Adolescents at risk of persistent antisocial behaviour and alcohol problems:
The role of behaviour, personality and biological factors

by

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Abstract

Antisocial behaviour and alcohol problems are areas of great concern to society, not only associated with personal and emotional costs for the affected individuals and their victims, but also with major societal financial costs. What makes some individuals more likely than others to develop these kinds of problems? The general aim of this thesis was to explore the role of individual characteristics in the development of antisocial behaviour and alcohol problems. More specifically, the research focused on aspects of hyperactive behaviour, personality traits and biological vulnerability indicators in relation to self-reported norm breaking and violent behaviour, registered general criminality and violent offending in particular, and further, on risky alcohol use and drinking offences. The studies were based on both a prospective longitudinal project in which a group of adolescent male lawbreakers and controls were followed from the 1960s into the 1990s, and on more recently collected data on a representative group of Swedish male and female adolescents.

The results of the thesis supported that neuropsychological deficits, manifested in attention difficulties, and personality traits reflecting disinhibition and negative emotionality, influence the development of antisocial behaviour and risky alcohol use, which in turn increases the risk of subsequent alcohol problems. The findings indicated, furthermore, that these neuropsychological deficits may be associated with an underlying biological vulnerability to various forms of disinhibitory psychopathology. Although the thesis focuses on individual characteristics, the results also support the view that environmental risk factors such as the influence of family and peers and possible stress experiences, play an important role. It was emphasized that individual characteristics continuously interact with environmental conditions in shaping each individual's developmental course. Results also revealed that adolescent females displaying violent behaviour and engaging in potentially harmful use of alcohol deviated more in personality traits than did the corresponding group of males. Further knowledge of the development of these problems in females is crucial, since most theories in this area have been developed primarily on male samples.

Key words: adolescence, gender, hyperactive behaviour, biological vulnerability, personality, norm breaking behaviour, criminality, violence, alcohol problems.
Svensk sammanfattning


Resultaten visar att neuropsykologiska brister, som tar sig uttryck i uppmärksamhetsproblem, och personlighetsdrag relaterade till bland annat impulsivitet, spänningsökande och aggressivitet, bidrar till utvecklingen av antisocialt beteende och riskdrickande, vilket i sin tur ökar risken för senare alkoholproblem. Vidare tyder resultaten på att de neuropsykologiska bristerna kan vara associerade med en bakomliggande biologisk sårbarhet för beteenden kopplade till en bristande impulskontroll och en oförmåga att förutse konsekvenserna av sitt handlande. Trots att avhandlingen huvudsakligen fokuserar på individegenskaper, ger resultaten även stöd åt betydelsen av familj- och kamratförhållanden, samt möjliga stressupplevelser. Det är viktigt att betona att individens utveckling formas av ett kontinuerligt samspel mellan hans eller hennes egenskaper och förhållanden i omgivningen. Ett resultat värt att lyftas fram är att tonårsflickor med våldsbeteende eller riskdrickande avvekar mer i sin personlighetsprofil än vad motsvarande grupp pojkar gjorde. Mer kunskap om utvecklingen av dessa problem hos flickor är av stor vikt, eftersom huvuddelen av teorierna inom detta område har utvecklats utifrån studier på pojkar.
List of papers
The thesis is based on the following papers:

**STUDY 1:**

**STUDY 2:**

**STUDY 3:**

**STUDY 4:**

**STUDY 5:**
Eklund, J. M., & af Klinteberg. B. Alcohol use and patterns of norm breaking and violent behaviour in male and female adolescents. Submitted manuscript.

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1. Introduction
The present thesis explores the role of behaviour and personality, and to some extent biological factors, in the development of antisocial behaviour and alcohol problems. These are areas of great concern to society, associated not only with major financial costs, but also with personal and emotional costs for the affected individuals and their victims. It has been shown that a small group of offenders are responsible for the majority of crimes committed (Dalteg & Levander, 1998; Stattin & Magnusson, 1991). In addition to the high crime rate in this group, young offenders have higher mortality rates than the general population and often die of unnatural and violent causes or under the influence of alcohol and drugs (Sailas et al., 2005). They are also more likely to have mental disorders, including substance use disorders (Robertson, Dill, Husain, & Undesser, 2004), and to have undergone treatment for mental disorders (Sailas et al., 2005; Sailas, Feodoroff, Virkkunen, & Wahlbeck, 2005). Thus, a better understanding of this problem is of great importance for preventing antisocial behaviour and alcohol problems, and further, for enhancing the quality of life of individuals at risk of developing such problems.

1.1 Theoretical framework
It is well known that numerous factors contribute to the development of antisocial behaviour and alcohol problems. The theoretical framework of the present thesis is an interactionistic perspective in which an individual's functioning is dependent on the interplay of various types of factors - biological, psychological and environmental (Bergman & Magnusson, 1997). Individuals continuously interact with their environment and individual differences in personality affect the way they perceive, interpret and respond to given situations. From a developmental perspective, continuous reciprocal interactions between various aspects of the individual, as well as between the individual and his or her environment, are emphasized (Magnusson & Torestad, 1993). Furthermore, in the present work a dimensional approach was used, which enables studying different levels of the risk factors in focus. Thus, it was assumed that normal individuals differ in their vulnerability to developing various kinds of problems.

The main focus in this thesis is on individual factors, although it also includes information on family and friends. What makes some individuals more likely than others to develop antisocial behaviour and alcohol problems? A general description of some of the theories available on the development of these behaviours will be presented below, and thereafter a more detailed description of the specific risk factors in focus.

First, some definitions: in this thesis the broad term ‘antisocial behaviour’ will refer to a variety of norm breaking and criminal acts. ‘Violence’ is defined as be-
haviour that causes or threatens physical or mental harm to others (see Loeber & Hay, 1997; Loeber & Stouthamer-Loeber, 1998) and thus, refers to interpersonal violence. The term ‘aggression’ often refers to acts that cause less harm than violence. Further, due to the number of different concepts in alcohol research, ‘alcohol problems’ is sometimes used instead of terms such as alcohol dependence, alcoholism, alcohol abuse etc. ‘Hyperactivity’ is used according to Taylor’s definition (1998), that is, as a comprehensive term that describes a pattern of attention deficits, restlessness and impulsive behaviour. Finally, the terms ‘attention deficits’ and ‘attention difficulties’ will be used interchangeably.

1.2 Antisocial behaviour

When one looks at the age-crime distribution in the population, registered offences peak in adolescence and then gradually decline through adulthood (Sampson & Laub, 2003). The age-crime curve described for general criminality also roughly applies to specific types of crime, e.g. violent offences, although with varying peak ages and rates of decline. The increase in criminality during adolescence is mainly due to more individuals committing crimes at this age (Moffitt, 1993). However, the majority of young delinquents do not proceed to adult offending. From this starting point, attempts have been made to generate developmental offender typologies, describing subgroups of offenders following different criminal trajectories across time. One of these typologies is Moffitt’s (1993) developmental taxonomy of antisocial development, in which she distinguishes between adolescence-limited (AL) and life-course persistent (LCP) antisocial behaviour. The two pathways are sometimes referred to as adolescent-onset and childhood-onset pathways (see e.g. Silverthorn & Frick, 1999). The life-course persistent antisocial pathway is characterised by a stable pattern of problems with an early debut in life (Moffitt, 1993) and poor prognosis concerning criminality, mental health and substance dependence (Moffitt, Caspi, Harrington, & Milne, 2002). The proposed origin of the antisocial behaviour in this group is early neuropsychological dysfunction, manifested in e.g. attention deficits and impulsive behaviour, which interacts with environmental risk factors, such as inadequate parenting skills. The ‘difficult’ behaviour of the child may lead to impaired relationships and interactions with peers and adults, which further reduces the child’s opportunity to learn prosocial behaviour.

Adolescence-limited antisocial behaviour is, on the other hand, assumed to be mainly attributable to the gap between social and biological age that adolescents experience during the transition from child to adult, the so called “maturity gap” (Moffitt, 1993). In order to obtain a mature status, many adolescents therefore mimic the lifestyle of antisocial youths or engage in other behaviours like alcohol or drug use.
According to the theory, the antisocial behaviour becomes less motivating when adolescents in this group grow older. Because they generally have a normal development and sufficient prosocial skills, they are able to desist from crime. Furthermore, there is support for personality differences between these two groups of offenders (Moffitt, Caspi, Dickson, Silva, & Stanton, 1996). It is assumed that individuals with childhood-onset antisocial behaviour develop a ‘disordered personality’, which in early childhood is already characterised by a ‘difficult temperament’ (Moffitt et al., 1996), in late childhood by traits of impulsiveness and negative emotionality (Taylor, Iacono, & McGue, 2000) and in adulthood by psychopathic traits such as callousness (Moffitt et al., 2002).

A male preponderance in antisocial behaviour has repeatedly been reported in the literature (Gorman-Smith & Loeber, 2005; Moffitt, 2001, 2001). This gender difference appears to be reduced during adolescence (Moffitt, 2001), which might be due to a larger increase in the number of females, as opposed to males, engaging in antisocial behaviour during this period, or the results of a later debut in females (Silverthorn & Frick, 1999). According to Moffitt’s theory (1993), a smaller proportion of females than males should become antisocial. Furthermore, the theory proposes that the majority of antisocial females belong to the adolescence-limited group and that the causes of their behaviour resemble those of the adolescence-limited male group (Moffitt & Caspi, 2001). However, the applicability of the taxonomy to females’ antisocial development has been questioned. Silverthorn and Frick (1999) argued that research into prevalence of antisocial behaviour at different ages support a delayed-onset pathway in females. They also concluded that the characteristics and backgrounds of the antisocial females are similar to those of life-course persistent antisocial males. The origins of the antisocial behaviour in this female trajectory were assumed to correspond to the risk factors for life-course persistent antisocial males. The delayed-onset of antisocial behaviour until adolescence in the female group was partly explained by socialization processes. Nevertheless, more recent research into childhood predictors of antisocial behaviour revealed similar risk patterns with respect to neuropsychological problems, temperament and behaviour characteristics, and parenting factors, among life-course persistent antisocial males and females (Moffitt & Caspi, 2001). Males and females with adolescence-limited antisocial behaviour did not deviate from the norm concerning these risk factors, which is consistent with the original theory.

