

Aggressive Antisocial Behavior: Risk Factors and Personality Profile

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UNIVERSITY OF GOTHENBURG

Gothenburg 2016

Cover illustration: Arrows by Pia Moberg

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ISBN 978-91-628- 9958-5 (Print)

ISBN 978-91-628- 9957-8 (PDF)

Printed in Gothenburg, Sweden 2016

Ineko

Evil is knowing better, but willingly doing worse

- Philip Zimbardo

The only thing necessary for the triumph of evil is for good men to do nothing.

- Edmund Burke

Better to do something imperfectly than to do nothing perfectly.

- Robert H. Schuller

To my family, friends and colleagues

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ABSTRACT

Background: There is an increasing knowledge that violent criminality is restricted to a group of individuals with early onset of behavioral problems. These problems often emerge in combination with substance abuse and evolve into an antisocial personality disorder when the individual reaches adulthood. This type of multifaceted problem can be defined as aggressive antisocial behavior (AAB).

Aim: The aims of this thesis were to determine the occurrence of AAB in the Swedish nation-wide general population, investigate the risk factors of AAB, identify the personality profile of individuals with AAB, and study the association between personality traits and level of AAB.

Methods and results: In a Swedish register study on violent crime convictions (1973–2004), including 2.5 million individuals, 4 % of the population was convicted at least once for a violent crime (AAB), of which almost one in four were persistent. They were characterized by male gender (90 %), early onset of criminality, personality disorders, substance use disorders, and a high rate of criminal recidivism. In two cross-sectional prison studies all study groups showed a common personality pattern, as measured by the Temperament and Character Inventory, deviating highly from the general population. Females were more deviant than males, and showed evidence of a stronger association between their personality and measures of trait aggression. A similar pattern in 9 and 12 year old children with AAB was found in a register study of Swedish twins, but with less pronounced gender differences. A salient pattern of low character maturity (Self-Directedness and Cooperativeness) combined with an extreme temperament (high Novelty Seeking and low Reward Dependence) emerged in all groups, where impulsiveness, sensation seeking and disorderliness together with detachment, insensitivity and independence from others were associated to AAB.

Conclusion: A mature character with strong self-governance and capability to meaningfully cooperate with others emerged as important protective factors against AAB, why these personality traits appears to be promising targets for interventions.

Keywords: Aggressive Antisocial Behavior, Life History of Aggression, Risk Factors, Personality, Character, Temperament and Character Inventory, Gender

ISBN: 978-91-628- 9958-5 (Print)

SAMMANFATTNING PÅ SVENSKA

Denna avhandling undersöker de individer, både på samhällsnivå och bland fängelsedömda, som dömts för allvarlig kriminalitet, i många fall i form av upprepad våldskriminalitet. Dessa personer utmärks av ett *aggressivt antisocialt beteende* (AAB). Vilket här definieras av att man vid något tillfälle dömts för våldsbrott och att man för övrigt har en kriminell livsstil med olika typer av brottsdomar. Denna grupp av AAB individer har en hög benägenhet att återfalla i vålds- och annan brottslighet, där nästan 50 % av denna population återfaller i våldsbrott igen efter sin första våldsbrottsdom.

AAB-gruppen består huvudsakligen av män (ca 90 %) som kännetecknas av en tidig debut i aggressivt beteende, kriminalitet och missbruk, hög förekomst av personlighetsstörningar och annan psykisk ohälsa, samt många fall av oavslutad grundskoleutbildning. De som diagnosticerats med en allvarlig psykisk störning så som schizofreni eller bipolär affektiv sjukdom, utgör en liten andel av alla som vid något tillfälle blir dömda för våld (ca 2,5 %). Det vanligaste problemet i gruppen av AAB individer är missbruksproblem och drogrelaterad brottslighet, där ca 20 % har en missbruksdiagnos och 35 % är dömda för drogrelaterad brottslighet. Personlighetsstörningar som diagnostiserats i samband med inneliggande sjukhusvård förekommer hos drygt 2,5 % av dessa individer. Det är lågt jämfört med andra fängelsstudier (ända upp till 40 – 50 %) men högt jämfört med befolkningen där det förekommer hos enbart 0,4 %.

Ett skattningsinstrument för personlighet som lämpar sig väl för att diagnosticera bl.a. personlighetsstörningar är *Temperament and Character Inventory* (TCI). Det baseras på en psyko-biologisk modell som består av 4 temperamentsdimensioner, vilka är relaterade till typ av störning, och av tre karaktärsdimensioner som är relaterade till störningens allvarlighetsgrad. I en grupp av våldsbrottsdömda unga män och en grupp med fängelsedömda män och kvinnor med blandad brottslighet, fann man ett tydligt personlighetsmönster med ett extremt temperament i kombination med mycket låg karaktärsmodnadsgrad. Ett liknande personlighetsmönster hittades bland barn 9 och 12 år gamla med uppförandestörningsproblem. Det som är utmärkande för denna personlighetsprofil är dess överlag låga grad av karaktärsmodnadsgrad, med förekomst av apati, avsaknad av livsmål, opålitlighet, socialt ointresse, hämndlystnad, låg grad av omsorg om andra, impulsivitet och sensationsökande.

Karaktärsmodnadsgrad har en stark koppling till AAB och diskuteras närmare i denna avhandling. I fortsatta studier bör man undersöka möjligheterna till en riktad behandling avsedd att öka karaktärsmodnadsgraden hos de med AAB. Både i form av tidiga insatser riktade mot unga i riskzonen för att utveckla AAB och till vuxna med manifesterade AAB problem, vilket skulle kunna leda till en minskad brottsbenägenhet och en reducerad återfallsrisk.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

- I. Falk Ö, Wallinius M, Lundström S, Frisell T, Anckarsäter H, Kerekes N (2013) “The 1 % of the population accountable for 63 % of all violent crime convictions” *Social Psychiatry and Psychiatric Epidemiology*: 1-13.
doi:10.1007/s00127-013-0783-y
- II. Nilsson T, Falk Ö, Billstedt E, Kerekes N, Anckarsäter H, Wallinius M, Hofvander B (2016) “Aggressive antisocial behaviors are related to character maturity in young Swedish violent offenders independent of ADHD”
(Accepted Oct. 31 2016 in *Frontiers in Psychiatry*).
- III. Falk Ö, Sfindla A, Brändström S, Anckarsäter H, Nilsson T, Kerekes N “Personality and trait aggression profile of male and female prison inmates” (submitted).
- IV. Kerekes N, Falk Ö, Brändström S, Anckarsäter H, Råstam M, Hofvander B “The protective effect of character maturity in child aggressive behavior” (submitted).

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ABBREVIATIONS

AAB	Aggressive Antisocial Behavior
ADHD	Attention Deficit/Hyperactivity Disorder
AQ-RSV	Aggression Questionnaire - Revised Swedish Version
A-TAC	Autism - Tics, AD/HD and other Comorbidities
CATSS	Child and Adolescent Twin Study in Sweden
CD	Conduct Disorder
CO	Cooperativeness
DAABS	Development of Aggressive Antisocial Behavior Study
HA	Harm Avoidance
LHA	Life History of Aggression
MMD	Major Mental Disorders
NDP	Neurodevelopmental problems
NS	Novelty Seeking
ODD	Oppositional Defiant Disorder
PCL-R	Psychopathy Checklist - Revised
PD	Personality Disorders
PS	Persistence
RD	Reward Dependence
SD	Self-Directedness
ST	Self-Transcendence

SUD	Substance Use Disorders
TCI	Temperament and Character Inventory

DEFINITIONS IN SHORT

Aggression	A heterogeneous behavior that involves potential or actual harm to self or to others.
Antisocial behavior	Any action that violates personal or cultural standards for appropriate behavior.
Violence	The physical category of aggressive behavior which manifest itself in the threatened or actual use of physical force or power to physically or psychologically harm another (WHO, 2002).
Personality	The ingrained patterns of thought, feeling, and behavior that characterizes an individual's unique lifestyle and mode of adaptation, and results from constitutional factors, development, and social experience (WHO, 1994).

1 INTRODUCTION

The human suffering and loss of quality of life for violent crime victims (even non-fatal violence) cannot be quantified. The disabilities and long-term physical, psychological, economic, and social consequences constitute a heavy burden on society. Both the direct and indirect costs of violence are enormous. Directly, violence affects health care expenditures. Indirectly, violence has a negative effect on national and local economies, stunting economic development, increasing economic inequality, eroding human and social capital, and increasing law enforcement expenditures (Krug 2002). The costs involved in a single assault, where a victim suffered dental damage, lacerations, minor concussion, including medical costs, loss of income during sick leave, judicial proceedings costs, and so on, have been estimated at between 8,000 and 30,000 Euros (Nilsson 2011).

The study of criminals has a long history, often with an assumption of autonomy, where personal responsibility for one's actions has been a cornerstone. It wasn't until the 19th century that the studies of Lombroso shifted the focus towards a more scientific approach where the cause of criminal behavior was biological factors (Nelson and Trainor 2007, Siever 2008). Even today, however, much remains unknown about the relation between complex behaviors, such as anti-sociality, and factors such as mental health problems, neurobiology, structural differences of the brain, etc. (Scarpa and Raine 1997, Raine 2013, Ribeiro, Fernandes et al. 2016).

1.1 Crime statistics

The most recent official international report on violence in the world is already a decade and a half old (Krug 2002). It found that 1.6 million people are killed every year worldwide, approximately 550,000 due to interpersonal violence. A contemporary report, from the World Health Organization (WHO), visually displayed the number of deaths caused by interpersonal violence during a year per 100,000 individuals in a country, and provides an index ranging between 0.28 (Japan) and 93.09 (El Salvador) (World Life Expectancy 2016).

According to Pinker (2011) there has been a steady and marked decline in violent crimes and deaths caused by violence from the beginning of mankind up until modern times. But during the last 50 years the decline rate has slowed down or even stopped.

In Sweden, the overall figures of interpersonal violence (assault) between strangers have declined over the last half-century, while other forms of violence have increased somewhat (Färdeman 2014). The rate of deadly violence has been fluctuating steadily, just below 1 death per 100,000 citizens (index 1.00), which is representative of Northern and Western Europe and low in the global context (Färdeman 2014, Trägårdh, Nilsson et al. 2016).

1.2 Aggressive Antisocial Behavior (AAB)

1.2.1 Aggression

The definition of aggression varies across different scientific areas of investigation. One of the latest definitions comes from Anderson and Bushman (2002), who defined human aggression as a behavior directed toward another individual, carried out with the immediate intention to – and a belief that the behavior will – harm the target. They, like many other researchers, have defined aggression as an act aimed at another living organism, while there are definitions of aggression that also include acts aimed against oneself (Gothelf, Apter et al. 1997).

1.2.2 Violence

Violence is the physical category of aggression. Interpersonal violence, which is the main focus of this thesis, is divided according to the WHO's typology (Figure 1). As a further clarification of the definition of violence for the purpose of this thesis, it encompasses any physical action against another that potentially falls under the legal concept of a violent crime from minor offences (for example, violation of another's integrity) to aggravated assaults (such as premeditated murder).

A typology of violence

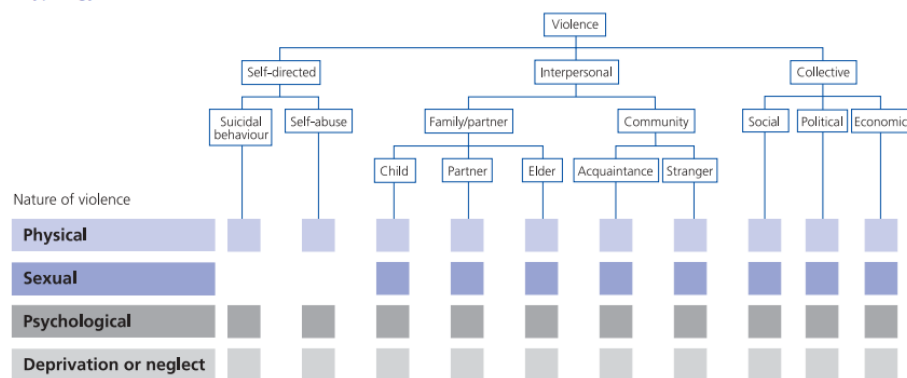


Figure 1. Reprinted typology of violence by WHO (World Health Organization 2001).

1.2.3 Antisocial behavior

Antisocial behavior is generally defined as any action that violates personal or cultural standards of appropriate behavior. This definition of antisocial behavior is not dependent on the violation of any law and therefore does not require that the person in question be held legally responsible for his or her actions. Antisocial behavior can, but does not necessarily have to, include aggression and violent behavior; likewise, aggression or violence does not always have to be considered antisocial (for example, violent acts as a means of self-defense or to uphold public order and law). Besides obvious criminal behavior, antisocial behaviors include lying, substance use, deceit, and similar behaviors often with negative effect on other individuals, the self and/or society. While other norm-breaking behavior, or behavior that some consider odd, such as ignoring dress codes, and talking about provocative topics, sexual preference, are not considered antisocial behavior.

1.2.4 Definition of AAB

Aggressive antisocial behavior (AAB) has previously been defined as any interpersonal behavior that meets the dual criteria of being aggressive and antisocial (Wallinius 2012). In this thesis the definition of AAB is extended to also include children under the age of 15 meeting these criteria.

