



A Bad Start: The Combined Effects of Early Onset Substance Use and ADHD and CD on Criminality Patterns, Substance Abuse and Psychiatric Comorbidity among Young Violent Offenders

Malin Hildebrand Karlén^{1,2,3,4}, Thomas Nilsson^{1,2,5}, Märta Wallinius^{2,7,8}, Eva Billstedt^{5,6}, and Björn Hofvander^{2,7}

¹ The National Board of Forensic Medicine, Department for Forensic Psychiatry, Gothenburg, Sweden

² Centre for Ethics, Law and Mental health, The section of Psychiatry and Neurochemistry, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden

³ Department of Psychology, University of Gothenburg, Sweden

⁴ IGDOR, Institute for Globally Distributed Open Research and Education

⁵ Sahlgrenska university hospital, University of Gothenburg, Sweden

⁶ Gillberg Neuropsychiatry Centre, Psychiatry and Neurochemistry, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden

⁷ Lund University, Faculty of Medicine, Department of Clinical Sciences, Lund, Child and Adolescent Psychiatry, Lund, Sweden

⁸ Research Department, Regional Forensic Psychiatric Clinic, Växjö, Sweden

Email address to corresponding author:

malin.karlen@psy.gu.se

To cite this article:

Hildebrand Karlén, M. H., Nilsson, T., Wallinius, M., Billstedt, E., & Hofvander, B. (2020), A bad start: The combined effects of early substance use and childhood ADHD and CD on patterns of criminality, substance abuse and psychiatric comorbidity among young violent offenders. *Journal for Person-Oriented Research*, 6(1), 39-54. <https://doi.org/10.17505/jpor.2020.22045>

Abstract: Substance abuse, conduct disorder (CD) and attention deficit/hyperactivity disorder (ADHD) are all known risk factors for developing aggressive behaviors, criminality, other psychiatric comorbidity and substance use disorders (SUD). Since early age of onset is important for aggravating the impact of several of these risk factors, the aim of the present study was to investigate whether young adult violent offenders with different patterns of early onset externalizing problems (here: substance use < age 15, ADHD, CD) had resulted in different criminality profiles, substance use problem profiles and psychiatric comorbidity in young adult age. A mixed-method approach was used, combining a variable-oriented approach (with Kruskal Wallis tests) and a person-oriented approach (with Configural frequency analysis). Overall, this combined approach indicated that persons with combined ADHD+CD and persons with CD + early onset of substance use had a more varied history of violent crimes, a more comprehensive history of aggressive behaviors in general, and more psychiatric comorbidity, as well as more varied SUD and destructive substance abuse in adult age, than persons without ADHD, CD or early SU. Results are in line with previous variable-oriented research, but also indicate that individuals in this group with heavy problem aggregation early in life have a wider spectrum of problems in young adult age. Importantly, among these young violent offenders, problem aggregation was the overwhelming norm, and not the exception, as in studies of the general population. This emphasizes the need for early coordinated interventions, but also that treatment within correctional facilities in adult age needs to be comprehensive and take individual patterns of comorbidity into account.

Keywords: psychiatric comorbidity, substance use, SUD, ADHD, conduct disorder, criminality, aggression

Different kinds of externalizing problems are often clustered together among affected individuals that represent a minor part of the population, a group characterized by extensive behaviour problems as well as psychiatric problems (Falk et al., 2014; Moffitt, 2018; Stattin & Magnusson, 1996). A focus on such “multi-risk persons” rather than on a “multitude of separate risk factors” may carry severe consequences regarding stigmatization that are essential to avoid (see Moffitt, 2018). Nevertheless, a parallel focus both on separate variables and on the impact of negative synergy between several problem areas for the individual’s development may provide important knowledge for designing early interventions and developing efficient treatments.

Regarding the persistence of early onset criminality, Moffitt (2018) summarized research on the two trajectories of life-course persistent (LCP) vs. adolescence-limited (AL) criminality (Moffitt et al., 2002). In line with the LCP hypothesis, Falk et al. (2014) showed that 1% of the general population were responsible for 63% of all violent crimes (based on national registries from the same country as the present study’s sample). To be able to halt, or hinder, this developmental trajectory early on has been argued to be of tremendous importance to society, from humane, societal as well as economic perspectives, since successful early interventions could cut the overall crime rate by more than half (Falk et al., 2014).

The group with externalizing problems in several areas during childhood/youth often displays a similar, but frequently severely broadened, scope of problem areas in adult age. Hence, it is obvious that comprehensive and coordinated interventions are required for this group. Such an aggregation of problems (i.e., within one person) at an early age is also a strong argument for making the *person* the focal point of investigation. This can be done by using person-oriented methodology in the search for cause-effect relationships regarding adjustment problems such as criminal behaviour and substance abuse (see Stattin & Magnusson, 1996). However, this can prove difficult within increasingly specialized psychiatric care systems and social service systems.

Nevertheless, to use such a combined perspective is important since it is rare that individuals with several problem areas cease to commit crimes without help (Stattin & Magnusson, 1996). Without such a combined focus, the unified impact of complex psychiatric comorbidity or the magnitude of their respective influence on the person can be missed. Also, without such a combined focus, interventions aimed at one or two of the person’s problem areas may also prove insufficient, or altogether wasted, since the overall problem profile of the person has not been considered. Therefore, in the present study, the impact of all possible combinations of early onset externalizing problems in different areas (here: substance use < age 15, ADHD and CD) on manifestations of criminality, psychiatric comorbidity and substance use disorders (SUDs) in young adulthood among violent offenders was investigated with both a

variable-oriented and a person-oriented methodological approach.

Early onset externalizing problems and their relationship to adulthood criminality

Research has shown that boys who display a wide range of aggressive and hyperactive behaviors at an early age (i.e., problem aggregation) are at particular risk of escalating their disruptive behaviors into criminal behaviors before adult age (Stattin & Magnusson, 1996). Early onset of substance abuse and SUD has been shown to correlate more strongly with aggressive behaviors, psychopathic traits and violent recidivism among young violent offenders than the duration of substance abuse (Boden et al., 2012; Gustavson et al., 2007; Pulay et al., 2008).

Different kinds of early onset externalizing problems, such as ADHD and CD, increase the risk of such outcomes (Carpentier et al., 2012; Knop et al., 2009; Marshal & Molina 2006; Roy, 2008). For example, ADHD and CD, alone or in combination, has in previous research each been argued to contribute to the risk of experimenting early in life with substance use and developing SUD through different pathways (e.g., personality traits such as impulsivity, and sensation seeking behaviors) (Wilens & Biederman, 2006; see also van Emmerik-van Oortmersson et al., 2014). To complicate matters further, comorbidity between ADHD and CD is common, especially among incarcerated samples (Young et al., 2015). According to Carpentier et al. (2012), increasing evidence suggests that coexisting ADHD and CD poses the highest risk of all for SUD.

In addition, a study of the age of onset for substance use, SUD, conduct disorder and other kinds of psychiatric disorders has shown that patients treated for SUD with preceding Axis I psychiatric disorders had more severe current anxiety and personality disorder-related symptoms compared to those who developed Axis I disorders after their SUD onset (Guldager et al., 2011). In sum, this research highlights the complexity of problems in this group as well as the dimensional aspect of psychiatric diagnoses, with psychiatric problem profiles often overlapping several DSM-diagnoses (e.g. HITOP, Kotov et al., 2017). It also lends credence to the assumption of some underlying common ground between early externalizing problems relating to disinhibited behavior and psychopathology (e.g. Dubow et al., 2008; Englund et al, 2008; Krueger et al., 2005; Krueger et al., 2007; McGue et al., 2001). Previous studies have argued that such circumstances make a strictly variable oriented method and categorical diagnoses in research sub-optimal when examining the relationship between early psychiatric problems and different psychiatric, criminal and substance abuse profiles in adult age (Elkins et al., 2007; Stattin & Magnusson, 1996).

Risk variables vs. problem aggregation

The theoretical and methodological basis of the present study is twofold. First, it is based on the core conception of the HiTOP-model of psychopathology (Kotov et al., 2017),

where central psychopathological dimensions, present to varying degrees in different constellations, contribute to different symptomatic and behavioural outcomes. Second, it is also based on a person-oriented and holistic theoretical approach, where not only dimensional variables but also the combined profiles of problem areas of each individual are considered units of analysis.

Many theories of criminal career and development of substance abuse emphasize the detrimental role of early adversity and psychiatric as well as externalizing problems (Stattin & Magnusson, 1996; Wilson et al., 2009). The results from Stattin and Magnusson's (1996) comprehensive, multi-method analysis showed a strong impact of breadth of problem aggregation in adolescence on future criminality and substance abuse. Stattin and Magnusson (1996) concluded from their review and analyses of three prospective general population samples in Sweden (total $n=9612$), that the real increased risk for adult problems with criminality and drug abuse was due to the accumulation of different problems in adolescence, and that adult problems in one particular domain should not be understood and explained primarily as a continuation of similar adolescent problems (see p. 641). Within this holistic approach, it is assumed that complex mechanisms (e.g., those behind development of criminal behaviour or SUD) cannot be understood by only investigating single risk variables taken out of the individual's total context, but also requires analytic methods based on individuals as totalities (Stattin & Magnusson, 1996).