Further research also supports the distinction between adolescence-limited and persistent antisocial pathways (Fergusson, Horwood, & Nagin, 2000; Patterson, Forgatch, Yoerger, & Stoolmiller, 1998; Stattin & Magnusson, 1991; White, Bates, & Buyske, 2001), although some of these studies have identified additional criminal
trajectories. For example, Nagin and Land (1993) identified a group of low-rate chronic offenders, with persistent but low level antisocial behaviour. Similarly, Fergusson and co-workers (2000) identified a group with moderate and relatively stable offending (moderate offenders) in addition to the adolescence-limited and persistent criminal groups. Similar to Moffitt’s theory and previous research, the results showed that the persistent offenders had high risk levels for individual factors, such as attention and conduct problems, social and family features. However, unlike the hypothesis of there being distinct aetiologies for different trajectory groups, these findings revealed that the adversity level of the risk factors in focus increased as the offending trajectory increased in severity. Thus, the results indicated that a set of common risk factors are involved in the likelihood of developing offending behaviour. Fergusson and colleagues (2000) suggested that, in addition to these common risk factors, there are also trajectory specific risk factors, particularly concerning relationships with delinquent peers, which according to their study was likely to play a major role in the development of adolescence-limited offending.

A large proportion of the serious and persistent offenders also commit violent offences (Farrington & Loeber, 2000). Similarly, violent offenders often have serious and persistent criminality and commit a variety of different types of crimes. Thus, violence is frequently one part of a pattern of diverse antisocial behaviours. Loeber and Stouthamer-Loeber (1998) point out that Moffitt’s theory is based on the development of criminal behaviour in general and not violent behaviour in particular. It is therefore not possible to elucidate to what extent violent offending and property offending have common origins. However, several risk factors that predict persistent antisocial behaviour are also associated with the onset of violent behaviour (see Farrington & Loeber, 2000).

Although aggressive and violent behaviour is more frequently reported among males (Eagly & Steffen, 1986; Moffitt, 2001), it may well be manifested differently in males and females. While it has been demonstrated that males generally are more likely to engage in physical violent behaviour or violent criminality, physical violence towards a partner is as commonly reported among females as among males (Moffitt, 2001). Moreover, the tendency for males to be more aggressive than females appears to be more pronounced for physical aggression than for other types of aggression (Eagly & Steffen, 1986).

1.3 Alcohol use and alcohol problems

A similar typology to the one proposed by Moffitt (1993) for antisocial development has also been offered for alcoholism. This typology distinguish between subgroups Type I and Type II alcoholism (Cloninger, Sigvardsson, & Bohman, 1996; von Knorring,
Bohman, von Knorring, & Oreland, 1985; von Knorring & Oreland, 1996; von Knorring, von Knorring, Smigan, Lindberg, & Edholm, 1987). Type II alcoholism is characterised by an early debut and is assumed to be connected to genetic factors, while Type I alcoholism starts later in life and is to a higher extent influenced by environmental factors. Furthermore, Type II alcoholism is more frequently associated with additional problems like drug abuse and antisocial behaviour than is later developed alcoholism (Cloninger et al., 1996; von Knorring et al., 1985; von Knorring et al., 1987). It was previously assumed that early developed alcoholism (Type II) was present only in males (von Knorring & Oreland, 1996; von Knorring et al., 1987), but there are now indications of the existence of a Type II alcoholism-related group among females as well (Hallman, Persson, & af Klinteberg, 2001).

Males are generally more likely to have an early alcohol debut than females (Hellandsjo Bu, Watten, Foxcroft, Ingebrigtsen, & Relling, 2002) and a high frequency of binge drinking (Chassin, Pitts, & Prost, 2002). Research has shown that an early alcohol debut is related to higher subsequent alcohol consumption (Hellandsjo Bu et al., 2002) and a greater risk of alcohol dependence (Grant & Dawson, 1997; Grant et al., 2005). Furthermore, risky alcohol use during adolescence is assumed to increase the likelihood of developing early alcohol abuse (Schuckit & Smith, 1996). Although an early onset and high frequency of binge drinking appear to be related to the most negative outcomes, adolescents with later onset and moderate frequency of binge drinking have a higher risk of developing alcohol-use disorders than those who do not binge drink (Chassin et al., 2002).

1.4 Association between antisocial behaviour and alcohol use/problems

Several lines of research indicate an association between alcohol use or abuse and antisocial or violent behaviour. It has been shown that the national trends of alcohol consumption correspond quite well with homicide and assault trends (Norstrom, 1998; von Hofer, 2003) and that a considerable proportion of violent crimes is committed by individuals with an alcohol or drug use disorder (Grann & Fazel, 2004). Further research has supported the idea that there is both a relationship between and a co-occurrence of these behaviours (af Klinteberg, Andersson, Magnusson, & Stattin, 1993; Caspi et al., 1997; Magnusson & Bergman, 1990; Nash Parker & Auerhanh, 1998; Rydelius, 1983; White, Loeber, Stouthamer-Loeber, & Farrington, 1999). Adolescents with conduct or violence problems, are more likely than others to display problematic alcohol and drug use (Farrington & Loeber, 2000; White, Xie, Thompson, Loeber, & Stouthamer-Loeber, 2001). Correspondingly, adolescents and young adults who misuse alcohol are more likely than others to display externalizing problems and delinquent behaviour, especially with respect to violent
offences (Chassin et al., 2002; Fergusson, Lynskey, & Horwood, 1996; Richardson & Budd, 2003). Males and females who binge drink are also at higher risk of engaging in disorderly behaviour or criminality while under the influence of alcohol (Richardson & Budd, 2003).

Following this general description of the development of antisocial behaviour and alcohol problems, the next sections will give a more detailed account of the risk factors in focus in the present thesis, starting with behavioural characteristics.

1.5 Behavioural characteristics
Several studies have reported a high prevalence of Attention Deficit Hyperactivity Disorder (ADHD) in prison inmates and forensic samples (Dalteg, Gustafsson, & Levander, 1998; Rosler et al., 2004; Soderstrom, Sjodin, Carlstedt, & Forsman, 2004). Hyperactivity has also been related to violent criminality (af Klinteberg et al., 1993), violent recidivism (Soderstrom et al., 2004) and alcohol use or abuse (af Klinteberg et al., 1993; Biederman, Wilens, Mick, Faraone, & Spencer, 1998; Garland et al., 2001; Milin, Loh, Chow, & Wilson, 1997; Moss & Lynch, 2001; Tarter, Alterman, & Edwards, 1985; White et al., 2001). However, a large proportion of hyperactive children have other co-occurring psychiatric diagnoses, of which one of the most common is Conduct Disorder (CD) (Biederman et al., 1996; Burke, Loeber, & Lahey, 2001; Dalsgaard, Hansen, Mortensen, Damm, & Thomsen, 2001; Frick et al., 1991). Conduct disorder can be described as a pattern of antisocial behaviours which include aggressive behaviour, damage to property, deceitfulness or theft (American Psychiatric Association, 1994).

It has not yet been established whether hyperactivity in itself is associated with an elevated risk of developing criminal or violent behaviour and alcohol problems or whether the demonstrated relationships are due to the overlap with behavioural problems, such as conduct disorder. While some research has shown that the association between hyperactivity, criminality and alcohol problems is dependent on co-occurring conduct disorder (Fergusson, Lynskey, & Horwood, 1997), other results indicate that symptoms of ADHD as well as CD alone or in combination increase the risk among males of developing subsequent problems (Babinski, Hartsough, & Lambert, 1999). There is also support for the combination of hyperactivity and CD (or delinquency) contributing to later problems (Biederman et al., 1996; Forehand, Wierson, Frame, Kempton, & Armistead, 1992; Moffitt, 1990). Thus, there have been conflicting findings about the role of conduct disorder in the development of antisocial behaviour and alcohol problems.
1.6 Personality
The question of whether some people are more prone to crime than others or, more specifically, whether a personality style exists which is more associated with crime, has been raised in the literature (Caspi et al., 1994; Krueger et al., 1994). Research has shown that both males and females engaging in criminality or violent behaviour generally display impulsive and sensation seeking traits as well as a proneness to experience negative emotions such as anger and irritability (Caspi et al., 1994; Krueger et al., 1994). Furthermore, they are more likely than others to reject social norms and to have a hostile attitude towards the environment. These results also appear to apply to individuals with violent criminality (af Klinteberg, 1996; Caspi et al., 1997). Research by Caspi and co-workers (1997) revealed similar personality profiles in young adults with violent offending, alcohol dependence or other health risk behaviours and indicated that individuals with a combination of several health risk behaviours had more extreme personality scores. There are also studies which have found personality traits, such as those presented above, in groups characterised by substance use or abuse (Cloninger, Sigvardsson, & Bohman, 1988; Grau & Ortet, 1999; Kuo, Yang, Soong, & Chen, 2002; Wolff & Wolff, 2002; von Knorring, Oreland, & von Knorring, 1987; von Knorring et al., 1987), with the most pronounced personality scores among individuals with mixed alcohol and drug use or Type II alcoholism (von Knorring et al., 1987; von Knorring et al., 1987).

1.7 Genetic and biological factors
Personality traits related to criminal or violent behaviour and alcohol problems have also been found to be influenced by genetic factors (Blonigen, Hicks, Krueger, Patrick, & Iacono, 2005; Krueger, 2000). Other research has indicated a high degree of heritability of antisocial behaviour (Taylor et al., 2000) and alcoholism (van den Bree et al., 1998). In addition to focusing on genetic effects, part of the research has focused on biochemical measures as possible markers of a genetic vulnerability or dysfunction in the nervous system. One of the biochemical markers which has been looked at in relation to antisocial behaviour and alcohol problems is monoamine oxidase (MAO) activity, an enzyme involved in the metabolism of neurotransmitters such as serotonin, dopamine and noradrenalin. There are two types of MAO in the brain, Type A and Type B, which are closely interrelated (see review by Oreland & Hallman, 1995). The latter type, MAO-B, is also present in our blood platelets and often used as an indirect indicator of serotonin turnover in the brain. The MAO activity appears to be highly heritable (Orelan & Hallman, 1995; Pandey, Fawcett, Gibbons, Clark, & Davis, 1988) and although there is a large variation in the activity between individuals, it appears to be relatively stable across time in individuals (Orelan, 2004).
Low MAO activity has been demonstrated in criminal groups, with the lowest levels in persistent offenders (Alm et al., 1996; Alm et al., 1994) and violent offenders (Belfrage, Lidberg, & Oreland, 1992; Oreland, Ekblom, Garpenstrand, & Hallman, 1998). Furthermore, MAO activity is negatively associated with alcoholism in males and females (Hallman, von Knorring, Edman, & Oreland, 1991; Pandey et al., 1988; Yates, Wilcox, Knudson, Myers, & Kelly, 1990). Research has shown reduced platelet MAO activity particularly in groups with Type II alcoholism (Devor, Cloninger, Hoffman, & Tabakoff, 1993), a finding mainly demonstrated in male samples (Sherif, Hallman, & Oreland, 1992; Sullivan et al., 1990). In addition, a study by Pandey and co-workers (1988) showed that the subgroup of individuals with alcoholism and low MAO activity had an earlier onset of alcoholism, used drugs more frequently, and was more likely to have a family history of alcoholism, in line with the suggested features of Type II alcoholism.