1.3 Descriptors and covariates of importance to AAB

Several large population-based studies on antisocial behavior have found a close association between AAB and gender, age at debut of criminality, diversity in criminal behavior, mental health problems, and poor socioeconomic circumstances as some of the main factors among several other variables previously studied (Arseneault, Moffitt et al. 2000, Moffitt and Caspi 2001, Moffitt, Caspi et al. 2002, Elonheimo, Niemela et al. 2007, Sourander, Jensen et al. 2007, Elonheimo, Sourander et al. 2009).

1.3.1 Basic demographic factors

1.3.1.1 Socioeconomic factors

There is evidence that socioeconomic discrepancies contribute to homicide rates and level of interpersonal violence (Krug 2002). In countries with low gross domestic product (GDP) and a skewed distribution of wealth, where a small number of people possess the majority of the assets and a large part of the population struggles to afford education, health care and other basic necessities, crime rates often surge (Butchart and Engström 2002).

“The WHO report on violence and health estimates that more than 90 % of all violence-related deaths occur in LMICs¹ (Dahlberg and Krug 2002). The estimated rate of violent death in LMICs was 32.1 per 100,000 people in 2000, compared with 14.4 per 100,000 in high-income countries” (from Rosenberg, Butchart et al. (2006) chapter 40, p. 755).

Other socioeconomic factors that are of importance for crime and violence include lower levels of education or academic failures, unemployment and living conditions (for example marital status, such as not being in a stable relationship).

Although Scandinavia and the majority of Europe are both wealthy and have smaller gaps between the very rich and the relatively poor, the risk of mental health problems, substance use disorders, antisocial behaviors and crime is significantly elevated among the lower social groups (Repetti, Taylor et al. 2002).

¹ Low- and Middle Income Country

Social injustice is an extremely complex issue that is known to promote criminal behavior, such as organized crime (gangs/mafia/drug cartels), aggression, violence, terror acts (Agnew 2001), but this is not within the scope of this thesis. Nonetheless, it should be acknowledged that socioeconomic factors bare a great importance for, and coexist with other individual risk factors for aggressive antisocial behavior.

1.3.1.2 Gender

Among the best-known risk factors for being convicted of a violent crime is male gender. Males are highly over-represented in general criminal behavior as well, with about 70–80 % of such offenders being male (BRÅ 2016). Male offenders have been extensively investigated regarding underlying biological factors for criminal and violent propensity. Biological markers such as testosterone have been a major focus and are believed to be a strong candidate for explaining aggressiveness, but have not been proven to be a strong predictor of violence by themselves (Brain and Haug 1992, Bjorkqvist 1994). Testosterone has been linked to a behavior aimed at domination in social situations, but that is regardless of whether the method used is physical coercion or verbal maneuvering in a more socially accepted manor (Mazur and Booth 1998, Siever 2008). Furthermore, individuals with relatively low levels of testosterone have also been found to be violent. The relative shift in the level of other hormones and neurotransmitters has also been found to play a part in aggressive and violent behavior (Batrinos 2012, Tiihonen, Rautiainen et al. 2015). In a social context, the construct of masculinity has been shown to be an important part in the facilitation of aggressive behavior when there is a lack of appropriate outlets. Thus, a biological underpinning of higher levels of testosterone driving a dominating behavior, combined with a social construct of masculinity where toughness and assertion of respect are promoted, increases the likelihood of violent behavior in interpersonal conflict (Bjorkqvist 1994, Nelson 2005).

1.3.1.3 Age

Age at onset of antisocial behavior has been known for a long time to be a strong predictor of later frequent and diverse criminal behavior (Moffitt and Caspi 2001, Moffitt, Caspi et al. 2002). Peak of onset is considered to begin in mid-adolescence and to be the highest, as well as the most crime active period, between 18 and 22. The age of legal responsibility in Sweden is 15 and no criminal records are produced before that age, which makes it difficult to assess the onset of antisocial or criminal behaviors such as fire setting, school-yard bullying, shoplifting, and destruction of property in the general population before the age of 15. However, admitting that a childhood diagnosis of Conduct Disorder (CD), which is defined by rule-breaking

behaviors that as an adult would be considered criminal, could be used as a proxy for assessing antisocial and/or criminal activity in children. Nevertheless, such a diagnosis is used restrictively because it is widely considered to result in several negative consequences (including social stigma). Therefore, a fairly large group of adolescents are not given the attention they need by society in their disruptive antisocial behavior until they reach the age of legal responsibility. Approximately half of the children diagnosed with CD have a limited adolescent period of disruptive and criminal behavior. The other half have a life course of persistent antisocial behavior and are not discouraged from crime in spite of imprisonment and social and medical interventions (Moffitt and Caspi 2001, Hofvander, Ossowski et al. 2009).

1.3.2 Clinical factors

1.3.2.1 Substance Use Disorders

Alcohol use is one of the well-known major causes for interpersonal violence (Boles and Miotto 2003, Gustavson, Stahlberg et al. 2007). Even sporadic recreational drinking in larger social settings increases the risk of becoming a victim or a perpetrator of interpersonal violence, although the risk is substantially greater if an individual has a substance use disorder. The facilitating effect of alcohol intoxication on aggression and risk of interpersonal violence is undeniable, as is the risk of becoming a victim of interpersonal violence (Grann and Fazel 2004, Pulay, Dawson et al. 2008). The recreational use of other illegal substances and substance use disorders has several negative effects, both cognitive and social. Depending on the substance or combination of substances (such as psychoactive stimulants, hallucinogens, sedatives/anxiolytics, etc.), frequency, dosage, period of use, and the preexisting vulnerability of the user may have results including impaired cognitive and psychosocial development, loss of initiative, lowered threshold for impulsive behavior, somatic complications, paranoid delusions, and induced psychotic state (Grann and Fazel 2004, Gustavson, Stahlberg et al. 2007).

Since substance use is costly to maintain and such a cost is difficult to cover with a regular income, a drift towards criminality is common. The more removed from mainstream society the individual becomes, the more likely the substance use is to intensify as well. The earlier an adolescent is introduced to drugs and criminality, the more difficult it is to treat these problems later in life (McLellan, Lewis et al. 2000).

1.3.2.2 Major Mental Disorders

Major mental disorders (MMD) (such as schizophrenia and bipolar disorder) are regularly, but inaccurately, described as a cause of the majority of violent crimes in society (Pulay, Dawson et al. 2008). The risk for violent behavior among those diagnosed with MMD is undoubtedly increased, as several studies have shown (Fazel and Grann 2006), and a striking few are also responsible for erratic and disturbing homicides; nevertheless, this group as a whole, encompassing diagnosed and unstable offenders, is quantitatively small in comparison to the overall group of violent offenders. The view that MMD is the sole cause of violent behavior has been opposed, and those convicted of violent crimes either have a comorbid substance use disorder or some other comorbid mental health problem (Fazel, Gulati et al. 2009). In the cases of violent crimes committed by those diagnosed with MMD, where no comorbidity was present, it has been indicated that the violent incident occurred in connection with the first episode of the disorder and that the individuals were not medicated and were unaware of their illness (Nielsen and Large 2010). When an individual has been diagnosed with a MMD, and there is no comorbid drug use or psychiatric disorder present, and he or she has been adequately medicated, the relative risk for violence is not significantly increased compared to the general population (Robinson 1999, Walsh, Buchanan et al. 2002, Fazel, Gulati et al. 2009).

1.3.2.3 Neurodevelopmental problems

Neurodevelopmental problems (NDP; for example, attention deficit hyperactivity disorder (ADHD), autism spectrum disorders, intellectual disability, communication disorders, or specific learning disorders) are rarely the sole causes for premeditated violence. However, they may increase the risk in childhood and adolescence of asocial or antisocial behaviors (Shaw, Hodgkins et al. 2012, Saylor and Amann 2016). The prison population has an increased burden of NDP and other mental health problems compared to general population. One in five members of the prison population is suspected of fulfilling the criteria for ADHD (Teplin, Abram et al. 2002, Billstedt 2009, Fazel, Hayes et al. 2016). Nonetheless, ADHD is a fairly common condition and, according to several studies, does not increase the risk of violent behavior, although the risks of substance use, antisocial, and criminal behavior are increased (Mohr-Jensen and Steinhausen 2016). Individuals who have intact intellectual function but impaired social ability, unable to form mutual warm connections to others, rigid state of mind, compulsive preoccupation with right and wrong, and at times (borderline) delusional perceptions of circumstances, are at risk of becoming querulant. Most such individuals only become an annoyance to others, but some become dangerous as they resort to violence to seek vengeance or restore order by the

use of lethal force (in a work place, official offices, medical institutions, school, etc.) or serial killing (such as politically or racially motivated murders) (Allely, Minnis et al. 2014). This group of offenders is miniscule in numbers, but can cause great harm.

1.3.2.4 Personality disorders

Those individuals whose personality meets personality disorder criteria may experience difficulties in cognition, emotiveness, interpersonal functioning, and/or impulse control, and may subsequently be characterized by an enduring collection of behavioral patterns that are often associated with considerable personal, social, and occupational disruption. In the *Diagnosics and Statistics Manual (DSM)*, personality disorders are divided into three clusters: (A) odd or eccentric (paranoid, schizotypal and schizoid), (B) dramatic, emotional, or erratic (borderline, histrionic, narcissistic, and antisocial), and (C) anxious or fearful (avoidant, dependent, and obsessive-compulsive) (American Psychiatric Association 2000). The B-cluster disorders are the most relevant to criminal behavior, and the antisocial personality disorder (ASPD) is particularly associated with a criminal lifestyle, although individuals diagnosed with other categories of personality disorder (PD) may have a criminal behavior as well. Cluster-B disorders are characterized by an antagonistic, self-absorbed, paranoid, negative emotional, sensation-seeking, and impulsive behavior and disinhibited personality traits which have previously been shown to be closely associated with aggressive antisocial behavior. When an ASPD is diagnosed, a prerequisite behavior is a pervasive pattern of disregard for, and violation of, the rights of others that begins in childhood or early adolescence and continues into adulthood (Coid 2002, Fossati, Barratt et al. 2007, Glenn, Johnson et al. 2013).

In childhood, disruptive behaviors that fulfill a diagnosis of CD mirror ASPD in adults (Gelhorn, Sakai et al. 2007). The somewhat less severe problematic behavior of Oppositional Defiant Disorder (ODD) are fulfilled by a greater number of children, approximately half of whom go on to fulfill the criterion for CD. Half of those diagnosed with CD are on a path that will lead to a diagnosis of ASPD in adulthood (Storm-Mathisen and Vaglum 1994, Maughan, Rowe et al. 2004, Hofvander, Ossowski et al. 2009).

1.3.2.5 Psychopathic traits

Psychopathy is generally defined as a personality disorder comprising interpersonal, affective and antisocial traits and behaviors, and connected with a negative outcome in terms of a criminal lifestyle often combined with repeated acts of violence (Walters, Knight et al. 2008, Skeem, Polaschek et al. 2011, Sörman 2015).

Psychopathy is related, but not equal, to antisocial personality disorder, as its definition places greater emphasis on the interpersonal and affective features first described by Cleckley (1951). Most offenders with highly psychopathic traits also meet diagnostic criteria for antisocial personality disorder, while most offenders with antisocial personality disorder do not display high levels of psychopathic traits (Verona, Patrick et al. 2001, Skeem, Polaschek et al. 2011).

Hare's Psychopathy Checklist – Revised (Hare 2003) is commonly used as a measure of psychopathic traits and have consistently been associated with increased risk of aggressive antisocial behavior in different settings. (Dolan and Doyle 2000, Hare, Clark et al. 2000, Hare 2003, Hare and Neumann 2005, Gao, Glenn et al. 2009).

Individuals with highly psychopathic traits have an earlier onset and display more diverse, severe, and persistent patterns of aggressive antisocial behavior than other offenders (Glenn and Raine 2009, Skeem, Polaschek et al. 2011). Some studies have shown that psychopathy adds incrementally to the prediction of aggressive antisocial behavior when other risk factors (such as substance-related disorders, criminal history, and personality disorders) are controlled for. Measurements of psychopathy are commonly included in risk assessment guidelines (Dolan and Doyle 2000, Edens, Skeem et al. 2001, Glenn and Raine 2009).

1.4 Personality traits of importance for AAB

Personality has been defined and described in several different ways throughout history. The general assumption is that some qualities or characteristics of a person predict how he or she would act in specific situations.

The Encyclopedia Britannica provided the following comprehensive definition of personality:

“Personality is a characteristic way of thinking, feeling, and behaving. Personality embraces moods, attitudes, and opinions and is most clearly expressed in interactions with other people. It includes behavioral characteristics, both inherent and acquired, that distinguish one person from another and that can be observed in people’s relations to the environment and to the social group”. (Encyclopedia Britannica Online) (2016)

The role that personality (a characteristic pattern of thinking, feeling and behaving) plays in AAB has long been questioned, but that has changed in recent decades (Miller and Lynam 2001, Moffitt and Caspi 2001, Moffitt, Caspi et al. 2002). Most studies of the relationship between AAB and personality have used either Eysenck’s P-E-N, the five-factor model (“Big Five”) or Cloninger’s temperament and character inventory (TCI) (Jones, Miller et al. 2011). The relationship between antisocial behaviors in general, or aggression specifically, has focused on different dimensions of personality. The most extensively studied personality model is the Five-factor model, which relates to antisocial behavior and aggression and was summarized by Jones, Miller et al. (2011) in a meta-analytic review. The authors concluded that the higher-order traits of agreeableness, conscientiousness, and neuroticism had the most stable associations with measures of this kind of behavior (Jones, Miller et al. 2011).

