequent offenders in the capped measure of offense frequency. In order to suppress outliers, we continued our analyses with the capped measure of offense frequency.

5 The limited number of items in the parental supervision and parental involvement subscales might have suppressed the alpha values (Streiner & Norman, 1989). As the internal reliability could not be improved by deleting a specific item from the scale, we continued our study with these measures.

waves (0 = *non-criminal*, 1 = *criminal*). Subsequently, we constructed two interaction terms by multiplying scores on the dummy variable with variables measuring social bonds with parents.

Biological Vulnerability

The dummy variable on biological vulnerability (0 = *nonvulnerable*; 1 = *vulnerable*) was defined as the presence or absence of either prenatal exposure to substances (i.e., cigarettes, alcohol, or drugs), or pregnancy or birth complications (e.g., blood loss, or navel cord entanglement). Prior research shows both to be related to an elevated risk of delinquency (see for example Oddone-Paolucci, Violato, & Wilkes, 2000; Wakschlag et al., 2002). In order to assess whether within-individual effects of changes in social bonds on offense frequency varied across biological vulnerable and nonvulnerable children, we subsequently constructed six interaction terms by multiplying biological vulnerability by each of the social bond variables.

Control variables

We included two time-variant control variables in the analyses.⁶ These time-variant control variables consisted of participant's age at each wave, and the monthly interval between waves, as these varied between participants and waves. By including interval between waves, we were able to control for the fact that the length of time between waves – and therefore the length of time participants reported on – varied to some extent.

5.2.3 Analyses

Stata version 15.0 was used to perform hybrid random effect negative binomial models, in order to examine the extent to which individual fluctuations in offense frequency systematically changed as a function of changes in social bonds with family, peers, and school. We used hybrid random effect models, as fixed effect negative binomial models fail to control for stable covariates when the outcome is an overdispersed count variable (Allison & Waterman, 2002), like offense frequency in the current study (see descriptive information in Table 5.1).⁷ Allison (2005) suggests that hybrid models offer a solution in the case of overdispersed count variables, as these express time-varying independent variables at each measurement occasion as deviations from overall

6 As we are conducting within-individual analyses, there is no need to include time-invariant controls.

7 Estimating fixed effects models using a dichotomous measure of offending behavior was not preferred in the current study, as over a third of participants committed at least one delinquent act in all three waves (40.2% of the 209 children completing all three waves), and would therefore have been removed from the analyses due to a lack of within-individual variation on the outcome variable.

person means across measurement occasions. For example, if a participant's score on parental supervision was 1.0 at T1, 2.0 at T2, and 3.0 at T3, his or her person mean would be 2.0. Accordingly, his or her deviation scores would be -1.0 at T1, 0.0 at T2, and 1.0 at T3. By focusing on individual deviation scores, hybrid random effects models specifically estimate whether within-individual change in independent variables are related to change in the outcome variable, while simultaneously controlling for effects of other, time-stable risk factors (Allison, 2009).

The primary analyses in the current study consisted of both non-lagged (i.e., associations between concurrent changes in social bonds and offense frequency) and lagged (i.e., associations between changes in social bonds at one time-point and offense frequency at the next time-point) random effects models. While the lagged models allowed us to address questions on causal direction (Vaisey & Miles, 2017), scholars have shown that lagged models may lead to biased estimates when the lag structure of the data does not accurately capture real-world causal lags between continuously varying states of independent variables, such as parental supervision, and the dependent variable (Unnever & Chouhy, 2019; Vaisey & Miles, 2017). In the current study, findings from both the non-lagged and lagged models are therefore presented.

In both non-lagged and lagged models, we first examined associations between changes in social bonds and changes in offense frequency. Second, we added a main effect of the criminal parent-dummy as well as the interaction terms between the dummy and social bonds with parents. Third, we added a main effect of biological vulnerability to the original model, as well as interaction terms between biological vulnerability and the social bond variables.

To complement our primary analysis, we examined potential reverse causation by estimating the effects of offense frequency on each of the social bond variables. If the initial and reserved models both reveal significant results, the process might be cyclical, indicating that social bonds affect offense frequency and offense frequency affects social bonds.