Several studies have found an association between low MAO activity and impulsive or sensation-seeking related personality traits (af Klinteberg, Schalling, Edman, Oreland, & Åsberg, 1987; Schalling, Edman, Åsberg, & Oreland, 1988; Schalling, Åsberg, Edman, & Oreland, 1987; Stalenheim, von Knorring, & Oreland, 1997; von Knorring, Oreland, & Winblad, 1984). There is also some support for a link between low MAO activity/serotonergic responsivity and hyperactive behaviour (af Klinteberg & Oreland, 1995) and aggression-related traits (af Klinteberg et al., 1987; Manuck et al., 1998; Stalenheim et al., 1997). However, it has been demonstrated that smoking inhibits MAO activity (Oreland, Fowler, & Schalling, 1981) and smokers tend to display similar personality traits to individuals with low MAO activity (von Knorring & Oreland, 1985). As a consequence, the previously reported associations were questioned and it was suggested that they might be artefacts of smoking (for a review see Oreland, 2004). Non-human primate models, however, have given additional support to the link between MAO activity, alcohol consumption and Type II alcoholism (Fahlke, Garpenstrand, Oreland, Suomi, & Higley, 2002; Gerald & Higley, 2002; Higley & Bennett, 1999).

Another biochemical marker of interest is the thyroid hormone triiodothyronine (T3). Thyroid hormones are connected with the sympathetic nervous system and therefore assumed to be related to stress. It has been demonstrated that elevated levels of thyroid hormones reduce sympathetic activity (Whybrow & Prange, 1981). Interestingly, low sympathetic activity has been reported in criminal groups (Lidberg, Levander, Schalling, & Lidberg, 1978). Elevated T3 levels have been found in groups displaying antisocial disorder and criminality (Stalenheim, von Knorring, & Wide, 1998), particularly those with criminal recidivism (Alm et al., 1996; Stalenheim, 2004). In a forensic sample, T3 levels were found to be higher in patients with previous
conduct disorder than in those without this behaviour disorder (Ramklint, Stålenheim, von Knorring, & von Knorring, 2000). It has previously been suggested that there is a link between T3 and ADHD, with slightly elevated T3 levels reported in children with ADHD (Toren et al., 1997). Furthermore, there is some support for there being a positive association between T3 and personality traits such as novelty seeking (Wang et al., 1997) and boredom susceptibility (Balada, Torrubia, & Arque, 1992).

As described in the above introduction, a common denominator in antisocial behaviour and alcohol problems, in particular the early onset types, is that they are assumed to be highly influenced by genetic factors (Arseneault et al., 2003; McGue, Pickens, & Svikis, 1992; Taylor et al., 2000). Several of the risk factors associated with antisocial behaviour are also related to the development of alcohol problems. Because of this overlap, and given that these behaviours are also strongly linked, it is of importance to investigate them simultaneously.
2. Aims
2.1 General aims
The general aim of this thesis was to study the behaviour and personality characteristics during early adolescence that contribute to the development of antisocial behaviour and alcohol problems. The objective was also to focus on biological factors in relation to early behavioural characteristics and adult antisocial behaviour.

2.2 Specific aims
1) To study aspects of early hyperactive behaviour in relation to subsequent drinking offences and violent offending, taking the possible confounders of early criminality and aggressive behaviour into account (STUDY 1).

2) To examine personality characteristics in adolescents who display violent behaviour and risky alcohol use (STUDY 2).

3) To investigate possible biological vulnerability indicators associated with early behaviour problems and adult violent offending (STUDY 3).

4) To study stability of and change in criminal behaviour from early adolescence to early adulthood and to explore individual, family, peer and school-related factors associated with various criminal and non-criminal pathways (STUDY 4).

5) To investigate alcohol use in relation to patterns of norm breaking and violent behaviour in adolescence, focusing on similarities and differences between the sexes (STUDY 5).

More specific research questions and hypotheses are described in the Results section.
3. Material and methods

3.1 Participants

The studies in this thesis are based on data from the research project *Young Lawbreakers as Adults* and a sample of *adolescent males and females in 8th grade*.

3.1.1 “Young Lawbreakers as Adults”

“Young Lawbreakers as Adults” (YLA) is a prospective longitudinal project initiated in 1956 (described in SOU, 1971). The sample comprised a group of 192 young males who were registered for a first-time offence between the ages of 11 to 14 years and 95 matched controls. The participants lived in the Stockholm area and were followed from age 11-14 years to adult age. Males in the criminal and control groups were matched with respect to age, social class, family situation and residential area. The first data collection took place during 1959–1963 and included 84 males from a pilot study and 203 males from a main study (see Figure 1). The criminal males were selected from lists supplied by the police authority and the controls were chosen from the census register. The study was restricted to males who had not started working and whose crime debut involved a property crime. None of the criminal males were imprisoned because they were under the age of criminal responsibility. The crimes committed were, however, serious enough for them to have been prosecuted if they had been over 15 years of age.

A subgroup of males (n=213) were also examined on enrolment for military service, when they were approximately 18 years old (until 1971). The drop-out (n=74) was mainly due to some of them already having enrolled for or having been exempted from military service, having moved, died or dropped-out for some other reason. During the period 1984-1986, 199 males (aged 32-40 years) participated in a follow-up study (af Klinteberg, Humble, & Schalling, 1992), of whom 125 (aged 38-46 years) agreed to a further examination during 1988–1991 (Alm et al., 1996). The remaining 74 of the 199 invited males did not want to participate, were living too far away, could not be contacted or had died since the previous follow-up study. The assessment methods in the project included interviews with the young males, their guardian/parent and teachers, teacher ratings, a psychiatric interview, self rating questionnaires etc and comprised information about their social situation, home environment, peer relations, school factors, personality and behaviour characteristics, biochemical measures etc. Register crime data was also collected at several occasions.

The first study in this thesis (STUDY 1) included all subjects with complete data for each evaluation. Subjects with missing data for some variables did not differ from the remaining subjects with regard to the other variables. The third study (STUDY 3)
comprised males who participated in the final follow-up study (1988-1991) and had complete data for the included variables (n=103). There were no significant differences between the sub-sample and the rest of the original cohort concerning the variables in focus. STUDY 4 included 277 males, of whom 188 criminals and 89 controls. Ten males did not fulfil the criteria for inclusion and were thus excluded*.

3.1.2 Adolescent males and females in 8th grade
The second sample was part of a project which began during the fall of 1998 and followed a group of adolescents over 18 months. The project comprised a representative group of 8th grade male and female adolescents in a medium-sized town in Sweden. All adolescents present at school on the day of the first data collection were included (n=1186). The target sample was 1279 8th grade students; 93% were thus present during the data collection (Andershed et al., 2002). The mean age in the group was 14.4 years. A number of parents did not wish their child to participate in the study, and 12 adolescents were therefore excluded (Kerr & Stattin, 2000). The available data consists of information about behavioural and personality characteristics, parent-child interactions, peer relations and adjustment obtained from self-reports, as well as parent and teacher reports.

Information from the first data collection was used in the present thesis. The second study comprised adolescents with complete data for the relevant variables (n=966; 414 males and 552 females) (STUDY 2). In the fifth study 938 adolescents with complete information for the variables used for identifying subgroups were included (n=938; 406 males and 532 females) (STUDY 5).

3.2 Measures
3.2.1 Individual characteristics
3.2.1.1 Psychological and behavioural characteristics (YLA & Adolescent sample)
The data on psychological characteristics and behaviour in the YLA sample come from teacher ratings (in writing or from a structured interview) at the time of the first data collection. The teachers had known and observed the subjects for a couple of years and taught their classes in almost all subjects. Items were rated on five-point scales with brief end point descriptions presented below. One of the measures was obtained from a psychiatric evaluation, also carried out at age 11-14 years.

The teacher ratings included questions concerning aggressive behaviour (1=very obstinate and aggressive, often fights and teases his peers, 5=extremely peaceable, always avoids getting into a fight) and attention and concentration ability (1=very inattentive and easily distracted, 5=always attentive to the task and never distracted). In the first and the third study the variables were dichotomised and ratings of 1-2

* Males in the criminal group with a crime debut after the age of 14 (n=4) and those in the control group who committed crimes after inclusion in the study but before the age of 15 (n=6).
FIGURE 1
Description of the Young Lawbreakers as Adults project

1960

1959-63
FIRST DATA COLLECTION
11-14 years
287 Ss (192 D, 95 C)

1959-60
PILOT STUDY
11-15 years
84 Ss (42 D, 42 C)

1960-63
MAIN STUDY
11-14 years
203 Ss (153 D, 53 C)

DROP-OUT
16 Ss (8 D, 8 C)

DROP-OUT
3 Ss (3 D)

Psychological & behavioural characteristics
Social characteristics
STUDY 1, 3 & 4

1970

Until 1971
FOLLOW-UP STUDY
approx. 18 years
213 Ss (141 D, 72 C)

Self-reported criminality
STUDY 4

REGISTER DATA
up to 1971
Criminality < age 15
Drinking off. ≤ age 18
STUDY 1, 3 & 4

1980

1984-86
FOLLOW-UP STUDY
32-40 years
199 Ss (133 D, 66 C)

DROPOUT
88 Ss (59 D, 29 C)

REGISTER DATA
up to 1982
Criminality (16-34 yrs)
STUDY 4

1988-91
FOLLOW-UP STUDY
38-46 years
125 Ss (78 D, 47 C)