To date, Cloninger’s model of temperament and character (Cloninger, Svrakic et al. 1993, Svrakic, Whitehead et al. 1993), where the personality is assessed by the integration of emotion-based habits and skills together with concept based goals and values, has been used to a much lesser extent than other personality instruments in studies on criminal populations. From the few studies in which it has been used, it can be concluded that high Novelty Seeking and low Harm Avoidance and Cooperativeness seems to be a recurrent finding, even if there have been some exceptions (for example, inconsistent findings for Harm Avoidance) (Basoglu, Oner et al. 2011).

1.4.1 The TCI model

Cloninger's Temperament and Character Inventory (TCI) is based on a conceptualization of personality as consisting of four temperament and three character dimensions (Cloninger 1994). This instrument has been increasingly employed in psychiatric and psychological research. Even though TCI is a complex model embracing the human psyche, it has a strong advantage due to its neurobiological underpinning to psychological and psychiatric principles (Cloninger, Svrakic et al. 1993, Cloninger 2000, Gardini, Cloninger et al. 2009).

Cloninger (1994) defines personality as the “dynamic organization within the individual of the psychobiological systems by which the person both shapes and adapts uniquely to an ever-changing internal and external environment”. Cloninger proposed that neurochemical systems, related to procedural learning (associative conditioning) and propositional learning (conceptual insight), are the basis for the separation between the two domains of personality: temperament and character. Within these two domains, Cloninger defined four temperament dimensions and three character dimensions. A more detailed description of TCI can be found in chapter 3.2.5 (Methods and Instruments) and Table 3, as well as in Table 12 in the Appendix.

1.4.1.1 Temperament

Temperament is seen as individual differences in emotional responses acting as a part of the motivational system-regulating behavior. The four temperament dimensions are Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (PS). The systems responsible for activation, maintenance, and inhibition of behavior are independently varying systems of the brain. Thus, the variation in the temperament dimensions has been found to be linked to the monoaminergic brain systems. The dimension of NS correlates with the basal dopaminergic activity where a low activity increases the likelihood of higher level of NS. The HA dimension correlates with the serotonergic activity, where higher activity promotes increased HA. A low level of basal noradrenergic activity correlates with higher levels of RD. Further research has confirmed a strong heritability in the temperament dimensions and its stability over long periods of time (Peirson, Heuchert et al. 1999, Cloninger 2000, Gillespie, Cloninger et al. 2003, Gardini, Cloninger et al. 2009).

Individuals who score high in NS can be defined as impulsive, excitable, quick-tempered, and extravagant. They routinely seek adventure and fun and frequently engage in new activities and interests, but they are also unstable and seditious, cannot tolerate monotony, and can be easily provoked to fight. In contrast, individuals with lower-than-average NS scores are reserved, stoic, slow-tempered, and loyal. Typically, they do not engage in new activities and generally give extensive thought prior to making decisions. Individuals who score above average in HA are generally considered fearful, pessimistic, shy, and fatigable. Those with lower HA scores are confident, relaxed, optimistic, highly uninhibited, and carefree, even under situations of stress or personal risk of injury. Individuals with higher RD scores are sentimental, warmly sympathetic, emotionally dependent, and eager to satisfy and help others. On the other hand, those with low RD are emotionally independent in what they do, though-minded, and detached from the society. They are described as having low appreciation for the feelings of others and make only small efforts to satisfy others. People who are high in PS are characterized as determined, ambitious, industrious, and perseverant. In contrast, below-average scorers are often spoiled, underachievers, and have a “give up easily” personality (Cloninger, Svrakic et al. 1993, Svrakic, Whitehead et al. 1993, Cloninger, Przybeck et al. 1994, Cloninger, Svrakic et al. 1997, Svrakic, Draganic et al. 2002, Cloninger and Svrakic 2008).

1.4.1.2 Character

The character domains are linked to sociocultural mechanisms and, in contrast to temperament, they are less influenced by genetics and seem to mature stepwise until the 23–27 age group, after which they are very stable (Brändström, Cloninger et al. in preparation). Cloninger described character in terms of the response biases that are linked to different connotations of the self, and defined three dimensions: Self-Directedness (SD) – me and my aims; Cooperativeness (CO) – me functioning in my close surrounding; and Self-Transcendence (ST) – me and my part in a universal structure. Character refers to individual differences in goals, values, and self-conscious emotions like shame, guilt, and empathy, which are expressed by the relationships of an individual with him or herself, with other individuals, with groups of persons, with the society, and with the universe as a whole.

Character dimensions are defined to reflect individual differences in self-concepts according to the extent of identification with the person as an autonomous individual (SD), as an individual in reciprocal interaction with other people (CO), and as an individual that is a part of the whole universe (ST).

Being responsible, mature, resourceful, and self-accepting are predominant features of individuals who score high in SD, as well as being guided by meaningful values and goals (congruent second nature). Those who score low indicate an immature, aimless, inept character and usually blame circumstances on others or to chance. CO refers to the individual differences in viewing of the self as an integrated part of humanity or society. It represents its capacity for identification with and acceptance of other people and the level of integrated conscience. Individuals who score high in this dimension can exhibit features such as helpfulness, compassion, tolerance, and being principled. In contrast, low scores indicate a person who is socially intolerant, hostile, revengeful, insensitive, and disinterested in others. The ST dimension refers to how individuals view the inner or outer world, and whether they see themselves as an integral part of the universe. This describes a capacity to be self-forgetful that could appear as “absent-minded” or to have the possibility of transpersonal identification, and “idealistic thinking” or spiritual acceptance. People who score high in this scale are spiritual, creative, and idealistic. They potentially show altruistic attitudes and selfless spirituality. However, lower scorers are unimaginative, controlling, and materialistic.

In the present thesis character is defined by a combination of the two dimensions of SD and CO. Previous research has used this way of conceptualizing character maturity, and found it to be a reliable and meaningful measure associated with different forms of for example neurodevelopmental problems (Kerekes, Brandstrom et al. 2010, Brändström, Cloninger et al. in preparation).

1.4.2 The TCI’s ability to capture mental health problems

The field of psychiatry has increasingly adopted the view of spectrums and dimensions instead of the previous distinct taxonomic categories, which is reflected in the latest version of the Diagnostics and Statistics Manual (DSM-5). From this dimensional view, personality disorders only differ from normal variation in personality in terms of degree.

The TCI has repeatedly been shown to be able to reflect different diagnostic categories according to the DSM-IV, such as Bipolar Disorder, Major Depression, Personality Disorders, and Anxiety disorders (Allnutt, Wedgwood et al. 2008, Hori, Noguchi et al. 2008, Loftus, Garno et al. 2008, Celikel, Kose et al. 2009, Jylha, Ketokivi et al. 2013, Melegari, Nanni et al. 2015). It was found early on in the development of the TCI from the

psychobiological theory that the dimensions of temperament and character traits efficiently identify personality disorders and differentiate its individual subtypes (Battaglia, Przybeck et al. 1996, de la Rie, Duijsens et al. 1998, Cloninger and Svrakic 2008, Richter and Brandstrom 2009). Character dimensions are used to predict the *presence* of a personality disorder, whereas temperament dimensions are used to differentiate between the *types* of personality disorder. Cloninger, Przybeck et al. (1994) suggested that the configuration of temperament dimensions (NS, HA, and RD) defines the so-called temperament type and thus the type of PD, when there is a low character maturity present. If a subject shows extreme expressions on one or more temperament dimensions, the probability that the person suffers from a personality disorder will increase, although any temperament configuration can be observed in mature people who do not fulfill the criteria for a PD. When an individual shows extreme expressions on temperament dimensions, it is also likely that the person has an immature character (that is, low SD and/or low CO). The difficulty in coping with intense emotions derived from the extreme temperament leads to an increased probability of a PD diagnosis (Richter and Brandstrom 2009). The relation between psychopathic traits and the TCI has been studied and displays a similar pattern where; low CO, low RD, low HA and higher level of NS were correlated to the total PCL-R score (Snowden and Gray 2010).

The TCI's ability to aid in the advancement of well-being through early intervention among children with early-starting conduct problem has been found to be quite effective in regards to the reduction of later following substance abuse problems, risky sexual behaviors, and criminal behaviors. In other words, TCI has shown in itself to be an effective instrument by increasing the overall wellbeing scores among samples at risk of an adverse outcome (Cloninger 2006, Allnutt, Wedgwood et al. 2008, Moreira, Cloninger et al. 2014, Dodge, Bierman et al. 2015).

2 AIM

The overall aims of this thesis were to investigate the relationship between personality traits and aggressive antisocial behavior (AAB), and to define the relevant risk factors associated with AAB.

2.1 Specified aims

1. Determine the occurrence of aggressive antisocial behavior (AAB) in a Swedish nation-wide general population.
2. Investigate risk factors of AAB and determine the strength of their association to AAB.
3. Compare the personality profile of individuals with AAB (offenders and children with conduct disorder) to age- and gender-matched samples from the general population.
4. Study the association between personality traits (temperament and character dimensions) and the level of AAB.

3 STUDY GROUPS AND METHODS

3.1 Study groups

The study groups in this thesis include Swedish samples of children and adults from the general population (Papers IV and I) and samples from the Swedish Prison and Probation Service's inmate population (Paper II and III).

Paper I: The study population of this paper includes all individuals who were born and reside in Sweden and are at least 15 years old, during the study period from 1973 to the end of 2004 ($n=2,393,765$). In this cohort 93,462 individuals were convicted of at least one violent crime and were therefore defined as violent crime offender. For all of these violent crime offenders, another 10 non-violent crime offenders (who might have been convicted of other crimes) were randomly selected from the cohort through matching by gender, age (within birth month) and for having a sibling of same age and sex as the violent offender. This resulted in a final study population of 1,030,062 individuals.

Paper IV also collected data from the Swedish nation-wide population, but in this case focused on 9- and 12-year-old children. Parents of these children were identified through the Swedish twin registry and were contacted for structured telephone interviews, during which interviews data on somatic and mental health of their children were collected, as part of the Child and Adolescent Twin Study in Sweden (CATSS). The CATSS has had a response rate of 80 %. A detailed presentation of the CATSS study was published by Anckarsater, Lundstrom et al. (2011). The sample of Paper IV was drawn from the CATSS database in January 2010, when telephone interviews and questionnaire data were available for 2032 children. After excluding individuals with missing answers ($n=146$), the final study population of Paper IV consisted of 1886 children, with a close to equal distribution of ages and genders (59 % were 9 years old, 41 % were 12 years old; 55 % were boys, and 45 % were girls). Parental information on these children's mental health and personality was assessed by validated instruments (see below).

Papers II and III analyzed information from prison populations. In Paper II, young male offenders who had been convicted of violent or sexual criminality were clinically assessed during the Development of Aggressive Antisocial Behavior Study (DAABS). (For a detailed description of the DAABS study, please see: Hofvander (in preparation) and Billstedt (2009)). All male prison inmates aged 18 to 25 and serving a prison sentence in the

Western Region of Sweden, were asked to participate. Two hundred and seventy male offenders, out of 380 possible participants, gave their informed consent, resulting in a 71 % response rate (Table 1). In Paper II, we only analyzed data of those inmates who had completed the personality inventory (n=148).

Table 1. Basic characteristics of study group, Paper II.

	<i>n</i> ^A	Mean age (min-max)	Number of Conviction ^B (sd)	Violent crime in current conviction	Time to serve ^C (sd; min-max)
Male	148 (39%)	21.8 (18–26)	4.4 (4.2)	148 (100%)	23.6 (18.0; 2–108)

^A Sample size (proportion of the prison population)

^B Mean number of previous convictions

^C Sentencing in current conviction (months)

In Paper III, male and female offenders were recruited from medium-security correctional facilities for offenders with substance use-related problems in Gothenburg, Sweden. In the course of the study (18 months in the male correctional facility and 30 months in the female correctional facility), 65 male subjects (42 % of the total male offender population) and 50 female subjects (50 % of the total female offender population) were recruited. Table 2 summarizes sample size, the number of previous convictions and current sentence time for the study population.

A common finding was that subjects were convicted of multiple offenses in their current sentence. Twelve males (18 %) and three females (6 %) were first-generation immigrants, which reliably mirrors the occurrence of immigrants in the general prison population in Sweden, as presented in a report by Swedish National Council for Crime Prevention (Martens 2005).

Table 2. Basic characteristics of study group, Paper III.

	n^A	Mean age (min-max)	Number of Conviction ^B (sd)	Violent crime current conviction	Time to serve ^C (sd; min-max)
Male	65 (42%)	35.4 (19–59)	7.7 (9.2)	27 (42%)	19.2 (13.4; 4–84)
Female	50 (50%)	40.0 (23–68)	2.6 (5.6)	18 (36%)	20.4 (22.0; 4–120)
Total	115 (45%)	37.4 (19–68)	5.5 (8.2)	45 (39%)	19.6 (16.6; 4–120)

^A Sample size (proportion of the prison population)

^B Mean number of previous convictions

^C Sentencing in current conviction (months)

All group comparisons regarding risk factors and personality in Papers I–III were made against age- and gender-matched controls randomly selected from the general population. In Paper IV, the comparisons were made to children not characterized with CD.

3.2 Methods and instruments

3.2.1 Register data (Papers I and IV)

The unique personal identification number that is ascribed to each Swedish citizen upon birth or arrival to the country was used to merge data across nationwide registries. Data were anonymized in the linkage process by the transformation of the personal identification number into a randomly assigned coded string variable. In this study, the total follow-up period spans from 1973 to 2004, and includes summary information on parental data prior to 1973. The registers used were *Crime Register*, *Total Population Register*, *Cause of Death Registry* and *Migration Registers*, *Compulsory 9-year Comprehensive School Register*, and *Hospital Discharge Register*.