Sensitivity analyses were conducted to determine whether similar results could be obtained when offending was measured as a diversity score, or as the frequency of serious types of offending. The diversity score was defined by summing the presence or absence of each of the 20 different delinquent acts, based on self- and parent-reports, with the act considered present if either of the informants had reported it as present. In this case, a child that for example had stolen something twice and hit another child once, would have a diversity score of 2, resulting in a less skewed outcome variable. Alternatively, we defined the frequency of serious offenses as the sum of the offense frequency on items regarding stealing outside the home (6 items), and hitting or fighting outside the home (5 items).⁸

8 Property damage and arson, rule breaking and fare dodging, and weapon possession were excluded from the serious offense frequency scale.

5.3 RESULTS

5.3.1 Descriptive statistics

Table 5.1 presents the descriptive statistics and mean scores for independent and dependent variables across waves of the final sample used in the analyses. Table 5.1 shows that, on average, participants were fairly well bonded to their parents ($M = 2.42$, $SD = 0.42$; $M = 2.04$, $SD = 0.53$ at T1 for parental supervision and parental involvement respectively), had 'a few' friends that had been arrested by the police ($M = 0.99$, $SD = 0.83$ at T1), and rarely changed school over a year-time period ($M = 0.12$, $SD = 0.41$ at T1). Less than 15 percent of participants reported skipping class across waves. The mean number of reported delinquent acts varied from 3.86 ($SD = 5.01$) at T1 to 4.00 ($SD = 6.34$) at T2. Independent samples *t*-tests revealed that biologically vulnerable and nonvulnerable children differed in levels of parental supervision at T3, $t(206) = 2.37$, $p = .02$, with biologically nonvulnerable children being more closely supervised ($M = 2.46$, $SD = .51$) than their biologically vulnerable peers ($M = 2.28$, $SD = .49$).

Examining absolute within-individual change in social bonds revealed that participants experienced change in all three domains (family, peers, school), with average absolute within-individual change ranging from 0.25 to 0.65 within the one-year time intervals between waves for variables measures on a scale from 0 to 3 (i.e., parental bonds, affiliation with delinquent peers, and changing schools). Among participants experiencing change in social bonds, about half experienced a decrease, while the other half experienced an increase in social bonds. Regarding offense frequency, participants displayed an absolute change of approximately 4 offenses between waves, with about 40% of participants displaying a decrease and about 35% displaying an increase in offense frequency.

5.3.2 Effects of social bonds on offense frequency

The non-lagged hybrid random effects models are presented in Models 1 through 3 in Table 5.2. Results showed that changes in social bonds with parents were not significantly associated with changes in offense frequency (Model 1). Furthermore, none of the interaction effects between parental bonds and parental criminal behavior (Model 2), or parental bonds and biological vulnerability (Model 3) were significant. In contrast, changes in bonds with delinquent peers had a significant positive effect on offense frequency, such that with every one-unit increase in our measure of affiliation with delinquent peers – where one-point indicates an increase from 'none' to 'a few' delinquent peers for example – the number of delinquents acts is expected to increase with 43 percent ($IRR = 1.43$, $p < .01$). Adding the interaction term with biological

Table 5.1: Descriptive statistics for demographic, dependent and independent variables by wave