This methodological approach generates typologies of individual development patterns (see Bergman et al., 2003). Such "ideal types" are based on multi-dimensional assessments of symptoms and functions and are influential in clinical practice (e.g., in diagnostic assessment and as basis for treatment choice), as well as for the development of theoretical models of psychopathology (APA, 2013; Benjamin, 2003; Bornstein, 2017; Kotov et al., 2017).

Stattin and Magnusson (1996) emphasize (a) that patterns of externalizing problems early in life tend to gravitate in clusters of persons with certain types of adverse experiences; (b) that the concentration of several problem areas is prognostic for subsequent adjustment problems in adulthood (e.g., early age drinking may not only be related to drinking problems in adult age but also to other types of adjustment problems); and (c) that consequences of one type of social adjustment problem is similar to the consequences of another type. Hence, persons in the population at high risk for one type of problem are often the same individuals at high risk for other types of problems. For example, a relationship has been observed between ADHD and CD in childhood as well as SUD in youth and severe psychiatric problems (here: psychosis) in adulthood, and substance abuse has been found to be substantially more common among patients with psychosis and premorbid ADHD/CD (Dalteg et al., 2014). This is why the prognostic power of several risk indicators (e.g., early onset of crimi-

nality and substance abuse) tend to go together for several outcome measures relating to adjustment problems in adult age (Stattin & Magnusson, 1996).

The present study

The overall aim of the present study was to describe how different combinations of early onset externalizing problems were related to criminal behaviours and psychiatric characteristics among young adult violent offenders using analyses focused both on variables and on the person. More specifically, it was investigated whether groups of young violent offenders characterised by the presence or absence of different combinations of ADHD, CD and an early (i.e., < age 15) or late (i.e., > age 15) onset of substance use (SU), exhibited differences regarding criminality, SUDs and psychiatric comorbidity in early adult age (see Table 2, Analysis plan, for an overview). In accordance with Stattin and Magnusson (1996), a person-oriented and variable-oriented approach was used in parallel, discerning the merits of the respective theoretical perspective and its methodological approach for investigating the present group.

Method

Participants. The participants were part of the multi-site Swedish research project DAABS (*Development of Aggressive Antisocial Behaviour Study*), described in previous studies (e.g., Wallinius et al., 2016). The sample is a nationally representative cohort of young adult offenders ($n=269$; age: 18-25) sentenced for violent crimes (including hands-on sexual crimes) who were imprisoned at one out of nine prisons (low to high security) in the Western region of the Swedish Prison and Probation Service between March 2010 and July 2012. Out of a total of $n=421$ young violent offenders eligible at the prisons in question, 23 were excluded due to insufficient language skills for full participation without an interpreter, and 19 were excluded due to shorter stay at the current prison than 4 weeks. The total response rate for those who met inclusion criteria was 71%.

Procedure and measures. All participants were given oral and written information, provided informed consent and received 200 SEK (approx. £15) as compensation for participation. The project was approved by the Research Ethics Committee at Lund University (No: 2009:405). Participation took place during one day when they underwent clinical assessments conducted by licensed psychologists with experience from the forensic field. Participants had also been given self-report questionnaires to be completed before they met the assessing psychologist. For a full description of all measures included in the project, see Wallinius et al. (2016), Billstedt et al. (2017) and Hofvander et al. (2017).

In the present study, data on the following measures were obtained through a clinical assessment based on the summed information from clinical interviews, self-reports and file reviews from the Swedish Prison and Probation

Service including medical files. From the *Life History of Aggression* (LHA; Brown et al., 1982; Coccaro et al., 1997), which captures a person's lifetime history of aggressive and antisocial behaviours, the participants' total LHA scores, and scores on the subscales Antisocial behaviour, Aggression and Self-directed aggression were used. From the *Structured Clinical Interview for Axis II Disorders*, DSM-IV (SCID-II; First, 1997a), lifetime prevalence of personality disorders was assessed. From the *Structured Clinical Interview for Axis I Disorders*, DSM-IV (First, 1997b) and the clinical psychiatric interview, data on lifetime prevalence of ADHD, CD, anxiety disorders, SUD, severity of substance abuse, as well as historical amount of Axis I disorders was noted. Personality disorders and anxiety disorders were selected for analysis due to previous observed complex relationship both to criminality and SUD. From files and interviews, information on the total number and types of violent crimes committed was collected. The types of violent crime included were: murder, physical assault, threats, sex offenses, robbery and arson. The different types of drugs investigated were: alcohol, cannabis, sedatives (including opioids, benzodiazepines), and stimulants (including amphetamines, cocaine). All data were anonymized, coded and included in a database.

Analytic strategy

In the present design, the focus was to expand our theoretical understanding of potential interactions between early onset externalizing problem areas (i.e., risk factors) identified in previous variable-oriented research (here: before age 15) for developing (a) criminal behaviours, (b) psychiatric comorbidity, and (c) substance abuse pattern (including SUD and extremely destructive substance abuse) in young adult age. The present study was partly confirmatory and partly exploratory, and aimed to describe the group from a variable-oriented and a person-oriented perspective in parallel. The externalizing problems grouping variable, consisting of the subgroups presented in Table 1, was used in both kinds of analyses. For $n=38$, data was missing regarding ADHD, CD or age of onset of SU, wherefore these persons were not included in the independent grouping variable and hence excluded from the present study. Thus, a

total of $n=231$ participants were used in the analyses.

As seen in Table 1, the two groups with CD and early SU covered approximately 72% of the total sample. In the analyses, the presence or absence, as well as the combinations of these factors (ADHD, CD, age of onset of SU), were used.

The variable-oriented approach. For the variable-oriented approach, Kruskal-Wallis tests were used since the distribution of persons in the sample was uneven with small numbers in certain groups. The externalizing problem grouping-variable outlined in Table 1 was used as independent variable, and the following dependent variables were used in the analyses. Regarding criminality: (1) how many different types of violent crimes the person had committed, and (2) total and subscale scores on the LHA. Regarding substance use: (3) how early they started using other kinds of substances than alcohol. Regarding psychiatric comorbidity: (4) how many different Axis I disorders the groups were diagnosed with. All variable-oriented analyses were conducted in SPSS for Windows (Version 18; SPSS Inc., Chicago IL) using two-tailed p -values with significance level set at 0.05. To diminish risk for Type 1-errors, as multiple group comparisons were made, the adjusted significance level generated by Kruskal-Wallis test was used which takes number of made comparisons into account, with Mann-Whitney U -test as post hoc test.

The person-oriented approach. For the person-oriented approach, first-order configural frequency analyses (CFA) with a base model of independence were used. CFA is a multivariate statistical method for the analysis of cross-classifications, and allows for data exploration based on profiles of how factors cluster together in patterns within individuals, and tests whether these patterns occur more often (i.e., is a type) or less often (i.e., is an antitype) than chance (Schrepp, 2006; Stemmler & Heine, 2017; von Eye et al., 2015). CFA has been described as a "searching device" for where cause-effect relationship might exist, making it a "case"- or "person"-oriented method (see Dogan & Dogan, 2016, p. 173), instead of a variable-oriented method where the impact of a specific variable in isolation (or in interaction with one or two other) is investigated.

Table 1.

Overview of grouping variable (and abbreviations) and number of externalizing problem areas in childhood/youth, total sample ($n=269$)

Zero problem areas	Nothing and late SU (<i>Nothing+late SU</i>)	$n=5$
One problem area	Nothing and early SU (<i>Nothing+early SU</i>)	$n=4$
One problem area	ADHD and late SU (<i>ADHD+late SU</i>)	$n=7$
Two problem areas	ADHD and early SU (<i>ADHD+early SU</i>)	$n=11$
One problem area	CD and late SU (<i>CD+late SU</i>)	$n=11$
Two problem areas	CD and early SU (<i>CD+early SU</i>)	$n=51$
Two problem areas	Both ADHD, CD and late SU (<i>Both+late SU</i>)	$n=26$
Three problem areas	Both ADHD, CD and early SU (<i>Both+early SU</i>)	$n=116$
Total sample in the analyses: $n=231$		

An important factor for correct interpretation of results from CFA is the validity of the scores and groupings used in the analyses because of the person-oriented tenet of dimensional identity (von Eye et al., 2015). In the present study, such validity has been ascertained by having highly qualified clinical psychologists conduct a broad diagnostic assessment procedure (i.e., using different kinds of data sources, see Wallinius et al., 2016 for a detailed description) before they, together with external experts, made diagnostic conclusions.

The early externalizing problem grouping variable was used for classification in the present CFA:s, investigating within these groups the prevalence and patterns of the following factors: (1) Types of crimes committed, (2) Types of substance use disorders (here: alcohol, sedatives, stimulants and cannabis), (3) Type(s) of comorbid personality disorders and anxiety disorders (here: panic disorder and agoraphobia). All person-oriented analyses were conducted in ROP-STAT's CFA-module in which, using the exact binomial test for significance testing, value patterns are identified for types and antitypes (Vargha et al, 2015). The exact binomial test is considered to perform well under many conditions, but to diminish the risk for Type I-errors, the improved Bonferroni correction devised by Holm (Holm, 1979) and recommended by previous research, was used (see Bergman et al., 2003; von Eye et al, 2015). However, when the expected frequencies of cells are very low (e.g., <5), the exact binomial test of this CFA becomes imprecise. In such cases, follow-up cell-wise exact tests of types and antitypes have been recommended (von Eye et al.,

2015). One such procedure is Exacon (Bergman et al., 2003), which was employed in the present study for the exact analysis of single cells for further investigation of the reliability of the obtained types/antitypes in the CFAs.