The Crime Register (The Swedish National Council of Crime Prevention) contains records of all convictions in Swedish lower courts from January 1, 1973 to December 31, 2010, including custodial and noncustodial (probation and/or fines) sentences. In Sweden, offenders cannot be considered; not guilty by reason of insanity. Individuals who commit crimes under the influence of a severe mental disorder are generally sentenced to compulsory forensic psychiatric care. Anyone charged with a crime is tried in court and, if convicted, entered into the official Crime Register.

Criminal responsibility begins at age 15 in Sweden. The Crime Register includes no offenses committed before this age, and appeals and higher court decisions are not coded. Plea-bargaining is not allowed, which removes the risk of having charges for violent crimes pleaded down and recorded as convictions for nonviolent crimes.

The Total Population Register (Statistics Sweden) provides information on sex, birth year, and parents' country of birth from 1932 on.

The Cause of Death Registry and Migration Registers (Statistics Sweden) contain information on cause of death in the Swedish population from 1961–2004 (endpoint of follow-up period). They are updated annually according to WHO's diagnostic system ICD-8/ICD-9 and ICD-10, and were used to verify whether individuals were alive and residing in Sweden during the follow-up period.

The Compulsory 9-year Comprehensive School Register provided data on grades from the final compulsory school year, from 1988 to 1997.

The Hospital Discharge Register (1973–2004, National Board of Health and Welfare) provided information on psychiatric disorders at the time of discharge from the hospital, according to the WHO's ICD-8/ICD-9 (codes 290–319) and ICD-10 (codes F00–F99).

Variables were created from known risk factors that were collected from registers: non-violent crime activity (theft, traffic violation and drug-related crime), major mental disorders (Schizophrenia, Bipolar disorder), substance use disorder, personality disorders, age at first conviction for violent crime (15–18 years old, 19–23 years old, and 24 years and older), missing school grades and information on whether a parent had convictions of violent and non-violent crime, psychiatric diagnosis and/or substance use disorder, and finally, information on whether both parents were born outside of Scandinavia.

3.2.2 Criminal history (Papers I, II, and III)

Data on criminal history covering previous and current criminality (index offence included), as well as age at onset of different forms of criminality, was collected from The Crime Register (Paper I) or by means of a structured protocol that took both self-reported and file-based information into consideration (Papers II and III). When self-reported and file-based information was contradictory, self-reported data was chosen as long as it appeared credible and reasonable. This made it possible to include data about

criminal behavior and onset of criminality before the age of 15, since this is the age of criminal responsibility in Sweden and therefore the age from which files and sentence documents are available.

Criminal behavior was categorized into seven separate variables based on the classifications offered by The Swedish National Council for Crime Prevention (BRÅ 2015), which are: (1) any criminality (consisting of *all* kinds of criminal offences), (2) violent criminality, (3) sexual criminality (all unlawful sexual acts according to the Swedish Penal Code), (4) property crime (theft, fraud or destruction of property), (5) drug-related criminality (such as possession, distribution, smuggling), (6) traffic violations (such as driving under the influence, reckless driving), and (7) weapons act offenses (for example, unlawful possession of firearms or knives).

These seven categories were as well composited into three separate groups: (1) violent crime (defined below); (2) *any* non-violent crime (any crime not defined under violent crime) and a specific core set of crime (indicative of AAB); and (3) non-violent crime, including only conviction for theft, drug-related crime, and/or traffic violation.

Violent crime (including attempted and aggravated forms when applicable) was defined as any of the following: homicide, manslaughter, assault, robbery, threats and violence against a police officer, gross violation of an individual's integrity, unlawful coercion, unlawful threat, kidnapping, illegal confinement, arson, and intimidation. Sexual offences may have a partially different etiology and even though rape includes a violent and aggressive aspect, it was excluded from the analyses in Paper I. Aggravated violent crime was defined as murder, manslaughter, aggravated assault, and/or aggravated robbery.

3.2.3 Clinical data (Paper II) and self-reports (Paper III) or parental reports (Paper IV)

The DSM-IV diagnoses of ADHD, CD, and SUD were established based on clinical interview data, according to the Structured Clinical Interview guide for axis I (SCID-I), and file information provided by the Swedish Prison and Probation Services. The number of fulfilled symptoms of ADHD was assessed for childhood as well as for adulthood; in addition, categorical diagnoses were established, regardless of the presence of other diagnoses.

3.2.4 Measures of AAB

3.2.4.1 Life history of aggression (LHA) (Papers II and III)

Aggressive and antisocial behaviors in a lifetime perspective were measured by the Life History of Aggression (LHA) instrument. LHA is developed as a semi-structured assessment interview (Coccaro, Berman et al. 1997). It is an 11-item scale that can be divided into three subscales. The Aggression subscale (LHA-Aggression) contains five items (items 1–5), which assess verbal aggression, property destruction (indirect aggression), non-specific fighting (influenced by the subject or not), physical assault (with evidence of intent to harm), and temper tantrums. It has been shown that LHA-Aggression subscale's scores are strongly correlated with aggressive behaviors as shown by Coccaro, Berman et al. (1997). The Self-directed Aggression subscale (LHA-Self-directed Aggression) includes two items that quantify self-injury behavior and suicide attempts. Finally, the third subscale of LHA, the Consequences/Antisocial Behavior subscale (LHA-Antisocial) has four items: school problems, such as suspension or reproof; problems with supervisors, such as demotion and warnings; antisocial behavior involving the police (for example, arrest and convictions), and those not involving the police.

LHA is rated on a six-point Likert scale (0 = no occurrence, 1 = one event, 2 = two or three events, 3 = four to nine events, 4 = 10 or more events, and 5 = more events than can be counted). The LHA score is the sum of ratings on all 11 items (that is, the total score) or on the specific items in a certain subscale (the subscale score). This instrument is characterized by excellent test-retest stability, interrater agreement, and internal consistency for both the LHA total score and the LHA Aggression subscale, supporting the use of this instrument for especially the assessment of aggressive behaviors in a life history perspective (Coccaro, Berman et al. 1997). Scale scores are computed by adding the items that constitute each scale, rendering a total LHA scale score of 55.

According to the original validation study using psychiatric patient sample, when the total LHA score is greater than 15, or when the Aggression subscale score is greater than 12, it is an indication of an atypically high occurrence of lifetime aggression (Coccaro, Berman et al. 1997).

3.2.4.2 CD (Paper IV)

In the CATSS project, parents respond to the Autism – Tics, AD/HD and other Comorbidities (A-TAC) inventory about their twins. This instrument includes questions reflecting DSM-IV criteria completed with well-described

clinical experiences. They cover a broad range of child psychiatric problems, which are answered in a life-time perspective. Responses are coded “no” (0), “yes, to some extent” (0.5), and “yes” (1.0), respectively. The instrument has been validated in cross-sectional clinical studies and in longitudinal clinical follow-up (Hallerod, Larson et al. 2010, Larson, Anckarsater et al. 2010, Larson, Kerekes et al. 2014). With the help of these validated scales, both continuous and categorical measures of neuropsychiatric condition can be measured.

The CD and ODD scales of A-TAC consist of five items each. In Paper IV, the previously validated high cut-offs ($CD \geq 2$ and $ODD \geq 3$) were used to select children with disruptive behavior problems (Kerekes, Lundstrom et al. 2014).

3.2.5 TCI (Papers II, III, and IV)

The development, properties, and use of the TCI are comprehensively described under Introduction (see chapter 1.4.1). The instrument has been revised and restructured in several steps. The versions used in the present thesis are described in Table 3.

Table 3. Description of basic characteristics for the TCI versions used in the present thesis.

Abbreviation	Full name	No. items included	Item levels, measurement level
TCI (SV*)	Temperament and Character Inventory	238	True-False; dimensions and subscales
TCI-R140	Temperament and Character Inventory-Revised 140	140	5-point Likert scale; dimensions only
J-TCI	Junior Temperament and Character Inventory	108	True-False; dimensions only

SV =Swedish versions.

* The original version contains 240 items.

3.2.5.1 TCI-238 (Paper II)

The TCI-238 (Swedish version) consists of 238 yes/no items (Table 3). This version measures scores in the seven dimensions, but also subscales within dimensions (presented in Table 12 in Appendix). Raw-scores were used for comparison to normal population. T-scores (mean of 50 and standard deviation of 10) were calculated for each dimension based on Swedish normative data for statistical analysis of differences within the study group (Brandstrom, Schlette et al. 1998, Brändström, Cloninger et al. in

preparation). Character maturity was calculated as the sum of scores on the character dimensions SD and CO when comparing groups according different level of maturity.

3.2.5.2 TCI-R140 (Paper III)

The TCI-R140 is a revised and shortened version of the original TCI-238 that kept good psychometric properties in each of the different validated versions (Hansenne, Delhez et al. 2005, Pelissolo, Mallet et al. 2005, Martinotti, Mandelli et al. 2008, Goncalves and Cloninger 2010, Brändström, Cloninger et al. in preparation). It contains 136 items measuring the four higher-order temperament dimensions (NS, HA, RD, and P) and the three higher-order character dimensions (SD, CO, and ST), but does not measure subscales within the dimensions. All dimensions contain 20 items, except for ST, which has only 16 items and the questionnaire is completed with four additional control items (Zohar and Cloninger 2011). Items are rated on a five-point Likert-scale ranging from 1 (definitely false) to 5 (definitely true) (Fresan, Robles-Garcia et al. 2011).

3.2.5.3 J-TCI (Paper IV)

The Junior-Temperament and Character Inventory (J-TCI) and its Swedish version are validated measures of children's personality profile, using, for example, parental information (Luby, Svrakic et al. 1999, Kerekes, Brandstrom et al. 2010). J-TCI consists of 108 true/false items, which assess the four temperament and three character dimensions.

3.2.6 Psychopathy checklist-revised (Paper II)

Psychopathic personality traits were assessed by the Psychopathy Checklist-Revised (PCL-R) (Hare, Clark et al. 2000, Hare 2003, Hare and Neumann 2005). The PCL-R is developed to capture lifetime psychopathic personality traits through 20 items that are each rated on a three-point scale (0 = does not apply, 1 = may apply or in some respects applies, 2 = does apply) and summed up to a total score ranging from 0 to 40.

All available information – that is, from the interview, from observations during the assessment, and from accessible files – was used for the assessment. Both the four-facet structure (interpersonal, affective, lifestyle, and antisocial) proposed by Hare and Neumann (Hare and Neumann 2005), and the original two-factor model (Factor 1 encompassing the interpersonal and emotional features, and Factor 2 the impulsive, irresponsible, and antisocial features) (Hare, Clark et al. 2000) were used in the current analysis.

Internationally, a score of 30 or above has been established as the cut-off for a highly elevated level of psychopathic traits. However, this has been questioned with regard to European results, where a total PCL-R score of 25 or above has been suggested as the cut-off to signal an elevated level of psychopathic traits (Skeem, Polaschek et al. 2011).

3.3 Statistical methods

Basic descriptive statistical information includes mean, median, standard deviation, range, and percentages. When analyzing mean value differences and the effect size, they are presented by calculating Cohen's d , which is the mean value difference divided by a pooled standard deviation.

When performing correlation analyses, both parametric and non-parametric correlation analyses were used, rendering very small differences in both significance level and parameter strength.

Regression analyses were performed to estimate the strength of association between different risk factors as well as the predictive ability of the composed model.

In the analyses of the TCI's dimensions for predicting LHA, a linear regression was used. The natural logarithm was used to compute the equivalence of the odds ratio. When predicting the presence of CD diagnosis among children in Paper IV, a general estimated equation model (GEE) was used to adjust regression analyses to twin data.

Software program IBM SPSS Statistics version 22 was used.

4 ETHICAL STATEMENT

Among the ethical considerations is the question of whether the scientific investigations are necessary. In the present thesis, they definitely are, due to several important facts. Interpersonal violence is one of the leading causes of physical and mental suffering in the world today. The present study investigated groups on various population levels, down to subgroups of particularly violent offenders. It is already known that this AAB group has an increased mortality rate, higher frequency of somatic and psychiatric problems, and is socially detached from society, which means it is in great need of intervention, treatment, and supervision for both increased well-being and reduced criminal tendencies. Since this group is stigmatized by mental health issues and being restricted in prison, the integrity of participants are very important. In Papers I and IV, all data from registers were anonymized. All participation was voluntary and participants were given both written and oral information on the study. Participants from prison settings were given financial compensation equivalent to approximately 25 USD in the form of telephone cards for their participation.

Paper I. The Research Ethics Committee at Karolinska Institutet approved of the study, DNR 521-2010-2689.

Paper II. This study was approved by the Research Ethics committee at the Lund University, DNR: 2009-10.

Paper III. The project received ethical approval from the regional Ethical Review Board (in Gothenburg), DNR 432-12 (2012).

Paper IV. The Research Ethics Committee at Karolinska Institutet approved the study, DNR 2002-2689.

5 RESULTS

5.1 Occurrence of AAB

Out of a cohort of almost 2.5 million Swedish citizens, 93,652 individuals (3.9 % of the total population) were convicted of a violent crime at least once in the period between 1974 and 2004. This group constituted those people defined within this thesis as having AAB. The sub-group accountable for the majority (63 %) of all violent crime convictions, and thus defined as persistent violent crime offenders, constituted 26 % of the AAB group, which in turn corresponded to 1 % of the population. This small group of offenders had received three or more convictions specifically for violent crimes during the follow-up period, although they also were the most criminally active in general. A detailed description of the “1 % group” can be found in Paper I.