Variables	Total sample			Absolute within-individual change		Biologically vulnerable participants			Biologically nonvulnerable participants		
	T1	T2	T3	T1-T2	T2-T3	T1	T2	T3	T1	T2	T3
	N = 284 M (SD)	N = 254 M (SD)	N = 232 M (SD)	M (SD)	M (SD)	N = 171 M (SD)	N = 161 M (SD)	N = 149 M (SD)	N = 107 M (SD)	N = 89 M (SD)	N = 80 M (SD)
<i>Demographics</i>											
Males ^a	0.87	0.87	0.87			0.90	0.90	0.90	0.83	0.81	0.81
Non-Dutch ^a	0.51	0.49	0.49			0.41	0.41	0.40	0.65	0.62	0.63
Age	10.84 (1.20)	11.86 (1.42)	12.87 (1.46)			10.82 (1.21) (1.46)	11.78 (1.46)	12.76 (1.50)	10.90 (1.18) (1.35)	12.00 (1.35)	13.06 (1.38)
Time interval (months)		14.17 (3.79)	13.16 (3.77)				14.03 (3.58)	13.36 (3.86)		14.51 (4.20)	12.82 (3.67)
<i>Social bonds</i>											
Parental supervision	2.42 (0.42)	2.42 (0.43)	2.34 (0.51)	0.34 (0.32)	0.35 (0.33)	2.42 (0.42)	2.38 (0.45)	2.28 (0.49)	2.43 (0.42)	2.47 (0.37)	2.46 (0.51)
Parental involvement	2.04 (0.53)	2.03 (0.49)	2.02 (0.54)	0.41 (0.36)	0.41 (0.36)	2.04 (0.53)	2.00 (0.49)	1.98 (0.53)	2.05 (0.56)	2.08 (0.48)	2.12 (0.54)
Delinquent peers	0.99 (0.83)	0.95 (0.84)	1.01 (0.92)	0.65 (0.70)	0.61 (0.72)	0.97 (0.81)	0.91 (0.84)	1.02 (0.94)	0.97 (0.85)	1.01 (0.81)	0.97 (0.86)
Changing schools	0.12 (0.41)	0.16 (0.44)	0.13 (0.41)	0.25 (0.53)	0.26 (0.55)	0.11 (0.38)	0.18 (0.48)	0.14 (0.44)	0.13 (0.44)	0.13 (0.37)	0.08 (0.27)
Skipping class ^a	0.13	0.07	0.15	0.16 (0.37)	0.16 (0.37)	0.15	0.05	0.13	0.08	0.10	0.22
<i>Outcome</i>											
Offense frequency	3.86 (5.01)	4.00 (6.34)	3.81 (5.82)	3.92 (5.35)	3.80 (4.84)	3.90 (4.92)	3.98 (5.92)	3.99 (6.17)	3.36 (4.51)	3.61 (5.68)	3.18 (4.42)

Note: ^a These variables are binary and the mean represents the proportion.

vulnerability, results in the effect of peer delinquency on offense frequency only approaching significance in the biologically nonvulnerable group ($IRR = 1.33, p < .10$) while remaining significant in the vulnerable group. The difference in the effect of delinquent peers between biologically nonvulnerable and vulnerable children however was non-significant ($IRR = 1.02, p = .91$).⁹ Regarding bonds with school, main effects of changes in offense frequency were found to be non-significant (Model 1). The interaction effect between skipping class and biological vulnerability approached significance ($IRR = 2.11, p < .10$), suggesting that the effect of skipping class on offense frequency is over twice as strong in biologically vulnerable children than in biologically nonvulnerable children. In terms of the magnitude of the relationship, these findings suggest that at times biologically vulnerable children skipped class, they reported committing almost twice as many delinquent acts ($0.82 \times 2.11 = 1.73$, i.e., an increase of 73% in offense frequency).¹⁰

The lagged hybrid random effects models are presented in Models 4 through 6 in Table 5.2. In line with the non-lagged models, main effects of changes in social bonds with parents and school were unassociated with changes in next-year offense frequency (Model 1). Interaction effects between the criminal parent-dummy and parental social bonds were also shown to be non-significant (Model 5). In contrast with the non-lagged models, the main effect of affiliation with delinquent peers on offense frequency was non-significant (Model 4), indicating that change in the proportion of participants' delinquent peers did not affect offense frequency in the following time-period.

With respect to the interaction effects between biological vulnerability and social bonds, Model 6 overall showed that an increase in levels of parental supervision, affiliation with delinquent peers, and skipping class had offending-inducing effects in biologically nonvulnerable children, while they did not significantly affect biologically vulnerable children. Regarding parental supervision, the expected number of offenses in biologically nonvulnerable children was surprisingly found to increase when a child experienced a one-unit increase in the level of parental supervision ($IRR = 2.89, p < .05$). The effect

9 The absence of a significant effect of peer delinquency on offense frequency for the non-vulnerable group in Model 3 might be due to the fact that parameters were estimated for biologically nonvulnerable and vulnerable youth separately, resulting in smaller groups and therefore larger standard errors.

10 As prior studies found strongest biosocial interaction effects for prenatal smoking and prenatal complications (van Hazebroek, Werminck, et al., 2019), we also defined biological vulnerability as (1) as the presence ($n = 110$ at T1) or absence of prenatal exposure to nicotine or (2) as the presence ($n = 142$ at T1) or absence of pregnancy or birth complications. In addition to confirming findings from our primary analyses, results of hybrid random effects models with the alternative definitions of biological vulnerability showed that in both models the effect of affiliation with delinquent peers on offense frequency in biologically nonvulnerable children remained significant ($IRR = 1.38, p < .01$ for children who were not exposed to prenatal nicotine use, $IRR = 1.43, p < .01$ for children who were not exposed to prenatal complications).