DROPOUT
162 Ss (114 D, 48 C)

REGISTER DATA
up to 1991
Violent criminality
(≤ mean age 35)
STUDY 1 & 3

1990

1959-63
FIRST DATA COLLECTION
11-14 years
287 Ss (192 D, 95 C)

1959-60
PILOT STUDY
11-15 years
84 Ss (42 D, 42 C)

1960-63
MAIN STUDY
11-14 years
203 Ss (153 D, 53 C)

DROP-OUT
16 Ss (8 D, 8 C)

DROP-OUT
3 Ss (3 D)

Psychological & behavioural characteristics
Social characteristics
STUDY 1, 3 & 4

1970

Until 1971
FOLLOW-UP STUDY
approx. 18 years
213 Ss (141 D, 72 C)

Self-reported criminality
STUDY 4

REGISTER DATA
up to 1971
Criminality < age 15
Drinking off. ≤ age 18
STUDY 1, 3 & 4

1980

1984-86
FOLLOW-UP STUDY
32-40 years
199 Ss (133 D, 66 C)

DROPOUT
88 Ss (59 D, 29 C)

REGISTER DATA
up to 1982
Criminality (16-34 yrs)
STUDY 4

1988-91
FOLLOW-UP STUDY
38-46 years
125 Ss (78 D, 47 C)

DROPOUT
162 Ss (114 D, 48 C)

REGISTER DATA
up to 1991
Violent criminality
(≤ mean age 35)
STUDY 1 & 3

1990
and 3-5 respectively represented ‘high’ and ‘low’ manifestations of the behaviours (STUDY 1 & 3). None of the young males were rated as always being attentive and never distracted. Both ‘continuous’ variables were reversed and used in the fourth study (STUDY 4). A psychiatrist rated the number of symptoms of motor restlessness from 0 to 4. In the first and the fourth study males with two or more symptoms were considered as having ‘high’ motor restlessness and males with none or one symptom as having ‘low’ motor restlessness (STUDY 1 & 4). Hyperactive behaviour was defined as a combination of the two dichotomous variables attention difficulties and motor restlessness, and yielded the four categories: (1) low attention difficulties, low motor restlessness; (2) high attention difficulties, low motor restlessness; (3) low attention difficulties, high motor restlessness; and (4) high attention difficulties, high motor restlessness forming the hyperactive behaviour group (STUDY 1).

Teachers were also asked to indicate the boy’s emotional balance (1=very calm & secure; 5=very nervous & worried) and self esteem (1=Underestimates his own ability, feelings of inferiority; 5=overestimates his own ability, bragging). In the fourth study the variable ‘self esteem’ was dichotomised and referred to having ‘exaggerated’ or ‘low to normal’ self-esteem. Teachers also rated intellectual ability (1=above normal intelligence, extremely gifted; 5=below normal intelligence), reading and writing difficulties (1=no difficulties at all; 5=pronounced difficulties), ambition (1=very ambitious; 5=indifferent/not ambitious at all) and school achievement (1=higher than the grade of intelligence, extremely gifted; 5=considerably worse than the grade of intelligence would admit). Three additional items measured adjustment at school: school adjustment (1=good adjustment; 5=adjustment problems), adjustment to regulations (1=anxious to follow the rules and regulations; 5=constantly disregarding the rules and regulations) and truancy (1=no truancy at all; 5=frequent truancy) (STUDY 4).

Self-report questionnaires were administered to the participants in the other adolescent sample. Personality traits were assessed using the self-report questionnaire Karolinska Scales of Personality-Junior (KSP-J, Ekselius, von Knorring & af Klinteberg, 2003). The questionnaire was originally developed to dimensionally cover specific aspects of personality assumed to be of importance for psychopathology. Hence, it was not intended to measure “the whole personality” (af Klinteberg, Schalling, & Magnusson, 1986; Schalling et al., 1987). The questionnaire comprises 135 items designed to measure 15 scales: Impulsiveness, Monotony Avoidance, Detachment, Socialization, Social Desirability, Somatic Anxiety, Muscular Tension, Psychic Anxiety, Psychasthenia, Inhibition of Aggression, Verbal Aggression, Indirect Aggression, Irritability, Suspicion, and Guilt. The scales were largely developed on the basis of theoretical considerations rather than factor analyses, which explains some of the varying reliabilities. For a description of the scales see Appendix 1 (STUDY 2).
3.2.1.2 Biochemical measures (YLA)

Information about the biochemical measures monoamine oxidase (MAO) activity and triiodothyronine (T₃) level was obtained from a medical examination during the second follow-up study at adult age. Platelet MAO activity was estimated from blood samples by using a conventional radiometric method with tryptamine and 2-phenethylamine as substrates. Platelet MAO activity is expressed as nanomoles of substrate oxidised per 10¹⁰ platelets per minute. There was a highly significant correlation between the two MAO measures obtained by the substrates 2-phenethylamine and tryptamine (r=0.84, p<.001). Because in the analyses of the present research the results for the two MAO substrates were very close, only one MAO activity measure (2-phenethylamine) was chosen to be presented. The variable was dichotomised by using the median value (low MAO activity ≤ median < high MAO activity) (STUDY 3).

Venous blood samples were taken at the beginning and at the end of the examination (1.5–2 hours later) and T₃ levels were estimated using radioimmunoassay methods. The T₃ level is expressed as nanomoles per litre. The two T₃ measures ‘before’ and ‘after the examination’ were highly correlated (r=0.89, p<.001) and the results for the two measures were accordingly high. Therefore the results for the post-examination T₃ measure were presented. The variable was dichotomised by using the median value (low T₃ level ≤ median < high T₃ level). (STUDY 3) For a more detailed description of the procedures for estimating the biochemical measures see Alm et al (1996; 1996; 1994).

3.2.2 Social characteristics

3.2.2.1 Family and home conditions (YLA)

A structured interview with each male took place at age 11-14 years and included questions about family and home environment. Participants rated their relationships with their parents (relationship father-son and relationship mother-son) on a scale from 1=positive to 5=negative, as well as the emotional home climate (1=warm and affectionate emotional home climate; 5=poor emotional home climate or open hostility with quarrels and disagreements). They were also asked about the occurrence of parents’ alcohol abuse at home (yes/no) (STUDY 4).

3.2.2.2 Peer relationships (YLA)

The interview also included questions regarding peer contact (1=good peer contact; 5=pronounced difficulties in peer contacts) and peer criminality (1=no peer criminality; 5=high peer criminality), in addition to the presence or absence of a best friend (yes/no). The items concerning peer contact and peer criminality were only included in the main study and were thus available for a limited group of males only (n=203).
Information about peer stability was obtained from a teacher rating on a 5-point scale (1=always staying with the same friends, deep contact with friends; 5=is often changing friends, shallow contacts). The variable was dichotomised and refers to having low or high peer stability. Furthermore, teachers rated the male’s dependence on peer norms on a 5-point scale (1=extremely independent on peer norms; 5=extremely dependent on peer norms). The variable was dichotomised and refers to having low or high dependency of peer norms (STUDY 4).

3.2.3 Antisocial behaviour

3.2.3.1 Self-rated norm breaking and violent behaviour (Adolescent sample)

The adolescents were asked to complete a questionnaire on norm breaking and violent behaviour. The various behaviours were rated on 5-point scales (1=No, never; 2=1 time; 3=2-3 times; 4=4-10 times; 5=More than 10 times). Self-rated norm breaking behaviour was divided into the three types: minor offences, damage to property and burglary/theft. Six items concerning offences such as shoplifting, receiving stolen goods or cycle theft indicated involvement in ‘minor offences’: 1) Have you taken items from a mall, store, or newsstand without paying?; 2) At home, have you taken money that did not belong to you?; 3) Have you stolen anything from someone’s pocket or bag?; 4) Have you bought or sold something that you knew or suspected had been stolen?; 5) Have you without permission taken a bike?; 6) Have you purposely left a café, movie theatre, bus, or anywhere else without paying? Two items relating to vandalism, graffiti or similar acts were chosen to measure ‘damage to property’: 1) Have you purposely vandalized or taken part in vandalizing things such as windows, street lamps, telephone booths, benches, or gardens?; 2) Have you ever been involved in illicitly vandalizing with graffiti or writing something in ink or paint somewhere, e.g. on a wall? Finally, four items regarding more severe forms of norm-breaking behaviour formed the index ‘burglary/theft’: 1) Have you ever been involved in breaking into a house, store, newsstand, storage, or any other building with the purpose of stealing something?; 2) Have you ever been involved in taking a car without permission?; 3) Have you ever been involved in taking a moped, motorcycle, or scooter without permission?; 4) Have you ever been involved in stealing something from a car? (STUDY 5)

Involvement in violent behaviour was measured by five items: 1) Have you ever threatened or forced someone to give you money, cigarettes or something else?; 2) Have you ever been involved in threatening or forcing someone to do things that he/she did not want to do? 3) Have you ever been involved in a physical fight in the city?; 4) Have you ever been involved in hitting someone so severely that you believe or know that he/she needed medical care?; 5) Have you ever on purpose attacked
someone with a knife, stiletto, knuckle-duster, or something similar? In the second study violent behaviour was defined as having a score of 5 or more for the included items (1, 3, 4, 5), that is, having committed at least one of these acts. A total score of 4 was not considered as displaying violent behaviour (STUDY 2). In the fifth study items 1 and 2 were chosen to indicate violence manifested in ‘threat/force’ and the latter three items formed the index ‘physical violence’ (STUDY 5).

3.2.3.2 Self-reported criminality (YLA)
Information about self-reported criminality (approx. 18 years) was obtained from a questionnaire administered on enrolment for military service and was available for a subgroup of males (n=213). The questionnaire comprised 21 questions about damage to property, fraud, theft, receiving stolen goods, burglary, violent crimes, traffic offences under the influence of alcohol, narcotics crimes and arson. In addition to the separate crime types, an index variable of self-reported criminal versatility was used. The index variable was based on the number of reported criminal acts of various types (minimum value=0; maximum value=20). Two items concerning damage to property were very similar and therefore rated as one crime type (STUDY 4).