Hypotheses for confirmatory analyses. The aim of this study was principally exploratory, but general hypotheses were formed based on the HiTOP-model (Kotov et al., 2017), and previous results on problem aggregation (Stattin & Magnusson, 1996, see also Moffitt, 2018). These hypotheses postulated that the more problem areas that were present for the person in early age, the more of the following would be seen in adulthood: (a) a more varied and comprehensive violent criminality; (b) a more varied psychiatric comorbidity regarding both DSM-IV-TR Axis I psychiatric disorders, and Axis II personality disorders (APA, 1994); and (c) a more varied substance use with earlier onset during adolescence, as well as a more varied and destructive substance abuse in adulthood. Hence, the Nothing+late SU-group was presumed to have less comorbid psychiatric and SUD-problems and be less criminally versatile than the group with Both+early SU. Furthermore, based on the diagnostic descriptions of ADHD and CD regarding criminal activity, it was hypothesized that the ADHD groups should have a less versatile criminal history compared to (a) the two CD-groups and b) the two Both-groups (APA, 1994). No hypotheses were made for types and antitypes in the CFAs as the analyses were exploratorily conducted (see Table 2 for the analysis plan).

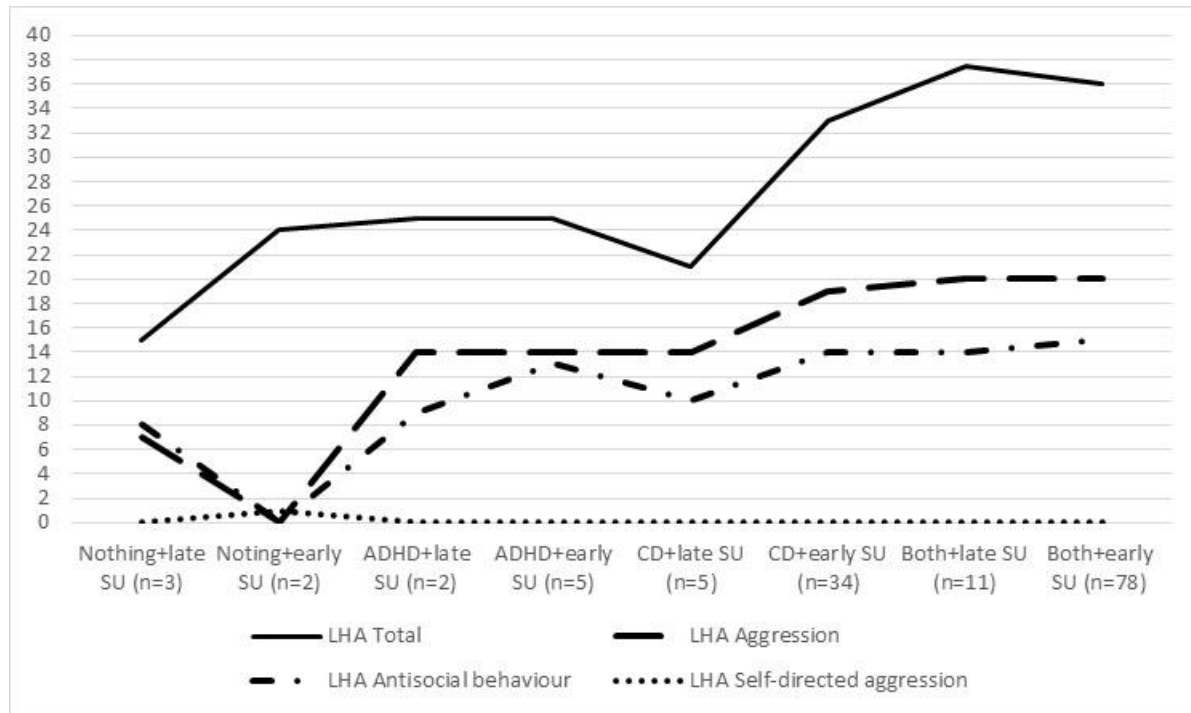
Table 2.

Analysis plan.

Research questions		
Whether groups with different combinations of the following early onset externalizing problems:		
<ul style="list-style-type: none"> a) Early onset SU (<15 years of age) b) ADHD c) CD 		
differed regarding pattern of criminality, substance abuse and psychiatric comorbidity		
Variables used in variable-oriented analyses		
<i>Criminality and violent behaviours:</i> 1. How many committed types of violent crimes? 2. Total LHA score and subscale score Aggression, Antisocial behaviour and Self-directed aggression	<i>Substance use:</i> 1. Onset age of different groups of drugs: a) alcohol b) sedatives c) stimulants d) cannabis	<i>Psychiatric comorbidity:</i> 1. Number of Axis I psychiatric disorders (excl. SUD)
Factors used in Person-oriented analyses		
<i>Criminality:</i> Pattern profile of previously committed types of violent crimes	<i>Substance use:</i> Whether they a) met two or more SUD diagnoses and b) their substance abuse was considered extremely destructive	<i>Psychiatric comorbidity:</i> Pattern profile of adult comorbid personality disorders and anxiety disorders
Analyses		
Variable-oriented analyses: Kruskal Wallis test		
Person-oriented analyses: Configural frequency analysis (CFA)		

Figure 1.

Overview of median (IQR) of Life history of aggression-scores.



Results

Part I: Variable-oriented analyses

Criminality and violent behaviour. A Kruskal Wallis test showed that the number of types of committed violent crimes differed between the groups with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=231)=15.42$, $p=0.031$. Specifically, it showed that, compared to the group with Nothing+late SU ($Md=1.5$, $IQR=0.58$), the number of committed violent crimes were higher in the CD+early SU-group ($p=0.006$; ($Md=3$, $IQR=0.88$) as well as in the two groups with ADHD/CD, both early ($p=0.008$; $Md=3$, $IQR=0.96$) and late SU ($p=0.008$; $Md=3$, $IQR=0.95$).

The LHA total scores varied with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=231)=49.93$, $p<0.001$ (see Figure 1). After adjusting the significance level for multiple comparisons, five pair-wise comparisons remained significant: The Both+early SU group scored significantly higher than (a) the Nothing+late SU ($p=0.002$); (b) the ADHD+early SU ($p=0.041$); (c) the ADHD+late SU ($p=0.012$); and (d) the CD+late SU ($p=0.010$). In addition, the Both+late SU also scored significantly higher than the Nothing+late SU-group ($p=0.009$).

LHA Aggression scores also varied with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=231)=39.33$, $p<0.001$ (see Figure 1). After adjusting the significance level for multiple comparisons, three pair-wise comparisons remained significant: (a) Nothing+late SU vs. Both+late SU ($p=0.027$); (b) Nothing+late SU vs.

Both+early SU ($p=0.005$); and (c) ADHD+late SU vs. Both+early SU ($p=0.040$).

The LHA Antisocial behaviour scores varied with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=231)=43.93$, $p<0.001$ (see Figure 1). After adjusting the significance level for multiple comparisons, five pair-wise comparisons remained significant with Mann-Whitney U -test where the Both+early SU scored significantly higher than (a) the Nothing+late SU ($p=0.009$); (b) the ADHD+late SU ($p=0.014$); and (c) the CD+late SU ($p=0.003$). In addition, the Both+late SU-group also scored significantly higher than (d) the CD+late SU ($p=0.042$) and the Nothing+late SU-group ($p=0.037$). However, the LHA Self-directed aggression scores were very low for all groups and did not vary significantly with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=231)=4.87$, $p=0.676$.

Substance use. Three Kruskal Wallis tests were conducted to investigate, on a general level, whether age of onset for different groups of substances (sedatives, stimulants, cannabis), differed with different combinations of ADHD, CD and early/late SU. Regarding sedatives, the age of onset varied between the groups, $\chi^2(7, n=155)=20.96$, $p=0.004$ (see Table 4 for an overview of all results). After adjusting the significance level for multiple comparisons, the two only significant differences concerned a higher sedatives-use onset age for the Both+late SU-group compared to the (a) CD+early SU ($p=0.019$) and the (b) Both+early SU-group ($p=0.011$).

Table 3.

Overview of median (IQR) age of onset for the use of different substances.

	<i>Sedatives</i>	<i>Stimulants</i>	<i>Cannabis</i>
Nothing and late SU (n=3)	19(0)	18(0)	19(2.25)
Nothing and early SU (n=2)	17(0)	18(0)	14(2)
ADHD and late SU (n=2)	18(0)	17(0)	18(1.5)
ADHD and early SU (n=5)	15(3.5)	19(3)	14(2.75)
CD and late SU (n=5)	17(4.5)	18(2.75)	17(2)
CD and early SU (n=34)	16(3)	16(2)	14(2)
Both and late SU (n=11)	19(3)	18(1)	14(1.5)
Both and early SU (n=78)	16(3)	16(3)	18(2)

Regarding stimulants, the age of onset varied with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=182)=31.65, p<0.001$. After adjusting the significance level for multiple comparisons, the only two significant differences according to Mann Whitney *U*-test of stimulants age of onset were a higher age of onset for the Both+late SU-group compared to the (a) CD+early SU ($p=0.002$) and the (b) Both+early SU-group ($p<0.001$).