Table 5.2 Random effects models for the effect of social bonds on offense frequency

	Non-lagged models					
	Model 1			Model 2		
	<i>B</i>	(SE)	IRR	<i>B</i>	(SE)	IRR
Individual characteristics						
Criminal parents				-.02	(.15)	0.98
Biological vulnerability						
Control variables						
Age	.04	(.04)	1.05	.05	(.04)	1.05
Wave interval	-.003	(.003)	1.00	-.004	(.003)	1.00
Social bonds						
Parental supervision	.12	(.19)	1.13	.17	(.24)	1.19
Parental involvement	-.09	(.16)	0.91	-.10	(.19)	0.91
Delinquent peers	.36**	(.09)	1.43	.35**	(.09)	1.41
Changing schools	-.15	(.17)	0.86	-.10	(.17)	0.90
Skipping class	.30	(.20)	1.35	.29	(.20)	1.34
Criminal parents × parental supervision				-.15	(.38)	0.86
Criminal parents × parental involvement				.14	(.38)	1.15
Biosocial interactions						
Bio × supervision						
Bio × involvement						
Bio × delinquent peers						
Bio × changing schools						
Bio × skipping class						
No. of observations		515			502	
No. of groups		239			232	
Wald χ^2		20.08**			19.33*	

Note. IRR = incidence rate ratio, indicating the percentage increase (IRR greater than 1) or decrease (IRR less than 1) in delinquency rates for every one-unit increase in the independent variable.

* $p < .10$, ** $p < .05$, *** $p < .01$.

of parental supervision on offense frequency was significantly smaller in biologically vulnerable children (IRR = 0.34, $p < .05$), rendering the effect of an increase parental supervision near zero in this group (i.e., $2.89 \times 0.34 =$ [an IRR of] 0.98). Regarding change in bonds with delinquent peers, we found a positive effect on subsequent offending in biologically nonvulnerable children, such that with each one-unit increase in our measure of delinquent peers, the number of delinquent events participants reported in the following time-period increased by 42 percent (IRR = 1.42, $p < .05$). This effect was significantly smaller in biologically vulnerable children (IRR = 0.60, $p < .05$), resulting in a non-significant effect of bonds with delinquent peers on offense

Lagged models											
Model 3			Model 4			Model 5			Model 6		
<i>B</i>	(SE)	IRR	<i>B</i>	(SE)	IRR	<i>B</i>	(SE)	IRR	<i>B</i>	(SE)	IRR
						.12	(.20)	1.13			
.15	(.13)	1.17							-.001	(.17)	1.00
.07	(.04)	1.07	.08	(.05)	1.08	.08	(.06)	1.08	.04	(.06)	1.05
-.003	(.003)	1.00	.03	(.02)	1.03	.03*	(.02)	1.03	.04*	(.02)	1.04
-.11	(.36)	0.90	.35	(.26)	1.41	.54	(.34)	1.71	1.06*	(.45)	2.89
-.24	(.32)	0.78	-.02	(.20)	0.98	-.05	(.23)	0.95	.05	(.35)	1.05
.29 ⁺	(.16)	1.33	-.01	(.11)	0.99	-.001	(.11)	0.99	.35*	(.17)	1.42
.08	(.32)	1.08	.30	(.23)	1.35	.14	(.23)	1.15	.12	(.39)	1.13
-.19	(.33)	0.82	-.02	(.27)	0.98	.01	(.26)	1.01	.70 ⁺	(.45)	2.00
						-.69	(.51)	0.50			
						-.01	(.45)	1.01			
.30	(.42)	1.35							-1.09*	(.55)	0.34
.22	(.37)	1.24							-.07	(.43)	0.93
.02	(.20)	1.02							-.51*	(.24)	0.60
-.32	(.37)	0.73							.29	(.48)	1.33
.75 ⁺	(.41)	2.11							-1.11 ⁺	(.57)	0.33
509			393			381			388		
235			214			207			211		
25.05*			8.45			8.27			19.52		

frequency ($1.42 \times 0.60 = [\text{an IRR of}] 0.85, p = 0.31$). Lastly, findings from Model 6 suggest that when biologically nonvulnerable children skipped class during one time-period, they reported an increase in delinquent acts in the following time-period ($\text{IRR} = 2.00, p < .10$). However, and in contrast to the non-lagged models, Model 6 suggests that the effect of skipping class on offense frequency is 67% ($\text{IRR} = 0.34, p < .10$) smaller, and non-significant ($2.00 \times 0.33 = [\text{an IRR of}] 0.66, p = 0.22$), in biologically vulnerable children.¹¹

11 When biological vulnerability was defined as either the presence or absence of prenatal exposure to nicotine or prenatal complications, hybrid random effects models showed that none of the interaction effects were significant.