Figure 2 shows the reconviction rate of the whole AAB group, by the number of convictions received for a violent crime. Among those convicted the first time for violent criminality, 44 % were subsequently convicted again of another violent crime. The fraction of reconviction rate increased steadily until six convictions, where it leveled off at approximately 80 %. These figures show that individuals with AAB have a substantial risk of relapsing into violence. A more detailed description of reconviction data may be found in Paper I.

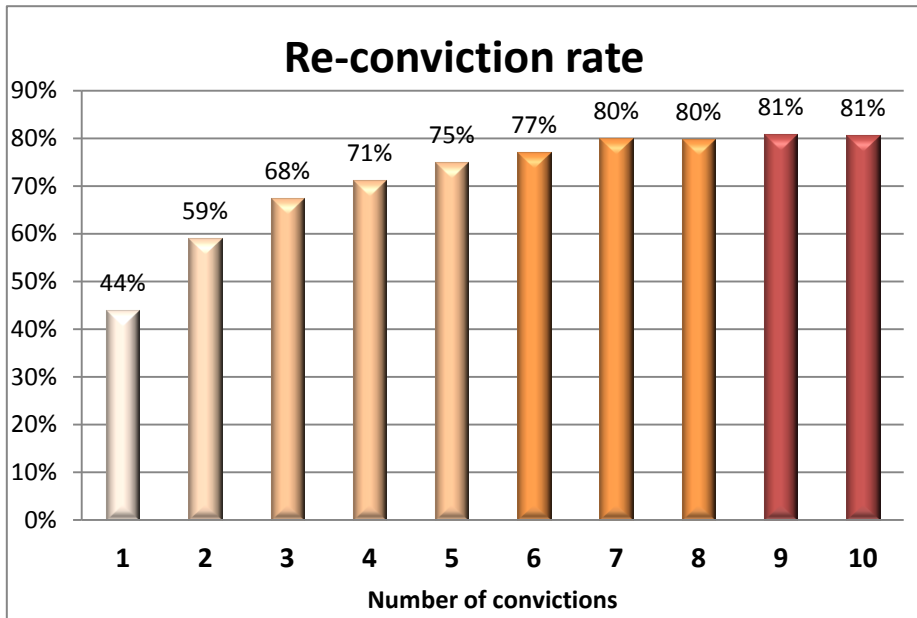


Figure 2. Graphical representation of reconviction rate by number of convictions.

5.2 Risk factors of importance to AAB

Several different risk factors of AAB were studied in the four papers included in this thesis. They cover historical, clinical and biological risk factors and are listed (in alphabetic order) in Table 4. Table 4 also guides readers to where they can find more detailed information about any specific risk factor of AAB.

Table 4. List of studied risk factors of AAB, and their appearance in the different studies

Risk factors for AAB	Paper			
	I	II	III	IV
Attention Deficit Hyperactivity Disorder (ADHD)		X		X
Age at debut of criminality	X ^A	X ^B		
Autism Spectrum Disorder (ASD)				X
Conduct Disorder (CD)		X		X
Gender	X		X	
Non-violent crime conviction	X	X	X	
Other psychiatric diagnoses (except PD and SUD)	X			
Parental mental health	X			
Parental non-violent crime	X			
Parental substance use	X			
Parental violent crime	X			
Personality		X	X	X
Personality Disorder (PD)	X	X		
Psychopathic trait		X		
Substance Use Disorder (SUD)	X	X		
Trait aggression		X	X	
Violent crime conviction	X	X	X	

^A = Age when receiving the first conviction for a violent crime

^B = Self-reported age at first criminal act

In Paper I, the prevalence of some of the risk factors in the groups of “low,” “medium” and “high-persistent” violent criminality were defined and compared to age- and gender-matched controls without any violent conviction. Here, we present – in addition to what is presented in Paper I – the prevalence of those risk factors in the whole group of individuals with AAB compared to age- and gender-matched controls without any violent conviction (Table 5).

Table 5. Characteristics of individuals born in Sweden (1958–1980) and followed up between 1973 and 2004. The group of those convicted for at least one violent crime (AAB group) is compared with those not convicted for any violent crime (control group) (based on data from Paper I).

	Control group (n=936 420)	Percent Within Group	AAB group (n=93 642)	Percent Within Group
Sex: Male	835,240	89.2%	83,524	89.2%
Female	101,180	10.8%	10,118	10.8%
Any missing school grade	9118	1.0%	4966	5.3%
Age at 1 st conviction for a violent crime:				
15-18 years	N/A	N/A	29,648	31.7%
19-23 years	N/A	N/A	33,179	35.4%
≥24 years	N/A	N/A	30,815	32.9%
Number convicted for nonviolent crime	183,792	19.6%	62,120	66.3%
Any psychiatric inpatient diagnosis:	21,404	2.3%	19,657	21.0%
Major mental disorder	4749	0.5%	2379	2.5%
Personality disorder	3859	0.4%	4754	5.1%
Substance use disorder	15,407	1.6%	17,229	18.4%
One or both parents:				
Any conviction for a violent crime	31,555	3.4%	12,667	13.5%
Any conviction for a nonviolent crime	278,204	30.7%	48,928	52.3%
Any psychiatric inpatient diagnosis (not including substance use disorder)	163,804	17.5%	31,044	33.2%
Any inpatient diagnosis substance use disorder	98,382	11.5%	20,877	22.3%

Note: All comparisons yielded significant differences at $p < .001$ (χ^2 -test).

Each risk factor was significantly more prevalent in AAB than in the control group. These risk factors were then placed into a multivariable logistic regression model to predict belonging to the AAB group (Table 6).

Table 6. Multivariable logistic regression model of risk factors for prediction of belonging to the AAB group (at least one violent crime conviction during 1973–2004)

Predictor	B	Odds Ratio	95% CI
Conviction non-violent crime ^A	1.8	5.9	5.8–5.9
Any diagnosis of a substance use disorder	1.6	4.9	4.8–5.1
Any diagnosis of a personality disorder	1.2	3.3	3.1–3.5
Any missing school grade	1.1	3.1	2.9–3.2
Parent with any conviction of a violent crime	0.7	2.0	1.9–2.0
Any diagnosis of a major mental disorder	0.6	1.8	1.7–1.9
Parent with any conviction of a nonviolent crime	0.5	1.6	1.6–1.6
Parent diagnosed with a psychiatric disorder	0.2	1.3	1.2–1.3
Parent diagnosed with a substance use disorder	0.1	1.1	1.0–1.1

All odds ratios significant at $p < .001$

^A Theft, drug-related crimes and traffic violation

The model was significant at $P < .001$, Nagelkerke R^2 .25

An important finding was the prominent male representation in the AAB-group where almost 90 % were men. Two-thirds of the AAB group was convicted of non-violent crimes², compared to one in five in the general population. A conviction for non-violent crimes had the strongest association with AAB (OR = 5.9) in the regression analysis, showing the close relation between general criminality and violence. Moreover, 95 % of the AAB group had *any* kind of non-violent crime conviction³ compared to 29 % of the control group (data not shown). This finding was confirmed in Paper II, where all subjects who at that time were convicted of a violent crime or a sexual crime and 95 % of this group was as well convicted of *any* non-violent criminality.

Age at first conviction was divided into three separate age-groups in Paper I and the 19–23 age-group had a slightly larger fraction of the AAB group, with 35 %. The mean age of first conviction was 23. In Paper II, the mean age of self-reported age of first criminal act was 13.

Mental health problems (any kind of diagnosis) were 10 times as common in the AAB group (Table 5), and SUD was a significant and strong factor in the regression model with an OR of 4.9, followed by PD with OR of 3.3 and a

² Theft, drug-related crime and traffic violation

³ Any kind of criminal conviction, thus covering all statutes in the Swedish Penal code, except for a violent crime

somewhat smaller for MMD with OR of 1.8 (Table 6). This picture was supported with the finding that 74 % of young, violent crime offenders in prison had a diagnosis of SUD (Paper II).

It was four times more common for a parent in the AAB group to be convicted for a violent crime. It was also twice as common for a parent to have been convicted of a non-violent crime, diagnosed with substance use disorder (any kind) and/or psychiatric problems (any kind) in the AAB group (Table 5). This statistic was reflected in the regression model, where the OR for having a parent convicted of a violent crime was 2.0, followed by the factor of having a parent convicted of a non-violent crime (OR 1.6). Psychiatric problems of parents were not as strongly associated to AAB.

Other clinical risk factors of AAB, which could not be studied in Paper I because no valid information about them could be retrieved from the inpatient hospital register, were then studied in Papers II and IV. Childhood ADHD was reported in 65 % and adulthood ADHD in 43 % of young male adults with AAB (Paper II). Among the 70 children (3.7 % of the study population) fulfilling the criterion for CD, almost half (47 %; boys 50 %, girls 42 %) had comorbid ADHD (Paper IV). About 21 % of this group of children also showed signs of ASD, and it was more common among boys (27 %) in relation to girls (12 %).

Aggressive traits were assessed by LHA in Papers II and III. Young male violent offenders (aged 19–26) had an average score on the LHA Total scale of 30.6 (range 3–53), and males (aged 21–59) had a mean of 31.8 (range 11–47), while females (age 23–68) scored 24.1 (range 2–46). In Paper II, the self-report AQ-RSV reflected the results from LHA by a total scale mean score 96.4 (range 40–139). The mean number of convictions for male violent offenders aged 19–26 was 4.4, and for males aged 21–59 was 7.7; for females aged 23–68, the mean conviction rate was 2.6 (Papers II and III).

5.3 Personality profiles of adults and children with AAB, compared to the general population

In Paper III, comparisons of the TCI dimensions were made between the offender group and gender- and age-matched controls (Paper III, Table 7, and Figure 3). In both genders, a statistically significantly low character maturity

(SD and CO) was found with a medium effect size. Male offenders were significantly low in RD with a medium effect size, while female offenders were significantly elevated in NS with a medium effect size.

Table 7. Comparison of personality profiles between age- and gender-matched controls from the general population and male and female offenders (male: n=65; and female: n=50) (Paper III).

TCI-R-140*	Mean (SD)		MV diff ^A	Effect size ^B	p
	General population	Offenders			
Novelty Seeking					
Male	60.5 (8.1)	62.7 (8.0)	2.2	0.27	.13
Female	58.7 (6.9)	62.3 (12.1)	3.6	0.37	<.001
Harm Avoidance					
Male	50.1 (12.5)	52.6 (12.5)	2.5	0.20	.26
Female	52.4 (10.6)	52.6 (12.9)	0.2	-0.02	.14
Reward Dependence					
Male	65.1 (8.2)	60.8 (9.8)	-4.3	-0.48	<.01
Female	68.5 (8.8)	62.7 (10.5)	-5.8	-0.60	.39
Persistence					
Male	67.0 (10.8)	64.7 (9.9)	-2.3	-0.22	.20
Female	64.9 (8.9)	62.4 (12.5)	-2.5	-0.23	.040
Self-Directedness					
Male	75.2 (13.5)	68.5 (12.8)	-6.7	-0.51	<.001
Female	77.3 (10.8)	72.5 (13.7)	-4.8	-0.39	.020
Cooperativeness					
Male	75.7 (7.9)	69.3 (10.5)	-6.4	-0.69	<.001
Female	79.6 (6.9)	74.9 (10.3)	-4.6	-0.53	<.01
Self-Transcendence					
Male	34.6 (7.9)	35.5 (9.0)	0.9	0.11	.63
Female	36.7 (9.5)	37.2 (12.0)	0.5	0.05	.02

* Raw score

^A Difference in mean values between groups

^B Cohen's *d*

In addition to what is presented in Papers II and IV, data from these studies were used to perform similar analyses. When comparing the personality profiles of offenders and children aged 9 or 12 with CD to the general population, a similar pattern emerged in Papers II and IV (Table 7, Table 8 and Table 9, Figure 3). A low level of character maturity (SD and CO), combined with a low level of RD and a high level of NS, was typical in all of the studied offender groups.

Table 8. Comparison of personality profiles between age-matched males from the general population and violent male offenders (n: 148) (Paper II).

TCI-238*	Mean (SD)		MV diff ^A	Effect size ^B	P
	General population	Offenders			
Novelty Seeking					
Male	22.2 (6.5)	25.7 (5.7)	3.5	0.58	<.001
Harm Avoidance					
Male	11.7 (6.0)	13.1 (6.8)	1.5	0.23	.048
Reward Dependence					
Male	13.7 (3.7)	11.8 (3.5)	-1.9	-0.54	<.001
Persistence					
Male	4.5 (2.2)	3.9 (2.0)	-0.6	-0.27	.021
Self-Directedness					
Male	30.2 (6.9)	25.9 (8.9)	-4.4	-0.55	<.001
Cooperativeness					
Male	30.9 (6.5)	23.9 (7.1)	-6.9	-1.02	<.001
Self-Transcendence					
Male	11.0 (5.3)	14.1 (6.4)	3.1	0.53	<.001

* Raw score ^A Difference in mean values between groups ^B Cohen's *d*

Table 9. Comparison of personality profiles in twin children aged 9 or 12 between those who did not fulfill criterion for CD and those who did (boys: 991 and 44 with CD, Girls: 825 and 26 with CD) (Paper IV).