3.2.3.3 Registered criminality (YLA)
Criminality during early adolescence: As was described above, the original sample (YLA) was selected with regard to early criminal behaviour. Two thirds (n=192) of the total sample were registered in police records for crimes committed after the age of 11 years and before the age of 15 years*. Of the 192 males with a criminal record, 131 had one registered crime (D1) and 61 had two or more registered crimes (D2). The debut crime was a property crime and in total, the types of crimes committed before 15 years of age were burglary, shoplifting, theft, crimes involving motor vehicles and in one case a violent crime. The remaining 95 males were matched controls and had no registered crimes at the time of inclusion in the study. In the first study the trichotomised crime variable as well as a dichotomised crime variable (presence – no presence) was used (STUDY 1). In the third study the trichotomised variable (C: n=34 Ss; D1: n=42; D2: n=27) was used in some of the analyses (STUDY 3). In the fourth study the crime variable used refers to the number of first, second and third degree crimes committed (STUDY 4). First degree crimes are those that would lead to a fine if the males had been over 15 years of age. Second and third degree crimes would have led respectively to imprisonment and imprisonment for at least six months (STUDY 1, 3 & 4).

* Except for 4 males with a crime debut slightly after 15 years of age. For more information about the selection criteria see the ‘Participants’ section above
Registered drinking offences during adolescence: The variable drinking offences refers to drinking offences committed when aged 11-18 years and includes drunkenness in public and disorderly conduct/behaviour under the influence of alcohol. Before 1977 this was considered criminal behaviour in Sweden (STUDY 1).

Criminiality during late adolescence to adult age: Criminality during late adolescence (16-19 years), early adulthood (20-24 years) and adulthood (25-34 years) refers to the number of registered violent crimes, narcotics crimes, fraud, theft, traffic offences and other crimes (than those previous mentioned) (STUDY 4). In the first and the third studies violent offending refers to violent crimes committed up to the mean age of 35 years (range 32-38 years) (STUDY 1 & 3).

3.2.4 Alcohol use and indications of alcohol abuse
In the YLA sample, information about alcohol use and indications of alcohol abuse was obtained from the structured interview with the young males at age 11-14 years. The two dichotomous variables refer to alcohol use and indications of alcohol abuse respectively. Indications of alcohol abuse were based on frequency of consumption and drunkenness, the kind of drink consumed, and in what environment the alcohol was consumed (STUDY 4).

The self-report questionnaires administered to the adolescent sample also comprised questions regarding frequency of drunkenness and excessive alcohol use. The first item “Have you ever been drinking beer, spirits, or wine to the point of feeling drunk?” was rated on a five-point scale (1=No, never; 2=1 time; 3=2-5 times; 4=4-10 times; 5=More than 10 times). The other question “I have used alcohol excessively” was dichotomous (True/False). The two alcohol-related items were also combined into the dichotomous variable risky alcohol use. It was defined by on some occasion either been drinking to the point of feeling drunk and/or been drinking large amounts of alcohol (STUDY 2 & 5).

3.2.5 Smoking
At the medical examination during the follow-up study at adult age the participants (YLA) were asked how many cigarettes they smoked daily (STUDY 3).

3.3 Data analyses
The statistical analyses carried out in the present thesis were a combination of variable- and person-oriented methods. To explore relationships between ‘continuous’ variables Pearson correlation coefficients were calculated. Student’s t-tests, both one-tailed for hypothesized direction and two-tailed, were used to test for group mean differences.
Levene’s test revealed heterogeneity of variances in some of the analyses. The differences were not pronounced and were thus assumed not to have affected the results. One-way and two-way Analyses of Variance (ANOVAs) were also performed and multiple comparisons examined by using Tukey’s Honestly Significant Difference (HSD) test. In STUDY 2 the KSP scores were transformed into T-scores for illustrative purposes. The T-scores were calculated separately for the group of male and the group of female adolescents. Furthermore, the Chi-squared ($\chi^2$) method was used in order to investigate possible dependence between categorical variables in contingency tables. In some of the analyses the contingency tables were further analysed cell-wise with EXACON, which reveals in which cells the obtained frequency is significantly higher or lower than the expected frequency (Bergman & El-Khoury, 1998). The binary p-values and the 5% significance level were used in the EXACON analyses.

In addition to the analyses described above, the person-oriented method confgural frequency analysis (CFA) (Krauth & Lienert, 1982) was employed to study discrete variables as they occur together in the same individual (Lienert, Reynolds, & Lehmacher, 1990). In person-centred research, the person is in focus and the main unit of analysis. A person is seen as a system of interacting components and his or her configuration of characteristics are studied. In CFA every theoretically possible pattern of variables is referred to as a configuration (Bergman, 2000). The obtained frequency for each configuration is compared to the expected frequency according to a chance model. A configuration that occurs more frequently than expected is called a ‘type’, and a configuration that is obtained less frequently than expected is referred to as an ‘antitype’. In two (of three) studies the adjusted p-values were used, obtained by multiplying the nominal significance level by the number of all possible variable combinations in the respective design used. The person-oriented analyses were performed with the statistical package SLEIPNER (Bergman & El-Khoury, 1998).

In STUDY 1, log linear analysis was used as a complement to the CFA in order to investigate interactions between variables (Christensen, 1990). In the CFA all included variables are assumed to be independent. The corresponding model in the log linear analysis is the main effects model, excluding possible interaction effects. If the assumption of independence is correct, the obtained and expected frequencies for each configuration in the CFA do not differ significantly. However, if the CFA reveals significant types and antitypes, the results indicate that there are interaction effects between included variables. Log linear analysis can therefore be used to reveal the existence of possible interactions (Christensen, 1990). The interactions are included as additive factors in the log linear model and the model which best fits the data is chosen. In the final model new expected frequencies are calculated which are more in accordance with the obtained frequencies in the CFA.
Finally, Ward’s hierarchical method of cluster analysis was used to identify subgroups of individuals with relatively similar behaviour patterns (Bergman, 2000). The aim of cluster analysis is to form groups ('clusters') that are *internally homogenous*, that is, members in each group should have relatively similar values with respect to the characteristics in focus. Furthermore, the clusters should be *externally heterogeneous*, which means that members in one cluster should not resemble members of another cluster. Cluster analysis was performed in SLEIPNER (Bergman & El-Khour, 1998). As a first step, multivariate outliers ('residue') were identified using the residue module. Outliers were excluded and the cluster analysis was applied on the non-residue group. The final cluster solution was chosen on the basis of the explained variance, the increase in error sum of squares and the homogeneity coefficients. As a final step, the Relocate module was applied, which relocates subjects in order to maximize cluster homogeneity.
4. Results and discussion
Presented below are the specific research questions, hypotheses and results in each of the five studies included in this thesis. The findings are also discussed in the light of previous research and some methodological considerations.

4.1 STUDY 1

Main aim: To study aspects of early hyperactive behaviour in relation to subsequent drinking offences and violent offending, taking possible confounders of early criminality and aggressive behaviour into account.

Specific research questions and hypotheses: First, are aspects of hyperactive behaviour differentially associated with adult drinking offences and violent offending? Second, does one and the same individual frequently display early criminality, hyperactive and aggressive behaviour and to what extent do co-occurring behaviour problems influence the possible association between hyperactivity and subsequent offences? We hypothesised that there was no independent association between hyperactivity and subsequent offences when taking the possible confounders into account.

Results: The results from the first study indicated an association between early hyperactive behaviour, in the form of attention difficulties and motor restlessness, and drinking offences and violent offending. Further analyses revealed that attention deficits contributed to these relationships, while motor restlessness was unrelated to both types of subsequent offences. Person-oriented analysis showed that early criminality, attention difficulties and aggressive behaviour frequently co-occurred in the same individual. When we took the possible confounding factors of early criminality and aggressive behaviour into account, attention deficits were related to violent offending among boys with early criminality, independently of early aggressive behaviour. Aggressive behaviour was, in turn, separately related to violent offending, but it did not appear to affect the association between attention difficulties and subsequent violent offending. Attention deficits did not significantly contribute to drinking offences, while both early criminality and aggressive behaviour were related to this outcome. In addition, the results showed that young males with a combination of all three early behavioural problems had the worst outcome in adulthood. Subsequent alcohol or violent offences appeared seven times more often in this group than among males with none of these behavioural problems. There was also a frequent co-occurrence between subsequent offences, with approximately half of the males with registered offences of one type having registered offences of the other type.

Discussion: When the possible confounding factors were taken into account, the results did not indicate that an independent association exists between hyperactive behaviour and later offences. The findings for violent offending were in line with
previous research that has emphasized the combination of hyperactivity and conduct disorder (or delinquency) as contributing to subsequent problems (Biederman et al., 1996; Forehand et al., 1992; Moffitt, 1990). There was no association between attention difficulties and drinking offences, in line with Fergusson and co-workers’ (1997) study. On the contrary, prior results have demonstrated an association between attention deficits and alcohol problems, independent of conduct disorder symptoms (Molina & Pelham, 2003). However, the findings from these studies are not completely comparable with our results since we used drinking offences as an indicator of alcohol problems. Before 1977 drunkenness in public was a criminal act in Sweden. Thus, even though registered drinking offences might reflect alcohol problems for some individuals, it may for others be an occasional event neither associated with alcohol problems, nor with what today is considered a crime. Moreover, the results were in agreement with findings from another longitudinal project in which males with several adjustment problems were over-represented among those with adult alcohol problems and criminality (Andersson, Magnusson, & Wennberg, 1997; Magnusson & Bergman, 1990).

The results further indicated that inattention was the aspect of hyperactivity that contributed to subsequent problems, which is consistent with some research (Molina & Pelham, 2003; Tapert, Baratta, Abrantes, & Brown, 2002), while other studies stress the importance of hyperactivity-impulsivity (i.e. over activity-impulsivity) (Babinski et al., 1999). The discrepancy in the results might partly be due to the focus on diagnosed ADHD symptoms in some studies, and behaviour rating in other studies. The behaviour measures used in the present study were assessed by teacher ratings which are assumed to demonstrate high stability over time (Backteman & Magnusson, 1981) and high validity (Magnusson, 1988). The advantage of using dimensional behaviour ratings is the possibility to identify vulnerable individuals at risk of developing more serious problems. There was no information about early impulsive behaviour, which restricts comparability with other results. In addition, impulsivity is assumed to influence the development of antisocial behaviour and alcohol problems (af Klinteberg, von Knorring, & Oreland, 2004). Nevertheless, in the present sample early hyperactivity symptoms were shown to be related to impulsive behaviour in adulthood (af Klinteberg, Magnusson, & Schalling, 1989). Since the present study comprised only male subjects, the findings may not apply to females as well. It is interesting to note, however, that the results emphasize the importance of attention deficits, which might be more common among girls than the predominantly impulsive-hyperactive type of ADHD or the combined type (Nadeau, Littman, & Quinn, 2002).
4.2 STUDY 2

Main aim: To examine personality characteristics in adolescents with indications of violent behaviour and risky alcohol use.