5.3.3 Potential reverse causation

As shown in Table 5.3, the effect of individual change in offense frequency was not systematically associated with changes in bonds with parents, the number of times participants changed schools, or whether or not they skipped class. However, Table 5.3 shows that within-individual changes in offense frequency affected bonds with delinquent peers. Findings revealed that in time-periods participants were exposed to a relative large proportion of delinquent peers, they were also more likely to offend more frequently ($B = .04, p < .001$).

5.3.4 Sensitivity analyses

Models with offending diversity and frequency of serious offending as outcome measures overall strengthen the reliability of our main findings, as they yielded substantially similar results, producing similar directions, significance levels, and largely comparable estimates.¹² Hence, results of the sensitivity analyses revealed non-significant effects of parental bonds on offending, while revealing a significant positive effect of increases in bonds with delinquent peers on offending. Differences between the primary and the sensitivity analyses were limited to the main effect of skipping class on offending, and the interaction effect between biological vulnerability and affiliation with delinquent peers. First, the non-lagged models showed that in time periods children were more likely to skip class, they were also more likely to display a higher diversity of

Table 5.3 Random effects models for the effect of offense frequency on social bonds

Independent variables	Dependent variable									
	Parental supervision		Parental involvement		Delinquent peers		Changed schools		Skipped class	
	B	(SE)	B	(SE)	B	(SE)	B	(SE)	B	(SE)
<i>Control variables</i>										
Age	-.04**	(.01)	-.01	(.02)	.10**	(.02)	.002	(.01)	.24*	(.13)
Wave interval	-.001	(.001)	-.001	(.001)	-.001	(.002)	-.001	(.001)	.001	(.01)
<i>Behavioral variable</i>										
Offense frequency	-.01 [†]	(.004)	-.001	(.004)	.04**	(.01)	.002	(.004)	.06	(.04)
Observations	530		532		522		532		529	
Individuals	242		242		242		22		242	
Wald χ^2	16.82*		3.22		41.60*		0.53		8.43*	

Note: We used fixed effects linear regression models for continuous measures of social bonds (i.e., parental supervision, parental involvement, affiliation with delinquent peers, and changes in schools), and logistic fixed effects models for dichotomous measures of social bonds (i.e., skipping school).

[†] $p < .10$, * $p < .05$, ** $p < .01$.

12 Results from sensitivity analyses are available upon request.

offending ($IRR = 1.56, p < .01$), as well as a higher frequency of serious offending ($IRR = 1.65, p < .05$). Furthermore, when offending diversity was used as the independent variable in the reversed models, it was shown that the diversity of offending also had a positive effect on skipping class ($B = .44, p < .001$). Second, the positive effect of affiliation with delinquent peers on offending remained significant for biologically nonvulnerable children in the non-lagged models with offending diversity as outcome variable ($IRR = 1.23, p < .05$). Lastly, none of the interactions between biological vulnerability and social bonds were significant in models with serious offending as the outcome variable.

5.4 DISCUSSION

The present study examined the effects of social bonds on delinquent behavior in early onset offenders during the transition from childhood into early adulthood. Specifically, this study examined (1) the association between within-individual changes in bonds with parents, peers, and school and concurrent as well as next-year changes in delinquency rates, and (2) whether such associations varied by participants' biological vulnerability to delinquent development.

Consistent with peer-influence models, findings indicated that an increase in affiliation with delinquent peers acted in the expected offending-inducing direction. Specifically, the current study revealed that when a greater proportion of participants' peers had a police contact, participants' offending behavior increased in the same year. These findings corroborate prior work on changes in bonds with peers and delinquent behavior in adolescent general population and inner-city samples (e.g., Beardslee et al., 2018; Peterson et al., 2016; Unnever & Chouhy, 2019). Our findings add to this literature by revealing the importance of changes in friendships with delinquent peers during the transition from childhood into adolescence in early onset offenders.