J-TCI*	Mean (SD)		MV diff ^A	Effect size ^B	p
	General population	CD-children			
Novelty Seeking					
Boys	7.2 (3.15)	9.8 (3.83)	2.7	-1.27	<.001
Girls	6.5 (2.95)	9.2 (3.86)	2.6	-1.12	<.001
Harm Avoidance					
Boys	7.4 (3.93)	8.3 (4.64)	0.9	-0.64	.08
Girls	7.9 (4.07)	8.6 (4.69)	0.6	-0.31	.39
Reward Dependence					
Boys	6.7 (1.71)	5.9 (1.86)	-0.8	0.53	<.001
Girls	7.4 (1.43)	7.0 (1.56)	-0.4	0.67	<.001
Persistence					
Boys	2.3 (1.53)	2.0 (1.40)	-0.3	0.35	.20
Girls	2.7 (1.44)	2.5 (1.54)	-0.1	0.38	.06
Self-Directedness					
Boys	15.3 (3.78)	11.8 (4.12)	-3.5	1.24	<.001
Girls	16.2 (3.15)	13.0 (4.19)	-3.2	1.19	<.001
Cooperativeness					
Boys	15.8 (3.22)	12.6 (4.00)	-3.3	1.08	<.001
Girls	16.7 (2.80)	14.2 (4.59)	-2.5	1.11	<.001
Self-Transcendence					
Boys	1.1 (1.51)	1.2 (1.70)	0.1	-0.28	.05
Girls	1.0 (1.41)	1.5 (1.83)	0.4	-0.29	.09

* Raw score ^A Difference in mean values between groups ^B Cohen's *d*

The effect sizes of the difference in each TCI dimension were calculated for both children with CD and offenders in comparison to age- and gender-matched controls from the general population.

The resulting effect sizes from this comparison of different samples with AAB to controls are summarized in Figure 3. The pattern of the effect size difference is shown, regardless of statistical significance. A personality profile characterized by low character maturity (SD+CO), coupled with a temperament high in NS and low in RD, emerged across age and gender in individuals with AAB.

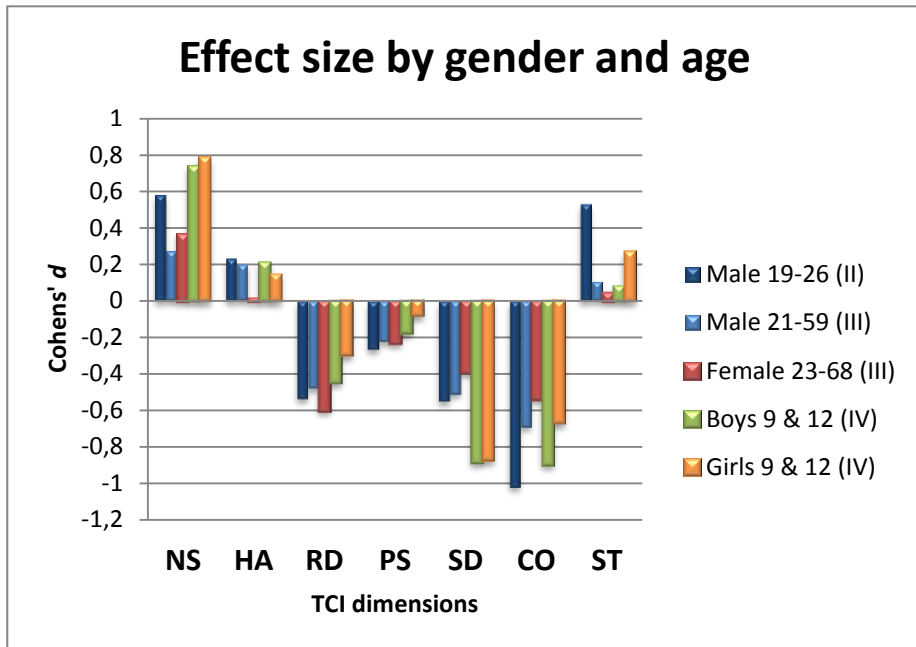


Figure 3. Graphical illustration of the effect sizes (Cohen's d) of the mean value difference on TCI between samples with AAB and age- and gender-matched controls from the general populations (Papers II–IV), presented by gender and age. Effect size of mean value difference as measured by Cohen's d .

5.4 Investigation of the association between personality traits and level of AAB

When examining the correlations between each personality dimension and measures of AAB, a salient pattern emerged in the different study samples. The study populations in Papers III and IV even provided a possibility for gender-specific analyses. The most consistent association in both genders was the negative and moderately strong correlations between the different measures of AAB (LHA-Total scale or CD-score by A-TAC) and the character dimensions of SD and/or CO. Moreover, a positive and moderately strong association with NS was found (Papers II, III, and IV). The temperament dimensions RD and PS were negatively associated with AAB and had a small-to-moderate correlation coefficient strength. This pattern reveals a consistent association between AAB and character immaturity, apathy, lack of goal orientation, unreliability, social intolerance or disinterest, unhelpfulness, and revengefulness combined with impulsiveness and excitement seeking.

In Paper III we found that female prisoners' personalities were of greater importance for the level of AAB than were those of males. All of the previously described correlations between SD, CO, NS, PS, and operationalization of AAB were generally stronger in the group of female offenders (Paper III). Gender differences among children were not prominent, and all dimensions except ST correlated significantly to CD in both genders.

Besides the gender differences with regard to AAB, another interesting gender difference emerged concerning the self-directed aggression subscale measuring self-harm and suicidal behavior. We found a moderate and positive correlation to HA (which was the only dimension significantly correlated to self-directed aggression) and this correlation was somewhat stronger in female offenders ($r = .40$) than in males ($r = .30$), as described previously. This would also confirm that self-harming behavior is a consequence of excessive worrying, pessimism, fearfulness, doubtfulness, and being easily fatigued (Paper III).

In Paper II, we found that a low level of character maturity was significantly related to several factors related to AAB, such as early debut in criminality, substance use, increased criminal activity, elevated level of aggressive traits, and psychopathic traits (Paper II).). In additional analyses of psychopathic traits according to the PCL-R a significant mean value difference was found for CO $t(144)=3.82, p<.001$, and RD $t(144)=2.67, p<.01$, where psychopathic offenders⁴ had lower scores. In the univariable correlation analyses for TCI dimensions and PCL-R total scores a significant association was found for; CO, $r(146) = -.45, <.001$, followed by RD, $r(146) = -.33, <.001$, and finally NS, $r(146) = .21, <.01$. The TCI dimensions CO ($b = -.44, t(138) = -4.63, p < .001$), and HA ($b = -.21, t(138) = -2.14, p < .05$), significantly predicted PCL-R scores and explained a significant proportion of the variance in PCL-R scores $R^2 = .30, F(7, 138) = 8.52, p < .001$.

⁴ PCL-R cutoff >25 according to European standard

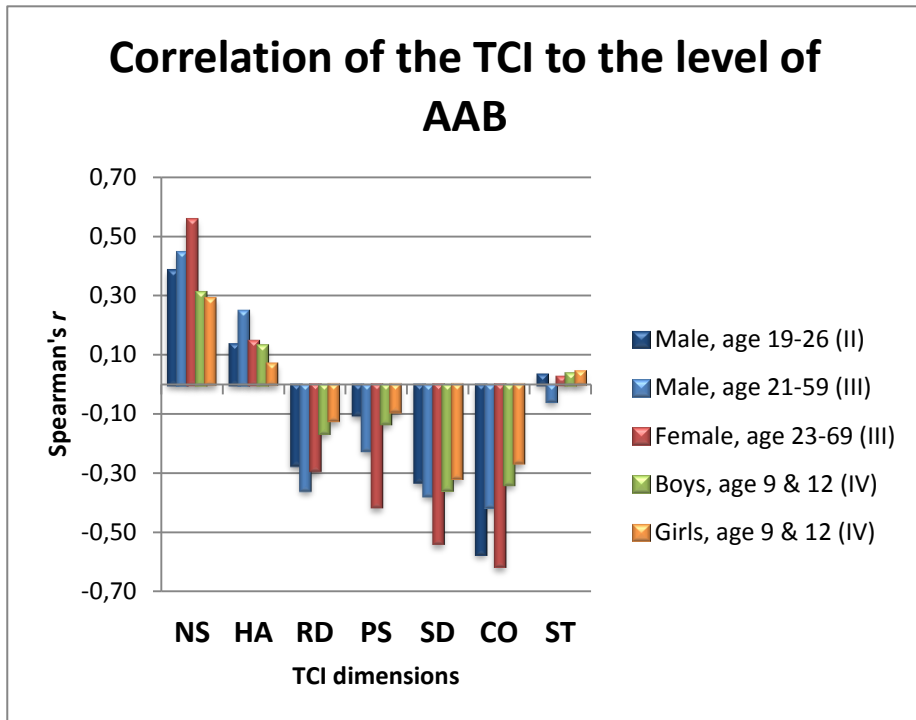


Figure 4. Correlation between the TCI and LHA in adults or to CD in children samples.

Table 10. Multivariable linear regression analysis for the level of AAB as measured by LHA (based on data from Paper II and III)

Multivariable linear regression analysis (Papers II and III)

TCI	Male, age 19–26 (II)				Male, age 21–59 (III)				Female, age 23–68 (III)			
	e ^(β)	β	SE 95%	p	e ^(β)	β	SE 95%	p	e ^(β)	β	SE 95%	p
NS	1.4	.34	.133	<.001	1.3	.28	.152	.045	1.5	.40	.201	.036
HA	1.0	-.03	.135	.76	1.1	.07	.120	.69	1.1	.05	.185	.79
RD	0.9	-.07	.229	.40	0.8	-.25	.121	.07	0.9	-.15	.156	.25
PS	1.1	.05	.380	.48	0.9	-.09	.120	.51	0.9	-.08	.164	.63
SD	1.0	.00	.116	.97	0.7	-.32	.120	.06	1.0	.00	.181	.97
CO	0.6	-.48	.123	<.001	1.1	.06	.143	.70	0.7	-.35	.175	.014
ST	1.1	.07	.115	.35	0.9	-.15	.120	.21	1.0	-.04	.127	.76

Males, age 19–26 (II): Model summary; F(7,140) = 15.452, p<.001, with R² of .44

Male, age 21–59 (III): Model summary; F(7,57) = 4.610, p<.001, with R² of .36

Female, age 23–68 (III): Model summary; F(7,42) = 6.178, p<.001, with R² of .51

When performing a linear regression analysis for the TCI dimensions for the prediction of the level of AAB as measured by the LHA total scale, all analyses resulted in a significant model and model summaries are presented below in Table 10. Across all offenders, regardless of gender, NS emerged as an important factor with a positive and weak-to-moderate effect size. In Paper II and among females in Paper III, CO was a statistically significant, negative moderate-sized predictor as well.

In a general population of twins, a CD diagnosis was used to identify those with childhood norm- and rule-breaking aggressive behaviors (childhood AAB) (Paper IV). When predicting the presence of a CD-diagnosis by the J-TCI in boys and girls separately, a similar pattern emerged for both genders (Table 11). Both boys' and girls' AAB behavior had a significant influence by NS (which was positively associated), as well as by SD (negatively associated). The HA dimension of temperament was also positively and significantly associated with the presence of AAB in boys, but not in girls (Table 11).

Table 11. General estimated equation model (n=1805). The A-TAC's CD-module score was entered as a dichotomous outcome variable and J-TCI dimensions as predictors (based on data from Paper IV).

General estimated equation model (n=1805) (Paper IV)						
J-TCI	Boys			Girls		
	OR	SE 95%	<i>p</i>	OR	SE 95%	<i>p</i>
NS	1.40	1.24–1.59	<.001	1.28	1.08–1.52	.004
HA	1.17	1.07–1.29	<.001	1.06	0.96–1.18	.28
RD	1.06	0.88–1.29	.54	0.90	0.68–1.19	.45
PS	1.28	0.98–1.66	.07	1.30	0.97–1.74	.08
SD	0.87	0.78–0.97	.013	0.86	0.77–0.97	.014
CO	0.94	0.85–1.04	.22	0.92	0.81–1.05	.24
ST	1.09	0.87–1.36	.45	1.05	0.82–1.35	.69

6 DISCUSSION

6.1 Summary of main findings

Aim 1: Those convicted at least once for a violent crime constitute approximately 4 % of the Swedish population and are considered as individuals with an AAB, whereas one-quarter of them were accountable for a majority of all violent crimes. Individuals in this latter group are reflected by an extreme risk of relapsing into violent crime.

Aim 2: Individuals in the group of AAB are characterized by male gender, an early debut in criminality, occurrence of a diagnosis of CD, SUD, and/or PD, frequent school failures, and – to a higher extent – parents who have been convicted of violent and non-violent crimes.

Aim 3: Those with AAB display during their life-course a characteristic personality pattern described as being low in character maturity (SD and CO), high in NS, and low in RD and PS compared to the general population.

Aim 4: The level of AAB is predicted by an increased level of NS in males and females, in both children and adults, combined with a low level of SD in childhood and low level of CO in adulthood.