Specific research questions and hypotheses: To investigate the co-occurrence of risky alcohol use and violent behaviour and, further, to study whether a combination of these behaviours is associated with more pronounced behavioural problems and more deviating personality profiles. We hypothesised that violent behaviour and risky alcohol use are frequently manifested in the same individual and that a combination of these behaviours is associated with more pronounced problems and personality scores.

Results: The results showed that adolescents with indications of risky alcohol use can generally be described as being more impulsive and having a stronger need for change and action than other adolescents. They were also less socially conforming, and more prone to experience negative emotions such as verbal and indirect aggression and irritability. Furthermore, our results showed that males in this group reported somatic anxiety, expressed in somatic complaints and muscular tension. Adolescent males involved in violent acts were more impulsive and more likely to reject social norms than males who did not display such behaviour. Violent females displayed more sensation seeking, greater verbal and indirect aggressiveness, a more suspicious attitude and a greater distrust of people’s motives than non-violent females. They also reported more muscular tension.

When males and females were analysed separately we found that the personality profiles in adolescents displaying these behaviours were relatively similar between the sexes with respect to form but not level. The personality scores for females with violent behaviour or risky alcohol use clearly deviated more from the norm level in the female group than did the scores in the corresponding group of males. In line with our expectations, the results also showed that adolescents with a combination of violent behaviour and risky alcohol use had more pronounced problems and personality scores which deviated more from the norm than adolescents with one such behaviour problem only. Where sex differences are concerned, our results also indicated that violent behaviour was manifested differently in males than in females, but this needed further exploration (see results STUDY 5).

Discussion: The results obtained are in line with earlier findings in which personality differences have been demonstrated in groups with criminal or violent behaviour as well as alcohol problems (e.g. Caspi et al., 1994; Cloninger et al., 1988; Krueger et al., 1994). Furthermore, the results showed that personality traits linked to violent behaviour corresponded quite well with the traits associated with risky alcohol use, in line with previous research (Caspi et al., 1997). Due to the frequent co-occurrence
of violent behaviour and risky alcohol use, both these behaviours were included in the same analysis. Thus, the findings of similar personality profiles were not an artefact of the same adolescents engaging in both behaviours. The main finding was that females displaying violent behaviour or risky alcohol use had more pronounced personality scores than the corresponding group of males. These suggested sex differences might be due to a much smaller group of females than males displaying these behaviours, especially regarding violence. In additional analyses of more equal proportions of males and females with these behaviours, the personality profiles obtained in the female group nevertheless deviated more, although sex differences were not tested. However, there were also indications that females chose more extreme response alternatives in the personality questionnaire. A further examination of the possible effect of different response styles did not indicate that this was likely to have caused the obtained sex differences.

The reliabilities in some of the personality scales were relatively low (Appendix 1), which might have affected the validity of the scales. The lowest reliabilities were reported in the scales related to aggression, which is consistent with other findings regarding the KSP questionnaire (Gustavsson, 1997). The main reason for the low reliabilities in the personality scales is that KSP was based on theoretical considerations rather than having been developed by means of factor analysis. Thus, instead of comprising highly inter-correlated items the scales cover various aspects of personality traits. Personality characteristics are assumed to be relatively stable traits, although research has indicated that personality mature slightly over time, with an increasing ability to adapt and better psychological functioning (McCrae et al., 1999; Morizot & Le Blanc, 2003; Robins, Fraley, Roberts, & Trzesniewski, 2001). Even so, longitudinal research has shown that children described as impulsive, irritable and emotionally unstable at age 3 were characterised by similar personality traits in late adolescence, and that they were also more likely than others to engage in criminal behaviour and to be diagnosed with alcohol dependence in early adulthood (Caspi, 2000).

4.3 STUDY 3
Main aim: To investigate possible indicators of biological vulnerability associated with early behavioural problems and adult violent offending.

Specific research questions and hypotheses: To study differences in adult monoamine oxidase (MAO) activity and triiodothyronine (T3) levels between males on different pathways from early adolescence to adulthood: 1) males with no early risk* and no violent offending, 2) males with early risk but no violent offending, and finally, 3) males with early risk and subsequent violent offending. In the subgroup of males included in this study, all of the violent offenders also displayed a pattern of early

* A pattern of criminality, attention difficulties, with or without co-occurring aggressive behaviour
behavioural problems. A further aim was to investigate whether smoking is a con-
founder for platelet MAO activity and whether a combined risk level of these two
biochemical markers is overrepresented in violent offenders with a history of early
behavioural problems. Our hypotheses were that males with an early risk pattern would
have lower MAO activity and higher T3 levels than males with no early behavioural
problems, and that males with early risk who proceeded to violent offending would have
even lower MAO activity and higher T3 levels than those who did not commit violent
or other crimes.

**Results:** The results confirmed the hypothesis that males with an early behavioural
risk pattern who proceed to violent offending differ from those with neither early
nor late problems in that they had lower MAO activity and higher T3 levels at adult
age. As hypothesised, the biochemical markers of males who displayed a pattern of
behavioural problems in early adolescence differed from those of males with no such
early risk. Interestingly, the lowest MAO activities and highest T3 levels were found
in males with persistent problems. Due to the limited sample size it was not possible
to control for smoking in all of the analyses. When smoking was taken into account,
the results indicated that MAO activity was lower in males with early attention dif-
ficulties, although these results only appeared to apply to smokers. Person-oriented
analysis was performed in order to study a combination of the two biological mark-
ers in relation to behavioural problems and violent offending. The main finding was
that a combination of low MAO activity and high T3 levels, although not interrelat-
ed, was found more frequently than expected among males with early risk who went
on to commit violent offences.

**Discussion:** The results supported previous research that has documented low
MAO activity and high T3 levels, studied separately, in groups displaying criminal
or violent behaviour (Belfrage et al., 1992; Devor et al., 1993; Pandey et al., 1988).
An association between attention deficits and low MAO activity has also been de-
monstrated in other research (af Klinteberg & Oreland, 1995), even if in our study
it only appeared to apply to smokers. Although smoking has been found to reduce
MAO activity (Olausson, Engel, & Söderpalm, 2002), research has established a link
between behaviour or personality traits and MAO activity independently of smoking
(Garpenstrand et al., 2002; Oreland, Damberg, Hallman, & Garpenstrand, 2002;
Oreland et al., 1999). Results from non human primate studies further support the
conclusion that the demonstrated low MAO activity is not an artefact of smoking
(Fahlke et al., 2002). A drawback that restricts our ability to draw conclusions from
the results is that the biochemical measures were obtained in adulthood and thus
preceded by the behaviour assessments. We argue that this is theoretically accept-
able since MAO activity has demonstrated relative stability over time (Higley et al.,
1996; Jernej et al., 2000). Since previous research has focused on MAO activity and T3 levels separately, the major contribution of this study is that it demonstrates that a combined risk level for the two biochemical measures was more common than expected in males with violent behaviour and an early risk pattern.

4.4 STUDY 4

Main aim: To study stability of and change in criminal behaviour from early adolescence to early adulthood and to explore individual, family, peer and school related factors associated with various criminal and non-criminal pathways.

Specific research questions and hypotheses: To investigate to what extent criminal behaviour in early adolescence is stable up to early adult age. Furthermore, to study whether more serious early criminal behaviour is associated with a greater likelihood of engaging in persistent criminality, and more problems concerning individual, family, peer and school related factors. We also wanted to examine whether males who followed different criminal and non-criminal pathways differ with respect to the various risk factors and associated problems in focus. Finally, our intention was to describe groups on different criminal pathways with respect to registered criminality up to 34 years of age. We expected that the majority of males with early criminality would have adolescence-limited criminality, while a limited group would have persistent criminality. The hypotheses concerning group differences in the risk factors and associated problems were in line with Moffitt’s theory.

Results: In accordance with our hypotheses, the majority of males who engaged in criminal activity during early adolescence appeared to have given up crime before early adulthood, while a limited group displayed persistent criminality. Interestingly, most of the males on the adolescence-limited pathway did not commit any registered offences during late adolescence. Similarly, almost all the males who committed crimes during late adolescence persisted in their criminality into early adulthood. In person-oriented cluster analysis four criminal subgroups were identified, with criminal activity ranging from occasional crimes with a low degree of seriousness to several repeated crimes of high seriousness. The results showed that the likelihood of persistent criminality as well as the adversity levels in the various risk factors increased gradually with an increasing severity of early criminal behaviour. In line with our expectations, males in the persistent criminal group had more teacher-rated attention difficulties and aggressive behaviour in early adolescence, as well as poorer achievement and adjustment at school, compared to males on the adolescence-limited criminal pathway. Unexpectedly, there were no such significant differences regarding family and home environment. Males on both criminal pathways had more delinquent peers than did non-criminal males. Contrary to our hypotheses, males on the adole-
scence-limited criminal pathway also displayed worse levels for several individual, family and school-related factors than non-criminal males. Finally, when we investigated their further criminal development, we found that the vast majority of males (97.5%) on the persistent criminal pathway had committed crimes during later adulthood as opposed to only 10-15% of males on the adolescence-limited and non-criminal pathways.