Unlike the effect of affiliation with delinquent peers, there was no evidence of an association between change in parental bonds and offending behavior during the transition into early adolescence. The absence of an effect of bonds with parents on offending contradicts some previous findings on associations between changes in parental bonds and offending behavior (Farrington et al., 2002; Hemphill et al., 2015), yet is in accordance with other prior studies focused on within-individual changes in offending (Beardslee et al., 2018; Childs et al., 2010). The non-significant effect of parental bonds, combined with the non-significant interaction effect between criminal parents and parental bonds, may point to a general decline in the influence of parental bonds on behavioral outcomes in adolescents, be it good or bad (Berndt, 1982; Larson & Richards, 1991; Moretti & Peled, 2004). Another possible explanation for this finding might be related to the fact that we did not distinguish between

paternal and maternal bonds, as prior research found an association between growth in maternal bonds and a decrease in youth's delinquent behavior, while changes in paternal bonds did not affect youth's delinquent involvement (Craig, 2016). Further assessment of the differential effects of change in maternal and paternal bonds on delinquency is therefore needed. Lastly, the lack of an interaction effect between criminal parents and parental bonds might also be due to the way parental criminal behavior was measured in the current study, as parents were asked at T1 whether or not they had ever been in contact with the police. Thus, parents identified as criminal in the current study may have been in contact with the police only during their adolescent years. Future studies focused on associations between parental bonds and change in children's delinquent behavior over time could therefore strive to examine a more direct effect of parental criminal behavior by asking whether parents had been in contact with the police during or directly prior to the observation period.

With respect to our secondary aim, our work extends prior research in that findings showed that the association between concurrent social bonds with school and offending are conditional upon early onset offenders' biological vulnerability. Although offense rates in biological nonvulnerable children seemed to be unaffected by concurrent bonds with school, biologically vulnerable children were found to commit more offenses in years they skipped class. These results may explain varying findings found in earlier work. While studies that failed to find an effect of bonds with school were conducted in a birth cohort (Unnever & Chouhy, 2019) and an inner-city sample (Farrington et al., 2002), the study reporting an effect of school dropout and subsequent arrest frequency was conducted among a sample of serious adolescent offenders (Na, 2017). As Moffitt (1993) suggests that biologically vulnerable individuals are more likely to display offending behavior, the study by Na (2017) may have been based on a relatively large share of biologically vulnerable participants, and consequently revealed an effect of bonds with school and offending behavior. Clearly, future research would further increase our understanding of the nature of the effects of changes in social bonds on delinquency by replicating the current effort in considering possible interactions between antisocial dispositions, like biological vulnerability, and time-varying social factors, like social bonds, especially when considering high-risk groups.

Importantly, we also examined whether changes in offense frequency had an effect on social bonds. In doing so, the current study found that when youths display an increase in their offending behavior, they are likely to experience an increase in the number of delinquent peers they affiliate with. As offending behavior was found to affect bonds with delinquent peers – in this and other studies (see for instance Weerman, 2011) –, and bonds with delinquent peers affect offending behavior, this process might be cyclical.

Lastly, we want to reflect on the somewhat surprising estimates produced by the lagged models in our study. In contrast to our expectations, lagged

models showed that biologically nonvulnerable children were especially susceptible to changes in social bonds compared to biologically vulnerable children. While some scholars have suggested that changes in the social environment will mostly affect individual with (biological) antisocial dispositions (Monroe & Simons, 1991; Wright et al., 2001; Zuckerman, 1999), it has also been proposed that stronger associations between social risk and offending behavior will be found in children who lack biological risk factors of offending (Raine, 2005). The reasoning behind this second argument is that the association between the social environment and offending behavior might be stronger when the biological 'push' towards crime is weaker, allowing for the link between social bonds and offending to shine through. Another possible explanation for the results produced by the lagged models is that the yearly time intervals between waves in the current study may be too large to paint a detailed picture of the relationship between changes in social bonds and offending, as prior work indicated that lagged models may lead to biased estimates when the lag in the model does not match with the time lapse in the real world (Unnever & Chouhy, 2019; Vaisey & Miles, 2017). Questions surrounding the developmental processes underlying the differential effects of social bonds on future offending in biologically vulnerable and nonvulnerable children entering early adolescence therefore warrant future research.