6.2 Occurrence of AAB

Individuals with aggressive antisocial behavior (AAB) were convicted of at least one violent crime. They constituted about 4 % of the population and were accountable for all the violent crime convictions in Sweden between 1973 and 2004 (Paper I). Those individuals characterized with AAB in the Swedish nation-wide general population also displayed a highly active general criminal behavior. The recidivism rate was high in this group: almost half of the individuals were reconvicted of a second violent crime, and the majority of them (70 %) relapsed at least once again into violent criminality (Paper I). These are the people (those with three or more violent crime convictions) who were defined as persistent violent offenders in Paper I. The persistent sub-group constituted a quarter of the AAB group, corresponding to 1 % of the whole population. The fact that only 1 % of the population was accountable for the majority of violent crime is also supported by previous research. A small body of population-based studies has described similar results, where a minor group of males (5–10 %) within a cohort are highly

crime-active and violent (Moffitt and Caspi 2001, Moffitt, Caspi et al. 2002, Odgers, Moffitt et al. 2008, Elonheimo, Sourander et al. 2009, Frisell, Lichtenstein et al. 2011). However, the study design of Paper I is special, as searches⁵ in online resources (PubMed, Scopus or Web of Science) revealed no other studies of violent crime convictions on a nation-wide total population scale.

The importance of being able to define those individuals most prone for relapse in efforts to prevent future violent crime is undeniable.

6.3 Risk factors for AAB

When comparing individuals with AAB to the general population regarding several previously known risk factors for criminal behavior, an image of heavily burdened individuals emerged.

Only one in 10 members of the AAB group was a woman (Paper I). As mentioned in the introduction, extensive research has been conducted on men regarding their disposition to be violent. Several studies have made important findings regarding both biological differences as well as socio-cultural variations that would promote males to act more aggressively than females (Bennett, Farrington et al. 2005).

The age at which a person conducts his or her first violent crime follows a previously defined curve that peaks between ages 19 to 23 (Moffitt, Caspi et al. 1996, Farrington, Ttofi et al. 2009); this was confirmed in the present study due to the increased prevalence of first conviction's rate in this age group in the Swedish general population as well (Paper I). Moreover, our results suggested that the earlier the first violent crime conviction, the more likely it is for the development of persistence into violent crime (Paper I). It was previously shown that the age at onset of disruptive behaviors is indicative of later antisocial and criminal behavior, where half of those diagnosed with CD will progress into ASPD (Hofvander, Ossowski et al. 2009). Since the age of criminal responsibility in Sweden is 15, there were no register records available for identifying the definite age at onset of criminal behavior in our register study. However, with the help of self-reported data regarding the age at first occasion of an act that at age 15 would have been criminally liable, it could be confirmed, in a sample of violent crime

⁵ Search string (in different combinations): violent crime, conviction, population, distribution, epidemiology.

offenders, that the actual age at which antisocial behavior and violent criminality begins is in the early teens (Paper II).

Mental health problems were significantly more common in the AAB group than in general population, and several psychiatric disorders have been shown to be associated with an increased risk of committing violent crime. The relation between major mental disorders (MMD) and violence is significant but modest (Paper I), although it seems to be favored by the media, where sporadic atrocious violent acts in the community towards strangers may provide an excellent news-material and lead to stigmatization and discrimination (Pescosolido, Monahan et al. 1999). Those most likely to be victims of violence caused by individuals diagnosed with MMD are family members, friends, and other relatives (Hiday 1997). When treated and showing compliance, the risk of violence is low, but one of the core problems in MMD is the lack of self-awareness of the disorder, which makes the individual less keen to take medication and therefore enhances the risk of relapsing into symptoms that increase the risk of violence. Importantly, MMDs are neither necessary nor a sufficient cause of violence (Stuart 2003). In fact, people with severe mental illnesses are more likely to be victims of violent crime than the general population (Desmarais, Van Dorn et al. 2014).

It is increasingly accepted that most people with mental illness are not violent; that most violent acts are committed by people who are not mentally ill; and that substance use disorder (SUD), which is often comorbid with other mental disorders, is the major risk factor for violent behavior (Fazel, Gulati et al. 2009). These results are confirmed by our findings in the Swedish nation-wide sample, where the prevalence of SUD was 10 times more common in the AAB group than in the general population (Paper I). SUD was also the second most strongly associated risk factor to AAB (after conviction for non-violent criminality), and it increased the risk of AAB almost five-fold (Paper I). A recent study showed that SUD (and bipolar disorder) also had stronger effects on violent reoffending than any other psychiatric disorders (Chang, Larsson et al. 2015). In the violent young male offender sample, 84 % had SUD, and they reported an onset of alcohol and drug use in early adolescence (Paper II). The symptoms of early age at onset alcoholism coupled within poly-substance use and male predominance were previously described as strong predictors of antisocial and criminal behavior (Cloninger, Sigvardsson et al. 1996).

Besides SUD, another important clinical predictor of AAB that emerged from our register study was personality disorders (PD). It was 10 times more common to have an inpatient established diagnosis of PD in the AAB group

than in the general population (Paper I). Again, cluster B PD diagnoses were found in almost two-thirds of the young male violent offenders (Paper II), which mirrors previous results from prison populations regarding the frequency of offenders fulfilling criteria for PD (Rasmussen, Almvik et al. 2001, Fazel and Danesh 2002). In concomitant use of alcohol and illegal drugs among those with PDs, and particularly those with comorbid SUD, the risk of criminal behavior increased, as has been described in previous studies (Hernandez-Avila, Burlinson et al. 2000).

Parental variables proved to be of importance in predicting AAB. At least half of the AAB group parents were convicted of a crime, and one in five AAB individual had a parent who was also convicted of violence (Paper I). Findings such as these would indicate a link to such factors as disadvantageous socioeconomic circumstance, social learning, and/or genetic pre-disposition. While the structure of our datasets did not make it possible to analyze heritability and environmental factors, it has previously been presented by Frisell, Lichtenstein et al. (2011), using this nation-wide general population of register data, that there is a strong familial aggregation of interpersonal violence among first-degree relatives. This is further confirmed in Ferguson's meta-analytic review, which showed that 56 % of the interpersonal variance in AAB could be explained by heritability factors (Ferguson 2010).

School performance was generally poor in the AAB group and was reflected in the finding that failing to complete compulsory elementary school was five times more common among this group than in the general population. Previous studies have shown that severe school adjustment problems predict AAB (Wallinius 2012). The measure of failed school performance probably covers multiple underlying reasons, as also shown in the present thesis, as these children were, for example, heavily burdened by mental health problems (Paper II, IV) and had an early onset of illicit substance abuse (Paper II), and at the same time as being more likely to have at least one parent with mental health problems and criminality (Paper I); all of these factors are severe obstacles to academic achievement.

The level of trait aggression in the AAB group was overall high. A score of 15 out of the maximum 55 points on the Life History of Aggression questionnaire has been suggested as a cutoff for an atypically high level of aggression (Coccaro, Berman et al. 1997). We found that almost all male Swedish offenders' scores were well above this cutoff (in both the young male violent offenders and the male imprisoned offenders, the mean points of LHA were 31 (Papers II and III)), and nearly 70 % of the female offenders

also scored above this cutoff (Paper III). As high scores on LHA were independent of the type of offences, this finding indicates a close relationship between elevated aggression and the presence of a general criminal life style. Similar results have previously been presented in a meta-analytic review by Assink, van der Put et al. (2015), where the authors also found that aggression was, next to criminal history, the strongest associated factor to life-course persistent offending.

This thesis confirmed previously found risk factors for AAB, such as male gender, early debut in criminal behavior, frequent substance abuse problems, mental health problems, and socio-economic factors such as a lack of basic education, parental substance abuse problems, and parental criminality.

6.4 Personality of individuals with AAB, compared to the general population

When comparing temperament and character dimensions of offenders and children with CD to the age- and gender-matched general population, a salient pattern of personality emerged. Individuals with AAB had a low level of character maturity, coupled with a temperament characterized by elevated NS, low PS, and low RD (Papers II, III, and IV); therefore, as a group, they mirrored a markedly increased likelihood of fulfilling criteria for antisocial PD (Svrakic, Draganic et al. 2002, Cloninger and Svrakic 2008).

The offender groups, as well as the children with CD included in this thesis, all scored very low in their character dimensions (CO and SD). On average, they scored almost one standard deviation below the mean value of the normal population, thus revealing clear signs of an immature character (Papers II, III, and IV).

In adults, a low level of character maturity is indicative of a personality disorder with the severity of the disorder discerned by the degree of the deviation from the norm (Svrakic, Draganic et al. 2002, Richter and Brandstrom 2009). The character dimension that seemed to show the greatest association with AAB in adults was the inability to work with others, having low compassion and conscience, and a lack of will to share these with others, which is characteristic of a low CO (Appendix Table 12). AAB in children – that is, a norm-breaking childhood coupled with oppositional and impulsive behaviors – was associated with low self-governance (that is, low SD) (Paper IV). The SD dimension has previously also been shown to be the most sensitive indicator of neurodevelopmental disorders (ADHD and ASD) in

children (Cho, Hwang et al. 2008, Kerekes, Brandstrom et al. 2013). As far as we can ascertain, our results are the first to suggest a possible shift between how the character dimensions of SD and CO are associated with AAB during the life course, since SD seems to be the dimension that is most strongly associated during childhood, while CO takes that role during adulthood. Our results suggest that, in children, an impaired concept of the self as an autonomous individual (SD) is the key problem, while an impaired understanding of the concept of the self as an integral part of human society (CO) is the main deficiency in adults. Whether this describes a personality pattern indicative of the development of AAB remains to be proven in longitudinal studies.

The temperament profile of the TCI dimension, when compared to the normal population (Papers II, III, and IV), corresponds in adults to the profile of cluster B PDs, and particularly ASPD, where there is a heightened level of NS, low RD, and low PS (Svrakic, Draganic et al. 2002, Cloninger and Svrakic 2008).

Moreover, we saw that female offenders were somewhat more deviant in their personality from the age-matched controls than males (Paper III). There was also a statistically significant difference for women on NS, but not for males when compared to controls. Results of multifactorial models suggest that the sex differences (male dominance) in frequencies of antisocial personality and criminality originate from the fact that females have a higher threshold (critical liability level) in order to manifest antisocial or criminal behaviors (Cloninger, Christiansen et al. 1978). In a Swedish study the risk for criminal female adoptees to have a biological parent with a criminal record was more than twice as high than the risk for male adoptees to have a parent with a criminal record (Sigvardsson, Cloninger et al. 1982). Furthermore, female criminals' parents had significantly more convictions than male criminals' parents, suggesting that the congenital predisposition to criminality usually is more prominent in affected females than in males. Beside these quantitative biological antecedents, the study also showed that social experiences contributing to the behavioral development of adult criminality differs between the genders (Sigvardsson, Cloninger et al. 1982). In other words, female offenders are more deviant than males in terms of genetic and other transmissible factors that contribute to the liability to develop a criminal behavior (Cloninger, Christiansen et al. 1978, Sigvardsson, Cloninger et al. 1982). Previous research has found that female offenders are generally more burdened by mental health problems, adverse life events, substance use problems, and somatic health problems than male offenders, which in turn is reflected by the deviation in the TCI from the

general population (Moffitt and Caspi 2001, Yourstone, Lindholm et al. 2008, Shirazi, Fardin et al. 2016).

The profile of temperament in our offender groups also fairly closely matches the profiles found in individuals who are high in psychopathic traits. According to the American cutoff, 5 % of Swedish young male violent offenders fulfilled criteria for psychopathy, while this figure increased into 15 % when the European cutoff was used (Skeem, Polaschek et al. 2011) (Paper II). In Paper II, a significant increase in mean values on the PCL-R total score was found for those who were medium and low in character maturity. Additional analyses showed a significant difference in CO and RD where psychopathic offenders scored lower than non-psychopathic offenders. The correlation analyses revealed a similar pattern, with low CO showing the strongest association with the PCL-R total score, followed by a low RD and high NS. However, in the prediction model CO was still the strongest predictor, while a shift was seen in which RD and NS became non-significant and HA emerged as a significant and moderately strong predictor for PCL-R total score. These results are in line with previous findings by Snowden and Gray (2010) and Lennox and Dolan (2014), although the results presented by Snowden and Gray showed a stronger correlation between the temperament dimension NS and PCL-R total score. Another difference from these previous findings is that we did not find any correlation between HA and PCL-R total score, as Snowden and Gray (2010), and Lennox and Dolan (2014) did. To summarize, our results resemble those from previous studies on offender samples, while there also are some differences that probably depend on sample characteristics. This group of offenders, which is high in psychopathic traits, has previously been shown to be highly recidivistic and more prone to be convicted of violent crimes compared to non-psychopathic offender groups with general criminal behavior (Hare and McPherson 1984, Hemphill, Hare et al. 1998, Grann, Långström et al. 1999, Wallinius 2012, Sörman 2015).

6.5 Predicting the level of AAB by (TCI) personality dimensions

Offenders, even those who were not convicted of a violent crime in the current conviction, generally scored high in trait aggression (LHA), a measure of AAB. A majority of the female offenders scored lower than male offenders, although still above the previously suggested cutoff for an atypical level of aggression (Coccaro, Berman et al. 1997). Females were also less crime active, with an average of two previous convictions (Paper III),

compared to males with more than four (Paper III) or almost eight (Paper II) previous convictions. This information distinguishes females from males in two ways. Firstly, they are less likely to be defined as having AAB, since only one in 10 meets the criteria for AAB (Paper I). Secondly, those that do fulfill the definition of AAB are less likely to be as intense and as persistent in their destructive behavior as males.

When studying the association between the temperament and character dimensions to the level of trait aggression, a medium to strong correlation was found in character dimensions and the temperament dimension NS. This pattern revealed a consistent association between AAB and character immaturity, lack of goal orientation, unreliability, social intolerance or disinterest, unhelpfulness and vengefulness, combined with impulsiveness and excitement seeking. Female offenders had an even more pronounced association between their personality traits and AAB, preferably in the form of a low SD, a low PS, and a high NS. This result is in line with previous research by Eysenck and Eysenck (1973). Thus, the personality profile of AAB females exhibits an even greater influence on the level of aggressive behavior than on males.