Discussion: The results appear to support the distinction between adolescence-limited and persistent criminal behaviour which was put forward in Moffitt’s theory and confirmed in several other studies (Fergusson et al., 2000; Moffitt, 1993; Patterson et al., 1998; Stattin & Magnusson, 1991; White et al., 2001). The findings appear to be in agreement with the suggestion that a common set of risk factors dimensionally related to offending (Fergusson et al., 2000), rather than that aetio-logically distinct risk factors exist for different criminal trajectories (Moffitt & Caspi, 2001). In addition to the common risk factors, Fergusson and co-workers (2000) suggested that there are also trajectory-specific risk factors. There were, in fact, some factors that distinguished the persistent criminal group from the adolescence-limited criminal group, which might indicate that these risk factors are especially important in the development of persistent criminality. However, since the adolescence-limited criminal group had higher risk levels than the non-criminal group, the results do not imply that these factors are specific to persistent criminality. Furthermore, as opposed to the predicted similarity in criminal behaviour in both offender types during early adolescence (Moffitt, 1993), our results indicated that the likelihood of belonging to the persistent criminal group increased with the increasing severity and frequency of criminal acts in early adolescence. Interestingly, the findings suggested that criminality in late adolescence was more often part of a stable criminal pathway than was criminality during early adolescence. This is in agreement with other studies indicating that criminality during late adolescence might be a better predictor of persistent criminality (Stouthamer-Loeber, Wei, Loeber, & Masten, 2004; White et al., 2001). The males included in our study were born during the 1940s and it is possible that changes in society since then, such as higher average age of marriage and parenthood, might have led to adolescents and young adults taking on adult roles later today (Arnett, 2000).

Our classification of males into criminal trajectories differs from other studies in some respects. First, the present study focused on a limited number of years in the lives of the men we classified into different criminal pathways. Consequently, we do not know whether males on the two criminal pathways displayed antisocial behaviour in childhood. Secondly, the criminal trajectories were based only on registered crime data. As a result we do not know whether males with adolescence-limited
crime abandoned criminality before adulthood. It is worth noting that in additional analyses, where males with criminal records in later adulthood were excluded, the differences in risk factors between the adolescence-limited and non-criminal groups remained. Information about self-reported criminality was available only for a subgroup of males at age 18. When the self-reported criminality on the criminal pathways was examined, the majority of males on the criminal and non-criminal pathways reported having committed crimes. However, the self-reported criminality was less serious in the non-criminal group, and more serious in the group with adolescence-limited criminality, which in turn had less serious self-reported criminality than the group of persistent criminal males. Thirdly, persistent criminality was defined entirely by persistence of general criminality rather than persistence of serious criminality. Thus, this group of males could comprise further subgroups with more or less serious persistent criminality. Loeber and Stouthamer-Loeber (1998) suggested that multiple pathways in offending might be required in order to describe both the development of violent and property offending, and further to identify which risk factors these offending types have in common. Further, the results of our study indicated the possible existence of a late-onset criminal pathway, because a group of males on the non-criminal pathway had committed registered crimes in late adulthood. Previous research has, in fact, identified additional criminal trajectories to the adolescence-limited and persistent criminal pathways used here (Fergusson et al., 2000; Nagin & Land, 1993). It is noteworthy that all but one of the males on the criminal pathway we defined as persistent committed recorded crimes in later adulthood as well. This implies that, despite the limitations of the study, we were able to identify a group of males with highly stable and persistent criminal behaviour.

4.5 STUDY 5

Main aim: To investigate alcohol use in relation to patterns of norm breaking and violent behaviour in adolescence with focus on similarities and differences between the sexes.

Specific research questions and hypotheses: To examine how frequent self-reported norm breaking, violent behaviour and risky alcohol use is in adolescents. To what extent do males and females display similar patterns of norm breaking and violent behaviour? A further aim was to investigate whether there is a difference in alcohol use between adolescents who display different kinds of behaviour patterns. We hypothesised that the patterns of norm breaking and violent behaviour would be relatively similar in male and female adolescents, although there would be fewer females engaging in these behaviours.

Results: The results showed that the majority of adolescents had participated in norm breaking or violent behaviours. Minor offences, damage to property, burglary...
or theft as well as physical violence were more common among males than females. There were, however, no such differences between the sexes for the other violent acts. Interestingly, as was also indicated in STUDY 2, the results showed that violent behaviour was manifested differently in males and females. In the male group, violent behaviour was chiefly expressed in physical aggression, while females tended to use threats or force more than physical violence.

Person-oriented cluster analysis identified four subgroups, comprising adolescents with relatively similar behaviour patterns. The majority of males and females were involved in occasional minor offences only, while a very limited group of adolescents displayed a pattern characterised by more serious types of norm breaking behaviour, for example burglary. The second most common behaviour pattern among males included physical violence as well as repeated minor offences and acts of damage to property. The second most common behaviour pattern in the female group was violence manifested as threats or force. The findings suggested that although a smaller group of females were involved in norm breaking and violent behaviour, the behaviour patterns were relatively similar in form, with a few exceptions with regard to level, that is the extent to which the behaviours are displayed. Adolescents who displayed a behaviour pattern characterised by physical violence and repeated norm breaking also had the highest occurrence of alcohol use, both regarding drunkenness and excessive alcohol use. They also reported the highest frequency of drunkenness. Males and females who engaged in occasional minor offences only were least likely to drink large amounts of alcohol or to drink to the point of feeling drunk.

Discussion: In this final study we wanted to further examine possible gender differences in violence (see also STUDY 2) as well as other antisocial behaviour. The results gave additional support to the proposal that norm breaking behaviour is more or less normative in adolescence rather than a rare phenomenon (Moffitt, 1993). The majority of adolescents had participated in norm breaking or violent behaviour. Males were over-represented in norm breaking behaviour as well as physical violence, which confirms previous findings (Moffitt, 2001; Windle, 1990). The results further confirmed that there is a gender difference in the manifestation of violence (Moffitt, 2001), in that females tended to use threat or force, and males tended chiefly to use physical aggression. In addition, although antisocial behaviour was more common among males than females, the results indicated that males and females displayed similar patterns of norm breaking behaviour. To conclude, adolescents with more serious patterns of norm breaking and violent behaviour reported more risky alcohol use, in line with the recognized association between antisocial behaviour and alcohol use or misuse in adolescents (Farrington & Loeber, 2000; Fergusson et al., 1996).
5. General discussion

The general aim of this thesis was to explore factors during early adolescence that contribute to the development of antisocial behaviour and alcohol problems. More specifically, the research focused on registered general criminality as well as violent offending in particular. Self-reported norm breaking and violent behaviours were looked at, as were registered drinking offences and self-reported risky alcohol use. The latter has previously been shown to increase the risk of subsequently developing alcohol problems (Schuckit & Smith, 1996).

From the theoretical framework emphasizing an interactionistic perspective on an individual’s functioning and development (Bergman & Magnusson, 1997), the thesis included various aspects of the individuals and their environment. Biological factors, behaviour and personality characteristics, as well as family and peer-related factors were investigated. The studies were based on both a prospective longitudinal project in which a group of young lawbreakers and controls were followed from the 1960s into the 1990s, thus enabling the focus on development across time, and on more recently collected data on a representative adolescent group. The information was collected using different assessment methods and obtained from different informants. The theoretical framework also had implications for the analytical framework. From an interactionistic perspective it is natural to focus on each individual’s pattern of characteristics and therefore to use person-oriented methods (Bergman, 2001). One of the strengths in person-oriented research is that it does not assume that all individuals develop in the same manner. This approach may therefore give a better understanding to individual development. In the present work variable- and person-oriented methods were combined and seen as complementary to each other. A similar approach have been fruitful in previous studies (af Klinteberg & Oreland, 1995; Magnusson, af Klinteberg, & Stattin, 1994).

Person-oriented methods make it possible to identify typical and atypical variable combinations, for example various behaviour patterns, that occur more or less frequently than would be expected according to a predefined null hypothesis, usually an assumption of complete independence (Bergman & Magnusson, 1997). A recurrent finding in the present work was the co-occurrence of behaviour problems. Several studies identified a group of individuals with either a combination of different types of problems, for example violent behaviour and risky alcohol use (STUDY 2), or who committed a number of criminal, norm breaking and violent acts (STUDY 4 & 5). Adolescents with co-occurring behaviour problems had more pronounced problem manifestations (STUDY 2), while adolescents displaying a pattern of diverse and severe delinquent acts were at greater risk of proceeding to persistent criminality (STUDY 4). One possible explanation of the co-occurrence of a variety of problems is that
they constitute a “syndrome”, which can be accounted for by a common underlying factor. This was suggested in the Problem-Behaviour Theory and replicated in more recent research (Donovan & Jessor, 1985; Donovan, Jessor, & Costa, 1988). The co-occurrence may also be explained by the fact that the behaviours have common risk factors. For example, Fergusson and colleagues (1996) demonstrated that the association between adolescent alcohol use and criminality was largely the result of the same risk factors contributing to both of these behaviours. The findings of the present research support the contention that similar personality traits are associated with both violent behaviour and risky alcohol use (STUDY 2). The adolescents who displayed these kinds of behaviours were generally characterised by impulsive and sensation seeking traits, as well as negative emotions such as aggression, irritability and hostility.

In what way can we explain the link between the personality style that emerged in our results and behaviours such as violence or using alcohol in a potentially harmful way? Personality traits can be defined as “…styles of relating to the world; they represent tendencies to behave, think, and feel in certain consistent ways” (Krueger, Caspi, & Moffitt, 2000). Individual differences in personality may therefore elucidate why individuals perceive, interpret and respond to a situation in different ways. For example, individuals who are prone to negative emotionality might interpret a situation as threatening because of their suspicious and hostile attitude towards the environment, which especially in combination with low self control, might result in aggressive outbursts (Krueger et al., 2000). Personality also indirectly influences individuals’ engagement in various behaviours by activating motives, needs and goals (Cooper, Agocha, & Sheldon, 2000). It has been suggested that impulsive and sensation-seeking individuals are especially responsive to reward (Cooper et al., 2000) and are therefore predisposed to stimulating and rewarding behaviour. Individuals high in anxiety are instead thought to engage in certain behaviours in order to regulate feelings of tension and distress, which in the case of alcohol would be consistent with the ‘self medication hypothesis’ according to which some individuals use alcohol to cope with negative emotions (Stewart, Karp, Pihl, & Peterson, 1997). Some researchers have also suggested that adolescents with anxiety symptoms may start using alcohol at an earlier age to fit in with a peer group and then continue to use alcohol to reduce worries and tension (Kaplow, Curran, Angold, & Costello, 2001).