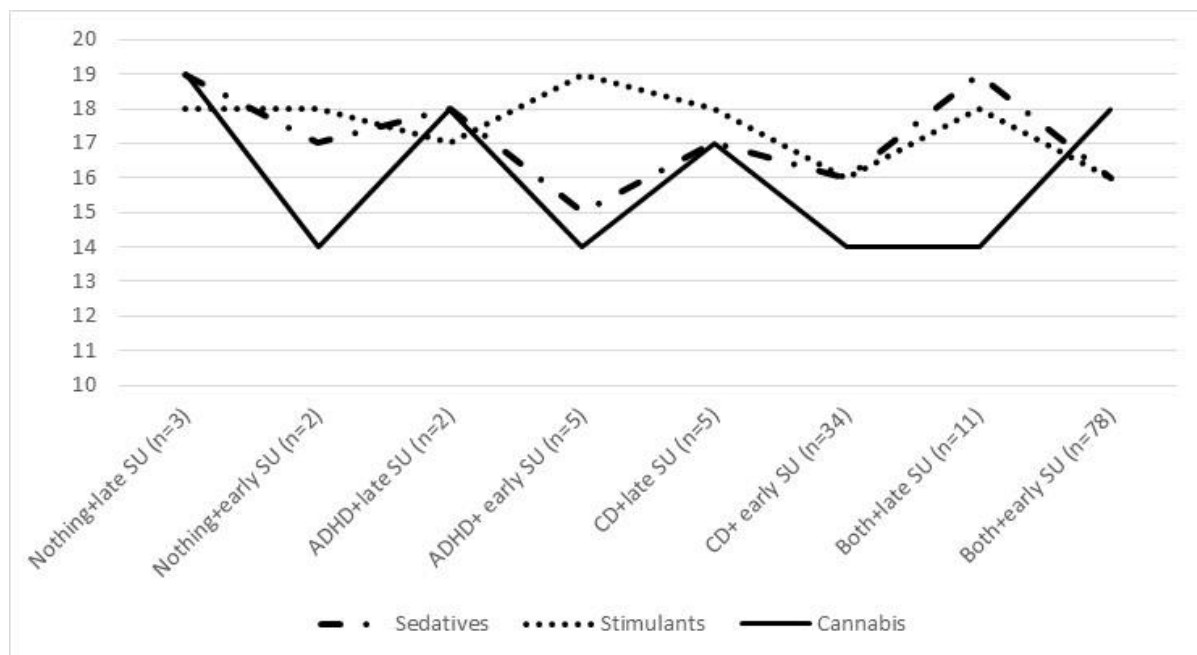
Regarding cannabis, the age of onset varied with different combinations of ADHD, CD and early/late SU, $\chi^2(7, n=207)=69.47, p<0.001$. After adjusting the significance level for multiple comparisons, the seven significant group differences of cannabis age of onset were the following: A lower age of onset for the CD+early SU-group compared to Both+late SU ($p<0.001$), CD+late SU ($p<0.001$), as well as the Nothing+late SU-group ($p=0.018$). A younger age of

onset was also found for the Both+early SU-group compared to the Both+late SU ($p<0.001$), CD+late SU ($p=0.001$), and the Nothing+late SU-group ($p=0.016$). Also, the ADHD+early SU-group had a lower cannabis age of onset compared to the Both+late SU-group ($p=0.038$).

Psychiatric comorbidity (except SUD). A Kruskal Wallis test showed that the accumulation of Axis I comorbidity in adult age (except SUD) differed between the groups, $\chi^2(7, n=231)=17.70, p=0.013$. The group who had Both+early SU had more Axis I psychiatric diagnoses in young adult age ($Md=2, IQR=1$), compared to the Nothing+late SU ($p=0.035; Md=0, IQR=1.5$), and the two groups with CD, regardless of early SU ($p=0.007; Md=1, IQR=2$) or late SU ($p=0.003; Md=0, IQR=1$). Otherwise, no differences in amount of Axis I -psychiatric disorders were found between the groups.

Figure 2.

Median age of onset for the use of different types of drugs by type of early comorbidity.



Part II: Person-oriented approach and Configural Frequency Analyses

Three exploratory CFAs were conducted using the same groups as in the variable-oriented analyses. The objective of the three CFA:s was to find potential combinations of early onset externalizing problems that result in specific problem aggregation patterns in young adult age regarding (1) criminality, (2) substance abuse and (3) psychiatric comorbidity related to Axis II disorders and anxiety disorders.

Criminality. The CFA for criminality patterns showed two significant types (i.e., patterns of crime types observed more frequently than expected) but no antitypes (i.e., patterns observed less frequently than expected). As to crime types, sex crimes, arson and murder were relatively rare, but both identified CFA types entailed having perpetrated sex crimes in combination with arson. The first CFA type was found in the CD+late SU group, consisting of persons having perpetrated sex crime and arson. The other CFA type was found in Both+early SU, consisting of sex crimes, arson and murder. In other words, among persons with the most comprehensive early externalizing problem aggregation, a larger number of persons than expected by chance had committed a combination of sex crimes, arson and murder. However, when performing Exacon analyses, these types were not reproduced, which indicates a lower stabil-

ity of these types and that this should be investigated further before drawing any conclusions.

Although, interestingly, one type was indeed found within the Exacon-analyses that concerned sex crime, showing that more than expected by chance in the group ADHD+late SU had committed either sex crimes or robbery and that the group displayed an antitype of having committed both (associated probability = 0.0286). Taken together, this could indicate that the observed CFA-type of sex crime in combination with other crimes may be more common in the Both+early SU and the CD+late SU, but atypical in other groups such as ADHD+late SU. The prevalence of the different crime types, and the most frequently observed crime pattern for each group, are presented in Table 5. The most prevalent crime pattern in the groups where $n > 10$ was a combination of having committed physical assault, threats and robbery. No types were found in the CFA:s regarding these crime types, but in the Exacon-analyses, types were found regarding these crimes for the Both+early SU group which consisted of having committed physical assault and threat and that it was atypical in this group to only have committed one of them (associated probability of 0.0157). The same type/antitype-structure was found for the group CD+early debut (associated probability of 0.0392), which indicate a similarity in this crime pattern between these two groups.

Table 4.
Patterns of criminality: Prevalence indicated by Yes/No.

	<i>Murder Yes/No</i>	<i>Physical assault Yes/No</i>	<i>Threats Yes/No</i>	<i>Sex of- fense Yes/No</i>	<i>Robbery Yes/No</i>	<i>Arson Yes/No</i>	<i>Most common type of crime in the group</i>	<i>Type/ antitype</i>
Nothing + late SU (n=5)	0/100%	60/40%	20/80%	20/80%	0/100%	20/80%	Only physical assault $n=2$	
Nothing + early SU (n=4)	0/100%	75/25%	50/50%	25/75%	25/75%	0/100%	One person repre- sented configura- tion	
ADHD + late SU (n=7)	14/86%	57/43%	14/86%	43/57%	57/43%	0/100%	Only sex offense $n=2$	
ADHD + early SU (n=11)	0/100%	73/27%	54.5/45.5%	27/73%	27/73%	0/100%	Only physical assault $n=3$	
CD + late SU (n=11)	9/91%	73/27%	73/27%	9/91%	54.5/45.5%	9/91%	Combination of phys- ical assault, threats and robbery $n=4$	Type: sex + arson $p=0.025^*$
CD + early SU (n=51)	6/94%	94/6%	65/35%	6/94%	67/33%	16/84%	Combination of phys- ical assault, threats and robbery $n=18$	
Both + late SU (n=26)	8/92%	96/4%	73/23%	11.5/88.5%	65/35%	4/96%	Combination of phys- ical assault, threats and robbery $n=10$	
Both + early SU (n=116)	5/95%	79/21%	67/33%	8/92%	70/30%	16/84%	Combination of phys- ical assault, threats and robbery $n=36$	Type: mur- der + sex + arson $p=0.045^*$

* p -level adjusted according to Holm's method for multiple significance testing

Table 5.*Substance use disorders indicated by Yes/No in the different groups*

	<i>More than two SUD:s in adult age Yes/No</i>	<i>Extremely destructive sub- stance abuse Yes/No</i>	<i>Most prevalent type of pattern in the group Yes/No</i>
Nothing+late SU (n=5)	<i>Too many missing values</i>	<i>Too many missing values</i>	<i>Too many missing values</i>
Nothing+early SU (n=4)	100%/0%	33%/67%	Only two or more SUDs n=2
ADHD+late SU (n=7)	67%/33%	0%/100%	Only two or more SUDs n=2
ADHD+early SU (n=11)	57%/43%	29%/41%	Nothing n=3
CD+late SU (n=11)	50%/50%	12.5%/87.5%	Nothing n=4
CD+early SU (n=51)	86%/14%	24%/76%	Only two or more SUDs n=26
Both+late SU (n=26)	83%/17%	18%/78%	Both n=12
Both+early SU (n=116)	95%/5%	42%/56%	Only two or more SUDs n=47, although observe that n=39 of the remaining group had prob- lems in both regards. Together these two subgroups make up n=86 of this group.