Personality, as assessed by the seven dimensions of TCI, could explain up to half of the variance in AAB. Low character maturity coupled with an extreme temperament, where impulsiveness, sensation seeking, disorderliness and the need for novelty (NS), together with a detachment, insensitivity and independence from others (RD), create the foundation for an aggressive and antisocial personality (Svrakic, Draganic et al. 2002, Richter and Brandstrom 2009).

In children, the low level of the SD dimension, together with a high NS, were the most important factors for prediction of AAB; this is in contrast to adults, where character dimension CO had the most significant importance. According to these findings, the promotion to achieve personally chosen goals in children may serve as a protective factor against a later development of an antisocial life style, while in adults increasing social acceptance and improving their ability of metallization may decrease their propensity to become persistent in AAB.

7 CONCLUSION

A fairly small part of the population fulfills the criteria for AAB being convicted of at least one violent crime, while an even smaller group constitutes what could be described as individuals persistent in AAB. Almost all of these AAB offenders are males, with a low level of character maturity and a problematic personality profile fitting early conduct disorder, antisocial personality disorder and an increased level of psychopathic traits. They have an early debut in violent crime, substance use-related problems, and diversity in crime, with a high frequency of convictions. The results in this thesis suggest that preventive measures should be engaged in at different levels in society, with a focus on early detection, multidisciplinary intervention (social and mental health), and psycho-educative therapy aimed at raising the level of character maturity and thus promoting self-agency and accommodativeness as the most cost-effective and efficient ways of preventing AAB.

8 LIMITATIONS

There are limitations to the data collected in all of the papers. In Paper I, there was sharp skewness to the data showing convictions; this could be context-specific and could be less extreme in societies with a higher base prevalence of violent crime than Sweden. No other socioeconomic factors, except school performance, were included in Paper I, which prevented us from analyzing the relative importance of adverse social circumstances specifically. Mental disorders presented in Paper I are solely based on inpatient diagnoses from the Hospital Discharge Register, which most likely led to an underestimation of the actual prevalence of these disorders, especially PDs and SUDs. Another limitation of the analyses of PDs in Paper I is that this category included all types of PDs and we were not able to separate the most relevant ones, such as ASPD, from the cluster B disorders. We were also unable to identify those members of the AAB group who would be so-called ‘one-timers’; that is, those who just once would commit a single violent crime and never again relapse into any kind of criminality. It is therefore incorrect to postulate that that all who were convicted of a violent crime during the follow-up period are part of the AAB group, although those who did not meet all of the criteria for AAB are most likely very small. As 95 % of all the AAB group also had convictions for any non-violent crime, it seemed safe to include them all in the analyses, as any bias would be negligent. Any eventual bias would reduce the effect sizes and thus prevent overestimation. The strength of the study in Paper I is that it encompasses total population register, including almost 2.5 million individuals, and follows the cohort over 32 years. Swedish citizens are assigned a personal identification number upon birth and are used to coordinate personal information. The Swedish registry has good coverage as well due to a long tradition in information gathering within the population.

In Paper II, analyses were conducted on a sub-sample derived from a larger cohort of young male violent offenders, and based on those who had valid TCI protocols. This could indicate a degree of bias, even though we found no statistically significant differences in any of the studied factors between those with valid protocols compared to those without. Variables regarding previous criminality are based on self-reports and it was not possible at the time to compare to official records or convictions. Nevertheless, research on the accuracy in self-reports has found that it is, in many aspects, representative of the actual crime history (Del Boca and Darkes 2003).

To some degree, the considerably low number of subjects (about 50 % inclusion rate) in Paper III limits the generalizability of that study (Kukull and Ganguli 2012). However, this group of offenders is mainly representative of individuals with versatile criminal behavior. It is known that the characteristics of the study group matches a majority of those sentenced to prison in Sweden and of those in prison populations in European countries (Salize H. J, Dressing H et al. 2007).

In Paper IV, the prevalence of the targeted problems is considerably low in the general population. Therefore, the number of children in some specific subgroups was low (for example, ODD $n=47$, CD $n=70$) compared to others (for example, NDP $n=413$), which may have led to some inability to detect group differences.

The data was collected by parental report, which could be a strong limitation, but the A-TAC parental interview instrument has previously shown excellent diagnostic utility to screen for children with ADHD and ASD (Hansson, Svanstrom Rojvall et al. 2005, Larson, Anckarsater et al. 2010) and for those with CD or ODD (Kerekes, Lundstrom et al. 2014). Also, the data in Paper IV relies on a study population of twins. It has previously been suggested that twin children might have a lower rate of behavioral problems (Moilanen, Linna et al. 1999) and that they have a lower risk of developing substance abuse or criminality than age-matched singletons (Hjern, Ekeus et al. 2012). This limitation, together with the use of cutoffs with low sensitivity but very high specificity to select for children with CD and ODD, would result in an underestimation of the prevalence of behavior problems. In the prediction model (logistic regression), we used a general estimated equation to balance eventual bias between independent and dependent variables of twin pairs.

In the additional analyses of data, beside what is presented in the specific papers (II–IV), the investigation of the LHA scale showed that it was not fully normally distributed. However, when both parametric and non-parametric analyses were performed, the results yielded very small differences, both in statistical significance and in parameter strength; therefore, a linear regression was subsequently used for the additional correlation analyses of data originating from Paper II and III (presented in aim 4 and Results chapter 5.4).

9 FUTURE PERSPECTIVES

Further studies should be conducted into the relationship among personality profiles, underlying mental health problems, the relative importance of disadvantageous social circumstances, and other individual variables in order to more accurately identify those individuals at severe risk of developing persistence in AAB. Alongside the extended research of the risk factors and personality profiles, specific studies designed for a deeper understanding and evaluation of the efficacy of psycho-educative therapy for this very specific group of heavily ill-health-burdened individuals is recommended.

The results presented in this thesis are also relevant for questions about the development of preventive strategies, both with regard to different levels of society and at different stages of individuals' evolution into offenders with AAB. At a more general and primary level of crime prevention, it has been shown that equality between different social groups and gender equality with regard to income levels, access to education, health care, child care, social support and civil liberties has positive effects, since societies with high levels of equality have lower levels of criminality (Butchart and Engström 2002).

An important – and probably the most efficient secondary preventive – strategy entails efforts to identify those young children who might be developing AAB. Early-life signs of disruptive behavior with disregard for the feelings and needs of others are strong predictors of later severe antisocial behavior in adult life, as described in some of the larger cohort studies, including the Dunedin study (Moffitt, Caspi et al. 2002, Woodworth and Waschbusch 2008). These studies have identified a fairly small group of children that, when properly identified and given ample attention by professionals within the fields' of education, health care, and social services, would be prevented from following the trajectory that leads to a criminal life.

The AAB group's persistent offenders (more than two violent crime convictions) seem to be less constrained by the risk of punishment and less receptive to society's efforts in different kind of treatment programs. Around 20 years ago, the United States implemented the "three strikes" life imprisonment principle, which was initially reserved for aggravated violent crimes, but has since expanded into encompassing property crime and other non-violent categories of criminal behavior. This has resulted in accelerated growth of the prison population in the US, and yet there has been no significant reduction of crime (Males 2000). Incarceration alone does not seem to be effective enough in the long-term aspect of criminality. As shown

in Paper I, approximately 1 % of the population are persistent aggressive antisocial individuals. In spite of successful primary and secondary interventions, there will still be a small group developing persistence in AAB, and those are the ones that society needs to put some far-reaching restrictions of freedom on, for the protection of the public.

ACKNOWLEDGEMENT

I would first like to acknowledge my primary supervisor, Dr. **Nóra Kerekes**, for her unwavering efforts to push me toward becoming a better scientist and loyalty. She has never failed to answer my questions, even when she has been bombarded with things to do on weekends and holidays. Throughout the time we spent working together on different projects, she has been supportive and honest in her evaluation. I wish her all the luck and success that she truly deserves in her continued career and role as a supervisor. Thank you!

Prof. **Henrik Anckarsäter** was the first person that I met during the formation of the research group in Göteborg, in a quiet and empty local in Lillhagen. He has been very supportive of my interest in forensic psychiatry, which has been keen but at times unfocused. He has been an inspiration to me regarding public speaking, about which I was quite anxious for a long time. He has given me good advice along the way and I look forward to receiving more advice in the future.

Thomas Nilsson was appointed as my co-supervisor about a year before my dissertation due date. He has always been helpful, answering questions and discussing difficult scientific topics throughout my time with the research group. He is well balanced in his feed-back, knowledgeable, and meticulous in his work as a supervisor, for which I am most grateful.

I would also like to acknowledge Prof. **Claude Robert Cloninger** for his very kind hospitality and willingness to share his thoughts and opinions during my visit to St. Louis, where I was fortunate to learn more about his research group, join a clinical psychotherapeutic situation and receive an opportunity to give a talk about my research. Thank you!

Thank you to **Sven Brändström** for his comprehensive knowledge on the TCI and for his input that helped shape my thesis, and to **Peter Andiné** for his positive and supportive approach.

Thank you to **Åse Holl** for your positive attitude and eagerness to help in all administrative matters and many thanks to **Stefan Axelsson** for your fantastic job in making the book look good.

I would also like to acknowledge my co-authors – **Björn Hofvander, Märta Wallinius, Sebastian Lundström, Thomas Frisell, and Anis Sfindla** – for their valuable contributions from which I have learned a lot.

I am very thankful to **Caterina Finizia** for her work to improve the medical and scientific education for junior physicians at the Sahlgrenska University Hospital. You have been very supportive to me allowing me to further my studies at conferences and highly specialized courses. Thank you!

I wish to thank my sectional manager of resident psychiatrists at Sahlgrenska University Hospital **Marzia Dellepiane**, for the extra financial support I received at the end of my PhD-studies.

I am grateful for the support, supervision and inspiration I received when working with **Lars Eriksson** and **Klas Attrell** at the forensic psychiatric care unit in Lillhagen and Rågården. I would also like to acknowledge **Alessio Degl'innocenti** and **Frances Hagelbäck Hansson** for giving me the opportunity to alternate between clinic and scientific work as needed during my employment.

I am grateful to **Svenska Läkarsällskapet** for granting me stipends to support me before my employment at Sahlgrenska University Hospital.

I am very grateful for my wonderful friends **Araz Rawshani**, **Fredrik Olsen**, **Bodil Gessler** and **Roger Jakobsson** with whom I have had many interesting conversations regarding different aspects of scientific work.

Special thanks are due to my lovely and fantastic family **Angela**, **Felicia** and **Sebastian** for supporting me and accepting my long working hours and occasional frustrations during my PhD studies.

And lastly to all of my colleagues and friends not on this list who's been supportive and given valuable input. Thank you!

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APPENDIX

Table 12 provides supplementary information on the Temperament and Character Inventory. The information is based on the revised version, including 238 items divided into the seven dimensions. Additional information on the sub-dimensions of the instrument, and suggested neurobiological correlates for the temperament dimensions (Cloninger 1994, Cloninger, Adolfsson et al. 1996, Cloninger, Svrakic et al. 1997) can also be found in the table.

Table 12. Descriptive characteristics of the TCI-R.

	Dimension	Abbreviation	Characteristic of dimension	Sub-scale as measured by TCI-R	Neurobiological correlate
Temperament dimensions	Novelty Seeking	NS	Tendency toward exhilaration in response to novel stimuli or cues.	-Exploratory Excitability vs. Rigidity -Impulsiveness vs. Reflection -Extravagance vs. Reserve -Disorderliness vs. Regimentation	Dopamine
	Harm Avoidance	HA	Bias in the inhibition or cessation of behavior (i.e., difference in the reaction to unpleasant stimuli).	-Anticipatory Worry vs. Optimism -Fear of Uncertainty vs. Confidence -Shyness vs. Gregariousness -Fatigability and Asthenia vs. Vigor	Serotonin
	Reward Dependence	RD	Tendency to maintain or pursue ongoing behavior in presence of a potential pleasant stimulus.	-Sentimentality vs. Insensitiveness -Openness vs. Aloofness. -Attachment vs. Detachment -Dependence vs. Independence	Noradrenaline
	Persistence	PS	Tendency to maintain or pursue ongoing behavior	-Eagerness vs. Laziness -Work Hardened vs. Spoiled -Ambitious vs. Underachieving -Perfectionist vs. Pragmatist	

	Dimension	Abbreviation	Characteristic of dimension	Sub-scale as measured by TCI-R	Neurobiological correlate
Character dimensions	Self-Directedness	SD	A person's concept of the self as an autonomous individual.	-Responsibility vs. Blaming -Purposefulness vs. Lack of Goal -Direction Resourcefulness vs. Apathy -Self-Acceptance vs. Self-Striving -Congruent Second Nature	
	Cooperativeness	CO	Individual differences in the viewing of the self as an integrated part of humanity or society.	-Social Acceptance vs. Intolerance -Empathy vs. Social Disinterest -Helpfulness vs. Unhelpfulness -Compassion vs. Revengefulness -Pure Hearted vs. Self- Serving	
	Self-Transcendence	ST	The individual difference in the view of the self as an integral part of the universe	-Self-Forgetful vs. Self- Conscious -Transpersonal Identification -Spiritual Acceptance vs. Materialism	