Our results showed, in addition, that attention deficits were related to general criminality (STUDY 4) and, in combination with early criminal behaviour contributed to violent offending (STUDY 1). Both Moffitt’s (1993) and Patterson et al’s (1989) developmental models of antisocial behaviour emphasize the importance of early hyperactive behaviour. In interaction with inadequate parenting practices, hyper-
active behaviour is assumed to influence the development of childhood antisocial behaviour. The hyperactive and antisocial behaviour may, in turn, lead to failure in school (Faraone et al., 1993; Fergusson et al., 1997; Fischer, Barkley, Edelbrock, & Smallish, 1990; Frick et al., 1991; Kadesjo & Gillberg, 2001) and peer rejection (Hinshaw, 2002). These individuals are then likely to join a deviant peer group which reinforces antisocial behaviour. The findings of the present research give additional support to the importance of family conditions, poor school achievement and peer delinquency (STUDY 4). However, in Moffitt’s and Patterson’s models this developmental sequence is specific to persistent offending, and Moffitt (1993) suggested that distinct aetiological risk factors are associated with the persistent offending type. Although the results presented in this thesis support the distinction between adolescence-limited and persistent criminality, the psychological and behavioural risk factors in focus were dimensionally related to criminal behaviour in general and not to persistent criminality in particular (STUDY 4), which is in line with Fergusson et al’s research (2000). In addition to a gradual increase in risk factors with the increasing severity of the criminal behaviour (STUDY 4), higher risk levels were also reported with co-occurring behaviours (STUDY 2).

The present research on different criminal trajectories comprised males only. Therefore we do not know whether the results apply to females as well. Due to the cross-sectional design of STUDY 2 and STUDY 5 it is not possible to draw conclusions about the development of antisocial behaviour across time in this group of adolescents. However, the views on antisocial development in females offered in the literature are good starting points for discussion. While Moffitt (1993) argued that antisocial females are similar to adolescence-limited antisocial males, Silverthorn and Frick (1999) maintain that these females are actually more similar to the group of life-course persistent males. STUDY 2 and STUDY 5 showed that fewer females than males displayed antisocial behaviour and were involved in risky alcohol use, although they had relatively similar behaviour patterns. Furthermore, the results also indicated that females displaying violent behaviour and/or risky alcohol use had more deviating personality scores (STUDY 2). This might suggest that the group of females we have identified or defined as antisocial or violent can better be compared with a subgroup of more seriously antisocial males. If so, our results would be more consistent with Silverthorn and Frick’s (1999) suggestion than with Moffitt’s original theory. This, of course needs further investigation using longitudinal data.

Because antisocial behaviour was previously assumed to be uncommon among females, most of the earlier studies in this area excluded females, as was noted by Gorman-Smith and Loeber (2005). As a consequence, many aspects of females’ development of antisocial behaviour remain unclear. It is assumed that early differences
in the socialization process for boys and girls affect the differences between the sexes in the development of antisocial behaviour (see review by Keenan & Shaw, 1997). For example, there is some evidence that parents and teachers respond to a child’s temperament and behaviour differently depending on the child’s gender. There are also indications that girls are encouraged to manifest their problems in more internalizing than externalizing behaviours. Gorman-Smith and Loeber (2005) propose that more adverse family conditions are required for females to develop antisocial behaviour, given the sanctions against and low approval of such behaviour in females. Similarly, our results may suggest that higher levels in individual risk factors are needed for females to display these kinds of behaviours. Thus, the demonstrated differences in the occurrence of norm breaking and violent behaviour and risky alcohol use, as well as in the levels in the associated personality traits (STUDY 2 & 5), may imply that females have a higher threshold for developing antisocial behaviours and other problems. Accordingly, females would require greater liability to manifest the behaviour problems in focus. This was suggested in the Polygenetic multiple-threshold model and has been supported in research by Rhee and Waldman (2004) with reference to ADHD.

In addition to the demonstrated contribution of behavioural and personality characteristics to antisocial behaviour, the present research focused on a possible underlying biological vulnerability, indicated by the biochemical marker MAO activity (STUDY 3). Low MAO activity was found in violent offenders with a history of early behavioural problems. With regard to early behaviour problems in particular, there were indications of low MAO activity being especially related to attention deficits. A possible explanation of these associations was offered in the ‘vulnerability hypothesis’ that Buchsbaum and colleagues (1976) put forward in the 1970s. According to this hypothesis, biological vulnerability, indicated by low MAO activity, is associated with certain personality traits which in turn increase the risk of developing problems of maladjustment and alcoholism. Low MAO activity is closely connected to disinhibitory psychopathology, i.e., deficient impulse control and the inability to foresee the consequences of one’s own behaviour (af Klinteberg et al., 2004; Schalling, 1993). Low MAO activity might therefore reflect an underlying propensity towards developing disinhibited personality and behaviour, which in STUDY 3 was manifested in early attention deficits. These deficits, in turn, might increase the risk of developing subsequent problems such as violent behaviour.

An explanation which can to some extent be seen as an alternative to the above-mentioned and which suggests that personality mediates the association between biological vulnerability and externalizing psychopathology (Ruchkin, Koposov, af Klinteberg, Orelend, & Grigorenko, 2005), was proposed by Krueger and co-workers
Similar to the Problem-Behaviour Theory mentioned earlier (see e.g. Donovan & Jessor, 1985), they suggested that a variety of behaviours such as alcohol problems, antisocial behaviour, and disinhibitory personality traits, can be explained by there being a common underlying factor with high genetic influence. In addition to the genetic factors contributing to this ‘externalizing’ factor, both genetic and environmental characteristics distinguished between the different behaviours. The authors suggested that while genetic factors might affect the likelihood of developing externalizing behaviour, the way this disposition is manifested is influenced by environmental factors.

Interestingly, the results of the present research showed that, in addition to the demonstrated low MAO activity, high T3 levels were found in the same group of violent offenders with early behaviour problems (STUDY 3). Since elevated T3 levels have previously been reported in groups exposed to traumatic experiences (Mason et al., 1996; Wang & Mason, 1999) and since T3 is associated with the sympathetic nervous system (Whybrow & Prange, 1981), it is suggested that high T3 levels might indicate experiences of severe stress. It has also been shown that the present group of young lawbreakers was more likely to develop violent behaviour in a victimising environment characterised by neglect and/or abuse (Lang, af Klinteberg, & Alm, 2002). Furthermore, Caspi et al (2002) reported that maltreated and abused boys were at higher risk of developing antisocial behaviour than boys who did not experience maltreatment. Interestingly, Caspi et al showed that males with a genotype linked to low MAO-A activity and who had been severely maltreated, were more likely to develop antisocial behaviour, including violence. Thus, a possible interpretation of our results is that biological vulnerability, indicated by low MAO activity and expressed in behaviours such as attention deficits, in combination with stress as indicated by high T3 levels, increase the risk of developing antisocial behaviour.

Concluding remarks

The results of the present work support the contention that neuropsychological deficits, manifested in attention difficulties, and personality characteristics which reflect disinhibition and negative emotionality, influence the development of antisocial behaviour and risky alcohol use, which in turn increases the risk of subsequent alcohol problems. The findings indicate, furthermore, that these neuropsychological deficits may be associated with an underlying biological vulnerability to various forms of disinhibitory psychopathology. Although the thesis focuses on individual characteristics, the results also support the view that environmental risk factors such as the influence of family and peers and possible stress experiences, play an important role. It is important to emphasize that individual characteristics continuously
interact with environmental conditions in shaping each individual’s developmental course.

A result worth highlighting is the indication that females displaying violent behaviour and engaging in potentially harmful use of alcohol deviated more in individual risk characteristics than did the corresponding group of males. Further knowledge of the development of these problems in females is crucial, since most theories in this area have been developed primarily on male samples.

To conclude, the research has identified groups with an elevated risk of antisocial behaviour and alcohol problems. Even though it is difficult to predict individual development, and although some individuals with early risk do not develop more serious problems, prevention and intervention are of great importance. Society should provide the resources not only to prevent crime and alcohol problems but also to help these children and adolescents achieve a positive and healthy development and thus enhance their quality of life.
6. Acknowledgements
In my family, I’m known as “the never-ending student”. I have often been asked whether I am going to study for ever, which I agree, is a justified question… But as the saying goes: “The more you learn, the more you realize how little you know.” In a way, completing this thesis also involves finishing my longitudinal career as a student. About nine years ago, after spending some memorable years at the Department of Mathematics, I decided to start studying psychology. I don’t remember what brought about this sudden change, but it was one of the best choices I have made in my life.
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### 7. Appendix

Descriptions of the KSP scales with reliabilities for males and females in STUDY 2.

<table>
<thead>
<tr>
<th>Personality scales</th>
<th>Reliabilities</th>
<th>Descriptions of high scores</th>
</tr>
</thead>
</table>
| Impulsiveness            | Males: 0.51  
Females: 0.65    | Acting on the spur of the moment; Talking before thinking; Quick decision making             |
| Monotony Avoidance       | Males: 0.54  
Females: 0.74    | Need for change and action; Thrill seeking; Avoiding routine                                |
| Detachment               | Males: 0.47  
Females: 0.65    | Distanced and withdrawn; Do not get close or personal with others                             |
| Socialization            | Males: 0.89  
Females: 0.91    | Good school and family adjustment; Good home climate                                         |
| Social Desirability      | Males: 0.61  
Females: 0.68    | Socially conforming; Polite; Helpful                                                        |
| Somatic Anxiety          | Males: 0.81  
Females: 0.83    | Autonomic disturbances (sweating, difficult to breath); Uncomfortable; Restless; Panicky     |
| Muscular Tension         | Males: 0.80  
Females: 0.82    | Tense and stiff; Not relaxed                                                                 |
| Psychic Anxiety          | Males: 0.74  
Females: 0.76    | Worrying; Lacking self-confidence; Self conscious in social situations; Sensitive            |
| Psychasthenia            | Males: 0.63  
Females: 0.72    | Easily fatigued; Feeling uneasy and pressured when urged to speed up and when facing new tasks |
| Inhibition of Aggression | Males: 0.67  
Females: 0.70    | Non assertive; Sad rather than angry when scolded; Difficult to speak up                    |
| Verbal Aggression        | Males: 0.57  
Females: 0.61    | Getting into arguments; Telling people off when annoyed; Saying nasty things when angry      |
| Indirect Aggression      | Males: 0.57  
Females: 0.64    | Sulking; Slamming doors when angry                                                           |
| Irritability             | Males: 0.49  
Females: 0.47    | Irritable; Lacking patience                                                                  |
| Suspicion                | Males: 0.43  
Females: 0.56    | Suspicious; Distrusting people's motives                                                     |
| Guilt                    | Males: 0.30  
Females: 0.29    | Remorseful; Ashamed of bad thoughts                                                          |
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