5.4.1 Theoretical implications

Overall, current findings offer mixed support for sociological theories of offending (Akers, 1973; Hirschi, 1969; Sutherland, 1947). In contrast to assumptions from social control theory (Hirschi, 1969), current findings showed that changes in bonds with parents were not associated with concurrent changes in delinquency rates, regardless of whether parents themselves had displayed criminal or law-abiding behavior. However, the finding that an increase in social bonds with delinquent peers exacerbates children's own engagement in delinquent activities provides support for differential association and social learning theories, which generally suggest that delinquent behavior is learned by interacting with delinquent others (Akers, 1973; Sutherland, 1947).

In line with developmental theories of offending (Moffitt, 1993), the results reported here confirm the importance of considering the dynamic processes that occur upon entering adolescence in order to understand variability in offending during this phase in the life-course. The transition from childhood into early adolescence was found to be a time where changes in the social environment affect delinquent behavior. Thus, failing to consider the influence of change in important social risk factors over time can lead to insufficient or partial explanations of offending behavior.

Lastly, findings furnished support for the theoretical assumption that the effect of changes in the social environment on delinquent behavior depend

on early biological differences (Moffitt, 1993; Monroe & Simons, 1991; Zuckerman, 1999). As such, sociological theories that dismiss these interaction effects appear to do so in error. While findings from the non-lagged models provide support for the hypothesis that biologically vulnerable children are more susceptible to their social bonds with others than their biologically nonvulnerable peers (Moffitt, 1993; Monroe & Simons, 1991; Zuckerman, 1999), the lagged models showed that social experiences in distinct life domains (at home, with peers, and at school) mostly affect biologically nonvulnerable children. Overall, the results of this study therefore show that social learning, biosocial, and developmental theories are complementary, as within-individual changes in offense frequency over time did not only vary due to changes in social bonds, but also due to variation in susceptibility to social influences based on biological makeup.

5.4.2 Limitations and recommendations

Some limitations need to be considered when interpreting the results. First, while this study is based on data collected across three waves in an important high-risk offender population, the use of three measurement occasions to study the effects of time-varying factors on offense rates may be somewhat limited. For example, prior studies on the effects of change in social bonds on offending across adolescence used about five to six waves (Childs et al., 2010; Peterson et al., 2016). Future research could further our analyses by including more measurement occasions over an extended period of the life-course, in order to reveal how stability and change in social bonds affect delinquent behavior across different periods of adolescence. Second, the current study is based on self-reported delinquency rather than registered offenses. A useful area for future research would be to test our findings using conviction data, as a judicial contact, in the form of either an official arrest or conviction, may have a more profound impact on social bonds. Third, no protective factors of offending in the peer and school domains were used in the current study. Future research including factors such as friendships with conventional peers, or connectedness between student and teachers, may offer a more detailed interpretation of the effects of changes in social bonds on offending. Lastly, the current study used biological vulnerability resulting from exposure to prenatal problems as a proxy for antisocial dispositions. It would be interesting to see if current findings on biosocial interactions are replicated when different definitions of biological vulnerability are used. For instance, future research could consider whether the effects of social bonds on offending vary across children differing in verbal and executive functioning (Moffitt, 1993), or psychophysiological functioning (i.e., individuals' 'fight or flight' response to stressful situations; for a study on the interaction between psychophysiological measures and social/environmental risk factors, see Raine et al., 2014).

5.4.3 Practical implications

Findings from the current study on the extent to which changes in social bonds affect variability in offending behavior in early onset offenders offer three main practical implications. First, that it is important for practitioners and clinicians to consider the type of peers early onset offenders surround themselves with, as an increase in affiliation with delinquent peers plays an important role in the increase of offense rates. Second, current findings suggest that it is beneficial to ensure that early onset offenders attend class. As skipping class has the potential to facilitate an increase in offense rates, it is important to address early signs of school disengagement in children who are at greatest risk of continuing their offending behavior. Lastly, criminal justice interventions may therefore be most effective when they are organized in ways to avoid hindering early onset offenders from following conventional developmental pathways, in order to prevent an increase in exposure to delinquent peers and school disengagement. On a final note, while no significant effect of changes in parental bonds on offending behavior was revealed, findings from the current study should not be taken to suggest that practitioners and clinicians should not focus on the parent-child relationship. In contrast, prior work has shown that interventions focused on the parent-child relationship can be effective (Baglivio, Jackowski, Greenwald, & Wolff, 2014). Questions on which changes in what particular aspects of the social bonds with parents may have protective effects in the early onset offender population as yet await future research.