Table 6.*Psychiatric comorbidity indicated by Yes/No in the different groups*

	Antisocial PD	Borderline PD	Two or more PD	Panic dis- order/ agoraphobia	Most frequent pattern presented in the group
Nothing+late SU (n=5)	0/100%	0/100%	0/100%	20/80%	No comorbidity n=4
Nothing+early SU (n=4)	25/75%	0/100%	0/100%	50/50%	Comorbid anxiety disorder more common than other prob- lems/combinations n=2
ADHD+late SU (n=7)	0/100%	0/100%	0/100%	43/57%	No comorbidity n=4
ADHD+early SU (n=11)	0/100%	0/100%	0/100%	50/50%	Comorbid anxiety disorder equally common as not having it (50/50)
CD+late SU (n=11)	54.5/45.5%	0/100%	18/82%	0/100%	No comorbidity n=5
CD+early SU (n=51)	76/24%	4/96%	22/78%	22/78%	Only Antisocial PD n=22
Both+late SU (n=26)	77/23%	11.5/88.5%	31/69%	31/69%	Only Antisocial PD n=9
Both+early SU (n=116)	88/12%	7/93%	24/76%	37/63%	Only Antisocial PD n=46; Type: pattern 1234 (i.e. all types of problems)

Substance use disorders and extremely destructive substance abuse. Substance abuse was very common in this sample and the CFA did not generate any significant types or antitypes. However, the distribution of percentages clearly indicated that multiple SUDs and extremely destructive substance abuse were most prevalent among persons in the CD+early SU-group, and the two ADHD/CD-groups (i.e., both early and late SU). A certain impact

of early SU on adult extremely destructive substance abuse was also indicated, since among persons in the groups with early SU (regardless of ADHD or CD) 24-42% had had an extremely destructive substance abuse in adulthood, while without early SU the figures ranged from 0-18% (see Table 6). The Exacon analyses did not generate any significant types or antitypes on a cell level.

Comorbid personality disorders and anxiety disorders. In the CFA focusing on psychiatric comorbidity, personality disorders and anxiety disorders were included. The CFA showed one type, a comorbid pattern observed significantly more often than expected in the Both + early SU group, characterized by having problems in all the investigated areas (i.e., diagnosed with two or more PDs, diagnosed with antisocial and borderline PDs, and with an anxiety disorder). The most prevalent comorbidity patterns of PDs and anxiety disorders in this sample included having been diagnosed with two or more PDs and antisocial PD, and the four most prevalent profile patterns incorporated 86% of the sample (see Table 6 for a summary).

The most prevalent profile (37.5%) in this sample only had these PDs, and the second most common profile (23%) had a comorbid anxiety diagnosis. Also, interestingly, borderline PD was only prevalent among persons with comorbid ADHD/CD and among those with CD+early SU. Exacon analyses confirmed these patterns, showing types for the groups Both+early SU, CD+early SU, but also for the group Both+late SU. Specifically, for the Both+early SU group, a co-morbid state of antisocial PD and anxiety disorder was typical rather than having only one or the other (associated probability = 0.0166). Also typical for the Both+early SU group was to be diagnosed with two or more personality disorders if these were either antisocial PD or borderline PD (associated probability = 0.0379 and <0.001, respectively). The same type emerged for the Both+late SU group, that is a co-morbid state of several PD:s if having been diagnosed with borderline PD, but interestingly, no corresponding type of co-morbidity emerged for this group regarding antisocial PD. For the group CD+early SU, types were found both for antisocial PD and for borderline PD that when diagnosed with these, they also had been diagnosed with two or more PD:s (associated probability = 0.0463 and 0.0449, respectively). This is of course reasonable since they had indeed been diagnosed with one PD, but it is interesting that these kinds of types were only found for the CD+early SU group and the Both-groups (irrespective of early or late SU) and not for the ADHD-only groups or the groups without any early problems (irrespective of early or late SU).

Discussion

The present exploratory study supports the notion that certain profiles of early onset externalizing problem aggregation, and their internal synergy, have different impact on patterns of criminality, substance abuse and both Axis I and II psychiatric comorbidity. Since interventions are likely to be more efficient if the individual's total problem patterns, and not only isolated problems, are considered, this is important knowledge. Such early problem profiles may have important implications for how societal crime prevention and substance abuse prevention strategies that target youth as well as treatment strategies for adults can be adapted in

the future to the person's problem profile to improve effectiveness. The contribution of the variable-oriented approach and the person-oriented approach for criminality, substance abuse and psychiatric comorbidity outcomes in adult age in this sample is analysed below, and the synergy between different kinds of early onset behavioural disorders and substance use for developing such outcomes, is discussed.

Criminality and violent behaviours

The variable-oriented analyses indicated that the two Both-groups (i.e., those with both ADHD and CD in combination with either early or late SU debut), as well as the CD+early SU-group, had perpetrated more types of violent crimes compared to the other groups of young violent offenders. Hence, the ADHD/CD-groups and the CD+early SU group had higher scores regarding criminal versatility, which is in line with previous research both on impulsivity and antisocial identification (Giancola, 2013; Moffitt, 2018). Regarding lifetime history of aggression and antisocial behaviours a similar pattern was found, where these three groups had the highest LHA total scores. Nevertheless, all the significantly higher total score differences were in fact only related to the two Both-groups, and in three out of the four obtained group differences, the Both + early SU-group had a significantly higher LHA total score than groups with no early problems, only ADHD or only CD. Specifically, regarding aggression (LHA, subscale Aggression), the same pattern of higher levels of aggression was found in groups who had an early SU, or had a combined ADHD and CD (i.e., "Both"-groups). Violent behaviour has been extensively linked to alcohol consumption (see Giancola, 2013), and in line with this research, it is interesting to note that all groups with comparatively high LHA total scores had an early SU debut. However, it is also important for future research to note that, although with somewhat less impact, to have both ADHD and CD in this group may generate similar levels of aggressive behaviour despite not having an early SU. The findings are in line with considering these problem areas on a common spectrum, such as the externalizing spectrum (Krueger et al., 2005; Krueger et al., 2007).

In the person-oriented analysis of criminality profiles, two similarities between the two groups with both ADHD and CD and the CD+early SU group was found. It was more common than expected that these three groups had (a) committed several violent crimes before the present sentence, and (b) had committed the same types of crimes, a combination of physical assault, threats and robbery. This underscores the previously noted similarity regarding criminality patterns between the "Both"-groups and the CD + early SU group, which the person-oriented Exacon analysis supported. Furthermore, the person-oriented CFA of criminality indicated two significant types in this sample of young violent offenders. The first consisted of a higher prevalence than expected of having perpetrated a combina-

tion of murder, sex crimes and arson among persons with both CD and ADHD + early SU. The other type was found in the group with CD + late SU, where more persons than expected had perpetrated sex crimes and arson. Since these types included few persons ($n < 5$) and these types were only found in the CFA and not in the Exacon analyses, these types should be interpreted with caution. However, these types could nonetheless be interesting findings due to the Exacon results of an antitype for sex crimes being committed in combination with robbery within the ADHD+late SU group (i.e., a group which differed in many respects from the Both-groups and the CD-groups) while the CFA types of the Both-groups and the CD+late SU group included sex crime in combination with other violent interpersonal crimes that did not include monetary gain. This pattern merits further investigation, tentatively with a focus on how CD (i.e., the common denominator between these two groups with a CFA-type that typically included sex crime in combination with other interpersonal violence not including monetary gain) and degree of impulsivity, or disinhibition, affects these persons' behaviour regarding interpersonal violence. Specifically for the CD group, early SU debut was associated with a broader range of violent criminal activity, whereas late SU debut in the CD group may be overrepresented regarding having committed a combination of sex crimes and arson, which could indicate a particular personality disorder profile in the CD+late SU-group. However, it is unclear from the present results what might have caused such eventual differences in developmental trajectory for the persons with CD, since the Both-groups (regardless of SU-debut) and CD+early debut group were more similar in other respects. Taken together, this picture of criminality patterns given by the variable-oriented and the person-oriented analyses indicate that the most important subgroups to focus on when investigating interventions for persons with high risk for varied criminality and higher levels of other-directed aggressive behaviour consist of (a) persons with comorbid ADHD+CD (regardless of SU debut age) and with (b) CD+early SU. These groups were similar in how their violent behaviour were expressed, both regarding aggressive behaviours, criminal versatility and typical patterns of violent crime. This should be considered when developing interventions, and more focused social and psychiatric interventions in an early age for these groups might be used to hinder, or perhaps even halt, the development of violent criminality for persons with early co-morbid ADHD+CD and CD+early SU.

Substance use disorders and extremely destructive abuse in adult age

The variable-oriented analysis showed that the age of onset of using other kinds of substances was related to age of onset for alcohol. Especially for cannabis, all significant group comparisons showed a lower age of onset in cannabis for early SU groups compared to late SU groups. This

may indicate a problem aggregation, perhaps parallel use of alcohol and cannabis, which was not apparent for stimulants and sedatives. For sedatives as well as stimulants, the pattern instead suggested specific similarities between the Both+early SU and the CD+early SU groups in which the age of onset were lowest, 16 years. However, and interestingly not in line with the above described criminality and aggression, it was the Both+late SU group that had significantly higher age of onset and not the non-problem groups. This significantly higher age of onset despite an ADHD+CD comorbidity, and the fact that only 18% in this group had an extremely destructive substance abuse in adult age compared to their counterparts with early SU debut, could indicate that late SU debut may be a protective factor for this group or that some factor makes these persons less inclined to start and/or continue substance use. Either way, this merits further investigation.

The person-oriented analyses of SUD-patterns lacked types/antitypes. This may be due to a ceiling effect, that too many in this sample fulfilled criteria for more than two SUDs, the prevalence was >50% in every group. However, the prevalence pattern indicated that early SU and broader early problem profiles was related to more comprehensive SUD profile regarding variability since persons with Both+early SU had the highest prevalence (95%), CD+early SU (86%) the second highest, and Both+late SU (83%) the third highest prevalence of two or more SUD diagnoses. Regarding gravity of substance abuse, the group profiles showed that an early age onset of alcohol use was consistently related to a higher prevalence of extremely destructive substance abuse, since the groups with early onset had between >11.5%-29% higher prevalence than their late SU onset counterpart.

In sum, the combined methodological approach regarding SUD underline early problem aggregation and that such effects hold over time for these persons. These persons had more often tried cannabis before age 15 and displayed multiple forms of substance abuse (often characterized as extremely destructive) as young adults. Also, multiple substance use disorders were the rule rather than the exception in this sample of young violent offenders, which is important to note for legal practitioners as well as those responsible for psychiatric treatment and prosocial rehabilitation within correctional institutions, since substance abuse is an important risk factor for relapse in violent criminal behaviour (Boden et al., 2012; Fazel et al., 2009; Douglas et al., 2013; Pulay et al., 2008).

Psychiatric comorbidity

The variable-oriented analyses indicated problem aggregation in adult age, since the group with Both+early SU had more Axis I-diagnoses than the Nothing+late SU group. Also, the Both+early SU group had more Axis I disorders than groups with a more "niched" antisocial PD profile, characterized by only CD or CD+early SU as youths. This

is in line with previous research on antisocial PD, indicating that this group manifests fewer psychiatric symptoms and at least on the surface seems to have few psychiatric problems. Conversely, the groups with ADHD and comorbid ADHD/CD manifested a broader array of psychiatric symptoms, mirrored in more Axis I-disorders within the variable-oriented analyses.

Person-oriented analysis showed, not surprisingly, that in the present sample of young violent offenders, antisocial PD was the most prevalent PD diagnosis. However, among the subgroups with CD and comorbid ADHD/CD it was also more common to be diagnosed with two or more co-morbid PDs than among the other subgroups (18-31% in these groups, 0% in the remaining groups). Hence, these results indicate that personality problems in these subgroups cannot solely be attributed to a “continuation” of youth CD into adult antisocial PD, since they entailed a problem aggregation and a broadening of personality problems in adulthood for approximately 20% of the individuals in these two groups. This is in line with the conclusion of Stattin and Magnusson (1996), as well as the notion of heterotypical continuation, as opposed to homotypical continuation, which describes persons who are broadening their flora of problem patterns rather than solely continue to have the same kind of problem.

Furthermore, a CFA type was found in the Both + early SU-group, where more persons than expected as adults manifested all investigated kinds of psychiatric diagnoses (i.e., antisocial PD, borderline PD, two or more manifested PDs and anxiety disorder). These results can be considered stable since they were confirmed with Exacon analyses and highlight not only a higher degree of psychiatric co-morbidity in these groups in line with an assumption of aggregated problems in the Both-groups, but also a broader personality disorder profile in the personality disorder B-cluster of the CD-group when early SU is present. Hence, only in the groups with (a) both ADHD/CD and (b) CD + early SU a typical comorbidity was found in a broader PD spectrum involving borderline PD and/or antisocial PD, a finding that warrants further investigation.

It is also interesting that comorbid anxiety disorder and antisocial PD was only typical for the Both + early SU-group and not for the CD-group, which also can be an indicator of a broader problem spectrum being prevalent in the Both + early SU-group, not only pertaining to several PD characteristics but also anxiety disorders. This supports the notion of problem gravitation (Stattin & Magnusson, 1996) in this sample, meaning that it is more common for persons with early problem aggregation to be the same persons who display a wide range psychiatric comorbidity in adult age. Hence, in the present study, problem gravitation was indicated for DSM Axis I and II, specifically for anxiety disorders, SUD, and for having had extremely destructive substance abuse. Another interesting finding regarding psychiatric comorbidity in this sample was that adult anxiety disorder was only the most prevalent pattern

among persons in the Nothing + early SU and the ADHD + early SU-groups, but also typical for persons in the Both + early SU-group provided they had comorbid antisocial PD. Whether the higher prevalence of anxiety disorder in these groups preceded their early onset alcohol use, or if the anxiety was an effect of their substance use, warrants further investigation. Nevertheless, since these groups' figures regarding presence of SUD did not differ, a higher prevalence of anxiety preceding SU could hypothetically be anticipated.

A potential explanation for the variable-oriented results is that, despite presence of CD, persons with comorbid ADHD/CD might experience more psychological distress. However, this result regarding CD was nuanced by the CFA, indicating that persons with CD + early SU in addition to an adult diagnosis of antisocial PD, also were overrepresented regarding diagnosed borderline PD. This is interesting and could indicate that the personality traits of unstable self-image and mood with relationship difficulties are contributing precursors of an early alcohol intake for these persons. It could also indicate that these disorders may increase risk of more comprehensive damage to the developing brain by alcohol, especially for prefrontal areas, which also would contribute to an increased risk of aggressive behaviours (e.g. Hoaken, Giancola & Pihl, 1998; Hyman, 2005, cited in Slade et al., 2007). These comorbid aspects would be interesting to investigate more within the CD group from the perspective of early vs. late onset criminality as well as the LPC/AL distinction (Moffitt, 2018).

Taken together, the results indicate similarities between, on the one hand, persons with no early onset externalizing problem areas and only ADHD, and on the other, persons with CD and comorbid ADHD+CD regarding aggregated psychiatric symptomatology (Axis I), including SUD, and personality disorders (Axis II). The patterns seemingly support the idea of such an “exponential increase” rather than a steady and cumulative increase in risk for each new risk factor added to a person’s profile. Stattin and Magnusson (1996) showed that even though one risk factor or two can be detrimental for a person, it is more often the multitude of disability, the range of problem areas, as well as a problem aggregation or a heterotypical continuation, that sharply elevates risk for both long term repetitive criminal activity and for substance abuse.

Individual developmental trajectories: Their investigation and treatment

The present results are in line with those from previous studies regarding an increased risk for continued problems in adult age due to early onset psychiatric problems as well as criminality (Stattin & Magnusson, 1996; Moffitt, 2018). Also, our results add that it is indeed the same persons with early problem aggregation that continue to display problems in several areas as young adults. That it is indeed the same persons who display several problem areas in early

age that display larger breadth of problems in young adult age regarding psychiatric comorbidity, more varied and severe substance abuse as well as violent criminality, is important. In their multi-method study, Stattin and Magnusson (1996) came to the same conclusions regarding the development of antisocial behaviour. They showed that associations between similar early age risk variables as used in the present study (e.g., hyperactivity, early oppositional behaviour, early SU) and later problem behavior outcome (i.e., criminality and substance abuse in adult age) disappear when these early multi-risk persons have been excluded from the variable-oriented analyses. Methodologically, this emphasizes the importance of not only considering variables and relying on mean values when investigating these groups since mean values may be heavily influenced by the inclusion of “multi-risk factor persons”, and it may in fact be the co-existence or synergy between several factors in a certain person’s psychiatric profile that elevates the risk, not the variable in itself.

Comparing the present results to those of Moffitt (2002; 2018) and the separation of LCP from AL criminality, the current sample were in many respects similar to the LCP-group described by Moffitt (e.g., neuropsychiatric problems; undercontrolled temperament, severe hyperactivity, psychopathic personality traits, violent behavior). In line with Moffitt (2018), the most important result in the present study is the indication of a multitude of childhood problems, and a maintained and often broadened, psychiatric comorbidity seen among these persons as they enter young adulthood. Similar markers for LCP criminality consisting of externalizing problems in childhood and young adulthood, as outlined by Moffitt (2018), in a variable-oriented approach and by Stattin and Magnusson (1996) in a person-oriented approach, were found among persons in the present sample who as young adults developed a broad spectrum of psychiatric problems, higher level of aggression and a more violent and varied criminal history. The second most important result worthy of note in the present study is that among these young violent offenders, complex comorbidity and problem aggregation over time was the overwhelming norm, not the exception as in studies of normal population samples.

Consequences for intervention planning. The results from the present study illustrate the dire need for psychiatric treatment in this group, but also that this treatment must be initiated early in life, be comprehensive and have a long-term focus, while taking individual patterns of comorbidity into account. However, a clear general treatment focus for this group was SUD, a major risk factor both for relapse in violent crime and worsening of psychiatric problems (e.g., Pickard & Fazel, 2009), emphasizing the importance of devising effective and efficient treatments of the complex SUD and frequently very destructive substance abuse that this sample displayed. From a methodological perspective, the results also indicate that when deciding interventions in general, a focus on individual pat-

terns of comorbidity is at least as important as a focus on the degree to which certain risk factors are present. From what we know about comorbidity and treatment success when personality disorder (Benjamin, 2006) or SUD (SAMHSA, 2012) is present, it should be evident that although general programs targeting specific symptoms or risk factors could have a certain effect, they would have less effect on this multi-risk subgroup and instead have to be complemented with other treatment interventions tailored to each individual’s co-morbid profile. They would also require a substantial amount of executive help and considerably more in-depth follow-up procedures than for offenders without such a broad comorbid profile.

Limitations and future directions

A strength of the present study was that the data originated from a multi-method clinical assessment procedure including data from multiple sources. However, as previously noted, one limitation was that the present sample included small cell counts ($n < 5$) in some of the investigated groups. Such small subgroups limit the possibility to generalize from these results and it is also possible that some types/antitypes have been missed in the present study due to the small subgroup sizes in question. Another limitation was that some of the observed types were unstable (i.e., found in CFA but not confirmed in corresponding Exacon analysis). Due to these limitations, the present results, especially regarding patterns of criminality, need replication in future research based on more participants, but could be used as an exploratory starting point for such studies.

Furthermore, regarding the measure of criminality used in the present study, one limitation was that persons in this sample could have committed previous crimes without having been sentenced and therefore not included in their criminal record. Also, despite the use of different methodological approaches to further enhance the explanatory value of the present results, the present study was cross-sectional and the early onset factors used can still only be thought of as markers for the presented subsequent patterns in criminality, SUD and psychiatric comorbidity. As with any other cross-sectional study design, as well as prospective variable-oriented or person-oriented designs, the effect of the markers used may not be the cause themselves, but a result of an underlying factor or an interaction from which the present study only captured one factor. However, the purpose of combining variable- and person-oriented methods in the present study was to delve deeper into this spectrum (i.e. ADHD, CD and SU) and investigate whether previous variable-oriented results also hold from a person-oriented perspective where the “whole person” is considered simultaneously as the degree of impact of risk factors for different diagnostic subgroups.

Future research using prospective designs and qualitative interview methods (including the use of personality measures) could focus on why some persons within the CD

group as well as the comorbid ADHD+CD group had an early SU debut. Such studies could provide information relevant to the question whether their early SU was due to availability (e.g., at home or among their peers), certain kinds of peer-association (see Moffitt, 2018), increased sensation seeking, decreased neuroticism, or other kinds of personality features that motivated them to try substances at an earlier age compared to late SU debut counterparts – and also to the question how aspects such as comorbid psychiatric problems might explain differences in criminal patterns.

It is important that, although the present study highlights the need for individualized and comprehensive psychiatric treatment and crime prevention, both in early childhood and as young adults, it does not support a deterministic approach regarding a continued criminal behavior for all these individuals (see Moffitt, 2018). Based on these results, there is no telling how many within the general population who display these multi-risk profiles but do not display criminal behaviour or substance abuse. In other words, it does not say who among the original population sample with these early problems that has managed to take another developmental path. Other promising avenues for future research is to capture how alternative paths are taken, and to discover protective factors and how these are utilized by persons with a psychiatric comorbidity but who do not engage in criminality.

Conclusions

The variable-oriented and the person-oriented methodological approaches contributed with different, and important, aspects of information to understand patterns of criminality, SUD, and psychiatric comorbidity among young violent offenders. A general conclusion from this study supports previous assumptions of problem gravitation and aggregation, and early multi-problem profiles were considerably more prevalent among those young adults with the most diverse violent criminal history, SUD and psychiatric problems. Related to this was the general pattern of an aggravated, psychiatric comorbidity over time for this group. Furthermore, not only early onset psychiatric problems and substance abuse is of importance to note in screening for the need of early interventions, but also early substance use, especially for persons with only CD. Early SU was associated with considerably worse outcomes in the CD groups. If interventions should have a significant effect in this group of young violent offenders, they cannot be aimed at more shallow information campaigns (e.g., in schools or informing parents). To be effective, they must be individually targeted, coordinated with the person's other interventions and closely followed up, since the nature of these early problems often entail problems with attention, memory and impulsivity, making it hard to follow through on interventions without external support. Although this task may seem daunting, the very small size of this early

problem aggregation group within the population could actually make such comprehensive interventions possible if early and in-depth screening methods are applied. In conclusion, this study supports previous research that so often has argued for the importance of early interventions that might, if not halt than at least hinder the kind of negative developmental trajectory of early problem aggregation seen in this sample of young adult violent offenders.

Declaration of interests

The authors declare that there is no conflict of interest.

Author contributions

MHK designed the study, carried out the statistical calculations, drafted the first version of the manuscript and collaborated in the subsequent revision process of the manuscript. TN and BH participated in designing the study, interpreting the statistical findings and aided in the draft of the first version of the manuscript. They both also collaborated in the subsequent revision process of the manuscript. BH, MW and EB organized the data collection and collaborated in the revision of the manuscript until the final version was created. All authors read and approved the final manuscript.

Action editor

Lars-Gunnar Lundh served as action editor for this article.

References

- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (5th Ed)*. Washington, DC: American Psychiatric Association.
- American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders TR-IV*. Washington, DC: American Psychiatric Association.
- Benjamin, L. S. (2003). *Interpersonal diagnosis and treatment of personality disorder*. Guilford press, New York
- Benjamin, L. S. (2006). *Interpersonal reconstructive therapy*. Guilford Press, New York.
- Bergman, L., Magnusson, E., & El Khouri, B. (2003). *Studying individual development in an interindividual context*. Lawrence Erlbaum Associates. London.
- Billstedt, E., Anckarsäter, H., Wallinius, M., & Hofvander, B. (2017). Neurodevelopmental disorders in young violent offenders: overlap and background characteristics. *Psychiatry Research*, 252, 234-241. <https://doi.org/10.1016/j.psychres.2017.03.004>
- Boden, J. M., Fergusson, D. M., Horwood, L. J. (2012). Alcohol misuse and violent behaviour: findings from a 30-year longitudinal study. *Drug and Alcohol Dependence*, 122, 135-141. <https://doi.org/10.1016/j.drugalcdep.2011.09.023>.
- Bornstein, R. F., (2017). Evidence-based psychological assess-

- ment, *Journal of Personality Assessment*, 99, 435-445.
<https://doi.org/10.1080/00223891.2016.1236343>
- Brown, G. L., Ebert, M. H., Goyer, P. F., Jimerson, D. C., Klein, W. J., Bunney, W. E., & Goodwin, F. K. (1982). Aggression, suicide, and serotonin: Relationships to CSF amine metabolites. *The American Journal of Psychiatry*, 139, 741-746.
<https://doi.org/10.1176/ajp.139.6.741>
- Carpentier, P.-J., Knapen, L. J. M., van Gogh, M. T., Buitelaar, J. K., & De Jong, C. A. (2012). Addiction in a developmental perspective: Influence of conduct disorder severity, subtype and attention-deficit hyperactivity disorder on problem severity and comorbidity in adults with opioid dependence. *Journal of Addictive Diseases*, 31, 45-59.
<https://doi.org/10.1080/10550887.2011.642756>
- Center for Substance Abuse Treatment (2005). *Substance Abuse treatment for Adults in the Criminal Justice System*. Treatment Improvement Protocol (TIP) Series 44. HHS Publication No. (SMA) 13-4056. Rockville, MD: Substance Abuse and Mental Health Services Administration.
- Coccaro, E. F., Berman, M. E., & Kavoussi, R. J. (1997). Assessment of life history of aggression: development and psychiatric characteristics. *Psychiatry Research*, 73, 147-157.
<https://doi.org/10.1176/ajp.139.6.741>
- Dalteg, A., Zandelin, A., Tuninger, E. & Levander, S. (2014). Psychosis in adulthood is associated with high rates of ADHD and CD problems during childhood. *Nordic Journal of Psychiatry*, 68, 560-566.
<https://doi.org/10.3109/08039488.2014.892151>
- Dogan, I., & Dogan, N. (2016). Configural frequency analysis as a statistical tool: A review. *Turkiye Klinikleri Journal of Biostatistics*, 8, 172-179. <https://doi.org/10.5336/biostatic.2016-51363>
- Douglas, K.S., Hart, S. D., Webster, C. D., & Belfrage, H. (2013). *HCR-20V3 Bedömning av risk för våld – Användarmanual*. Mental Health, Law and Policy Institute, Simon Fraser University.
- Dubow, E. F., Boxer, P. & Huesman, L. R. (2008) Childhood and adolescent predictors of early and middle adulthood alcohol use and problem drinking: The Columbia County Longitudinal Study. *Addiction*, 103, 36-47.
<https://doi.org/10.1111/j.1360-0443.2008.02175x>
- Elkins, I. J., McGue, M., & Iacono, W. G. (2007). Prospective effects of attention-deficit hyperactivity disorder, conduct disorder and sex on adolescent substance use and abuse. *Archives of General Psychiatry*, 64, 1145-1152.
<https://doi.org/10.1001/archpsyc.64.10.1145>
- Englund, M. M., Egeland, B., Oliva, E. M., & Collins, A. (2008). Childhood and adolescent predictors of heavy drinking and alcohol use disorder in early adulthood: A longitudinal developmental analysis. *Addiction*, 103, 23-35.
<https://doi.org/10.1111/j.1360-0443.2008.02174.x>
- Falk, Ö., Wallinius, M., Lundström, S., Frisell, T., Anckarsäter, H., & Kerekes, N. (2014). The 1% of the population accountable for 63% of all violent crime convictions. *Social Psychiatry and Psychiatric Epidemiology*, 49, 559-571.
<https://doi.org/10.1007/s00127-013-0783-y>
- First, M. B. (1997a). *User's guide for the Structured Clinical Interview for DSM-IV axis II personality disorders: SCID-II*. American Psychiatric Press; Washington, DC.
- First, M. B. (1997b). *User's guide for the Structured Clinical Interview for DSM-IV axis I disorders: SCID-I*. American Psychiatric Press; Washington, DC.
- Giancola, P. R. (2013). Alcohol and aggression: Theories and mechanisms. In M. McMurrin (Ed.), *Alcohol related violence: Prevention and treatment* (pp: 37-59). Wiley-Blackwell: Chichester.
- Guldager, S., Holm Linneberg, I., & Hesse, M. (2011). Order of age at onset for substance use, substance use disorders, conduct disorder and psychiatric illness. *Mental Health and Substance Use*, 5, 73-84. <https://doi.org/10.1080/17523281.2011.616178>
- Gustavson, C., Ståhlberg, O., Sjödin, A. K., Forsman, A., Nilsson, T., & Anckarsäter, H. (2007). Age at onset of substance abuse: a crucial covariate of psychopathic traits and aggression in adult offenders. *Psychiatry research*, 153(2), 195-198.
<https://doi.org/10.1016/j.psychres.2006.12.020>
- Hoaken, P. N. S., Giancola, P. R., & Pihl, R. O. (1998). Executive functions as mediators of alcohol-related aggression. *Alcohol and Alcoholism*, 33, 47-55.
<https://doi.org/10.1093/oxfordjournals.alcal.a008347>
- Hofvander, B., Anckarsäter, H., Wallinius, M., & Billstedt, E. (2017). Mental health among young adults in prison: The importance of childhood-onset conduct disorder. *BJPpsych Open*, 3(2), 78-84. <https://doi.org/10.1192/bjpo.bp.116.003889>
- Knop, J., Penick, E. C., Nickel, E. J., ... & Gabrielli, W. F. (2009). Childhood ADHD and conduct disorder as independent predictors of male alcohol dependence at age 40. *Journal of Studies on Alcohol and Drugs*, 70, 169-177.
<https://doi.org/10.15288/jsad.2009.70.169>
- Kotov, R., Watson, D., Bagby, R. M., (...) & Zimmerman, M. (2017). The Hierarchical Taxonomy of Psychopathology (HiTOP): A Dimensional Alternative to Traditional Nosologies. *Journal of Abnormal Psychology*, 126, 454-477.
<https://doi.org/10.1037/abn0000258>
- Krueger, R. F., Markon, K. E., Patrick, C. J., & Iacono, W. G. (2005). Externalizing psychopathology in adulthood: a dimensional-spectrum conceptualization and its implications for DSM-V. *Journal of Abnormal Psychology*, 114(4), 537.
<https://doi.org/10.1037/0021-843X.114.4.537>
- Krueger, R. F., Markon, K. E., Patrick, C. J., Benning, S. D., & Kramer, M. D. (2007). Linking antisocial behavior, substance use, and personality: an integrative quantitative model of the adult externalizing spectrum. *Journal of Abnormal Psychology*, 116(4), 645. <https://doi.org/10.1037/0021-843X.116.4.645>
- McGue, M., Iacono, W. G., Legrand, L. N., Malone, S., & Elkins, I. (2001). Origins and consequences of age at first drink. I. Associations with substance-use disorders, disinhibitory behavior and psychopathology, and P3 amplitude. *Alcoholism: Clinical and Experimental Research*, 25, 1156-1165.
[https://doi.org/10.1045-6008/01/2508-1156\\$03.00/0](https://doi.org/10.1045-6008/01/2508-1156$03.00/0)
- Marshal, M. P., & Molina, B. S. (2006). Antisocial behaviours moderate the deviant peer pathway to substance use in children with ADHD. *Journal of Clinical Child and Adolescent Psychology*, 35, 216-26.

- https://doi.org/10.1207/s15374424jccp3502_5
- Moffitt, T. E., Caspi, A., Harrington, H., Milne, B. J. (2002). Males on the life-course-persistent and adolescent limited antisocial pathways: Follow-up at age 26 years. *Development and Psychopathology*, *14*, 179-207.
<https://doi.org/10.1017/S0954579402001104>
- Moffitt, T. E. (2018). Male antisocial behaviour in adolescence and beyond. *Nature Human Behavior*, *2*, 177-186.
- Pickard, H. & Fazel, S. (2009). Substance abuse as a factor for violence in mental illness: Some implications for forensic psychiatric practice and clinical ethics. *Current Opinion in Psychiatry*, *26*, 349-354.
<https://doi.org/10.1097/YCO.0b013e328361e798>
- Pulay, A. J., Dawson, D. A., Hasin, D. S., et al (2008). Violent behaviour and DSM-IV psychiatric disorders: results from the national epidemiologic survey on alcohol and related conditions. *Journal of Clinical Psychiatry*, *69*, 12-22.
<https://doi.org/10.4088/jcp.v69n0103>
- Roy, A. (2008). The relationship between attention-deficit hyperactivity disorder (ADHD), conduct disorder (CD) and problematic drug use (PDU). *Drugs*, *15*, 55-75.
<https://doi.org/10.1080/09687630701489481>
- Schrepp, M. (2006). The use of configural frequency analysis for explorative data analysis. *British Journal of Mathematical and Statistical Psychology*, *59*, 59-73.
<https://doi.org/10.1348/000711005X66761>
- Slade, E. P., Stuart, E. A., Salkever, D. S., Karakus, M., Green K. M., Ialongo, N. (2007). Impacts of age of onset of substance use disorders on risk of adult incarceration among disadvantaged urban youth: A propensity score matching approach. *Drug and Alcohol Dependence*, *95*, 1-13.
<https://doi.org/10.1016/j.drugalcdep.2007.11.019>
- Stattin, H. & Magnusson, D. (1996). Antisocial development: A holistic approach. *Development and Psychopathology*, *8*, 617-645. <https://doi.org/10.1017/S0954579400007331>
- Stemmler, M., & Heine, J-H. (2017). Using Configural Frequency Analysis as a person-centered analytic approach with categorical data. *International Journal of Behavioral Development*, *41*, 632-646. <https://doi.org/10.1177/0165025416647524>
- Substance Abuse and Mental Health Services Administration (SMHSA) (2013). Substance Abuse Treatment for Persons With Co-occurring Disorders. Treatment Improvement Protocol (TIP) Series, No. 42. HHS Publication No. (SMA) 133992. Rockville, MD: Substance Abuse and Mental Health Services Administration.
- Vargha, A., Torma, B., & Bergman, L. (2015). ROPstat: A general statistical package useful for conducting person-oriented analysis. *Journal of Person-Oriented Research*, *1*, 87-98.
<https://doi.org/10.17505/jpor2015.09>
- Wallinius, M., Billstedt, E., Nilsson, T., Anckarsäter, H., Delfin, C., Hofvander, B. (2016). Offenders in emerging adulthood: School maladjustment, childhood adversities, and prediction of aggressive antisocial behaviours. *Law and Human Behavior*, *40*, 551-563. <https://doi.org/10.1037/lhb0000202>
- Wilens, T. E., & Biederman, J. (2006). Alcohol, drugs, and attention-deficit/hyperactivity disorder: a model for the study of addictions in youth. *Journal of Psychopharmacology*, *20*, 580-588. E-publ. <https://doi.org/10.1177/0269881105058776>
- Wilson, H. W, Stover, C. S, Berkowitz, S. J. (2009). Research review: the relationship between childhood violence exposure and juvenile antisocial behavior: a meta-analytic review. *Journal of Child Psychology and Psychiatry* *50*, 769-779.
<https://doi.org/10.1111/j.1469-7610.2008.01974.x>
- van Emmerik-van Oortmerssen, K., van de Glind, G, Koeter, M. W., ... & Schoevers, R. A. (2014). Psychiatric comorbidity in treatment-seeking substance use disorder patients with and without attention deficit hyperactivity disorder: Results of the IASP study. *Addiction*, *109*, 262-272.
<https://doi.org/10.1111/add.12370>
- von Eye, A., Bergman, L. R., Hsieh, C-A. (2015). Person-oriented methodological approaches. In: R.M. Lerner (Ed.) *Handbook of Child Psychology and Developmental Science 7th Ed. Vol. 1: Theory and Method*. John Wiley & Sons, Inc.
<https://doi.org/10.1002/9781118963418.childpsy121>
- Young, S., Gudjonsson, G. H., O'Roure, L., Woodhouse, E., Ashwood, K., Murphy, D., & Asherson, P. (2015). Attention-deficit-hyperactivity disorder and associated functional impairments in mentally disordered offenders. *Psychiatry Research*, in press.
<https://doi.org/10.1016/j.psychres.2015.09.024>