ORIGINAL ARTICLE

Association of ADHD with reactive and proactive violent behavior in a forensic population

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Abstract ADHD is associated with social problems and aggressive behavior. As hyperactive-impulsive traits are core symptoms of ADHD, it has been hypothesized that reactive-impulsive violence is more likely related to ADHD psychopathology than proactive-instrumental violence. One hundred and twenty-seven adult violent offenders participated in the study. Diagnosis of ADHD and ratings of reactive and proactive features of the committed crimes were performed using standardized instruments. According to DSM-IV, 16.5% subjects fulfilled diagnostic criteria for ADHD, 23.6% were diagnosed as ADHD in partial remission, and 59.8% had no ADHD. Univariate analyses revealed higher reactive violence ratings in both ADHD groups when compared to subjects without ADHD, whereas the opposite was found regarding proactive violence ratings. Using multivariate analyses of variance controlled for age, gender and comorbid substance use disorders, childhood ADHD psychopathology and current ADHD significantly increased the risk of reactive violence and decreased the risk of proactive violence. Significant impact of male gender on proactive violence was found. The findings suggest that ADHD is associated with reactive but not proactive violence in aggressive offenders.

Keywords Adult ADHD · Proactive · Reactive · Violence · Aggression

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Introduction

Attention deficit-/hyperactivity disorder (ADHD) is a highly heritable, disruptive condition with childhood onset and about 50% persistence in adulthood (Biederman and Faraone 2005). ADHD is associated with risks regarding daily functioning and social adaptation in several domains of life (Barkley 2002). School performance, professional success and interpersonal relations are often impaired. The number of jobs in a given time period is increased as well as the rate of separations and divorces. Also, the risk of traumatic injuries is much higher than in control subjects (Kaya et al. 2008). ADHD also increases the risk for violations of road traffic rules like speeding, driving after consumption of alcohol, driving without licence and the prevalence of traffic accidents (Jerome et al. 2006).

ADHD often co-occurs with additional disruptive behavior disorders. A substantial number of children with ADHD suffer also from oppositional defiant disorder and early-onset conduct disorder (CD; Angold et al. 1999). It has been also shown that aggressive behavior is a common phenomenon accompanying childhood ADHD (Barkley 1998; Hinshaw 1992). From a genetic view, ADHD plus CD has been proposed to be a more severe variant of ADHD with a common genetic etiology (Dick et al. 2005; Thapar et al. 2001). Association of serotonergic and dopaminergic genes with impulsive traits and aggression has been demonstrated in ADHD samples (Oades et al. 2008; Retz and Rösler 2009) and forensic populations (Reif et al. 2007; Retz and Freitag 2010; Retz et al. 2003, 2004b). Further, longitudinal studies have revealed that ADHD is followed by increased rates of antisocial personality disorder (APD), delinquent behavior and incarceration (Klein and Mannuzza 2010; Mannuzza et al. 2008). For example, in the New York follow-up study, a prevalence of 43% APD was found in the ADHD group at

age 25 years, compared to 3% in the control group (Klein and Mannuzza 2010). Substance use disorders and additional disruptive behavior disorders seem to be important mediators for an unfavorable outcome in ADHD patients (Lahey et al. 2005; Mannuzza et al. 2008; Satterfield et al. 2007). On the other hand, ADHD has been consistently emerged as a moderator of conduct problems in children. Numerous studies show that children with both CD and ADHD, when compared with children with conduct problems alone, tend to have an earlier onset and more stable course of antisocial behavior (Loeber et al. 1995; Moffitt 1990). As a result of these findings, the presence or absence of ADHD has become one key component of children's conduct problems (Moffitt 2003; Rösler 2010).

Another line of evidence supporting a link between ADHD and conduct problems including delinquent behavior comes from cross-sectional studies in forensic populations. The prevalence of ADHD in forensic and criminal populations is increased when compared to the general population, where a transnational prevalence of 3.4% has been reported (Fayyad et al. 2007). In studies from several European and non-European countries, the prevalence of ADHD in offender populations varied between 4 and 72% (Vermeiren 2003). The high variety of findings might be due to the different populations investigated, different criminal law systems, differences regarding the mean age of study populations and diagnostic procedures. In a German study with young adult incarcerated male offenders, the prevalence of ADHD according to DSM-IV was 45% (Rösler et al. 2004; Retz et al. 2004a). In middle-aged incarcerated women, a prevalence of 10% was found (Rösler et al. 2009).

More specifically, ADHD has been shown to be more prevalent in violent offenders when compared to subjects with non-violent offences (Blocher et al. 2001; Ziegler et al. 2003). Considering heterogeneity of aggression and violence, a sensible construct has been created in hypothesizing a dichotomy between a reactive-impulsive-hostile-affective subtype and a proactive-controlled-instrumental-predatory subtype of aggressive and violent behavior (Vitiello and Stoff 1997). Regarding the core symptoms of ADHD, an association of ADHD with reactive aggression seems plausible. Reactive aggression is not planned but a spontaneous reaction to a provocation or a conflict. Reactive aggression is driven by affective outbursts. It is short-lived and has no finalistic target except the reduction in tension and agitation. Usually, reactive violence is not rationale and without systematic or instrumental character of the aggressive actions. In so far, there are some similarities to the hyperactive-impulsive psychopathology of ADHD. Accordingly, it has been demonstrated in children with conduct problems that ADHD is a moderator of reactive but not proactive aggression (Waschbusch and Willoughby 2007). In addition, Bennett

et al. (2004) showed that reactive antisocial behavior was more closely related to ADHD than proactive antisocial behavior in 8–15 year old children and that the relation between ADHD symptoms and proactive antisocial behavior increased from middle childhood to adolescence. Following the hypothesis that reactive, but not proactive aggression is associated with ADHD in adult offenders, we performed a study in adult offenders with and without ADHD, who had committed violent crimes.

Method

Subjects

A sample of 127 consecutively recruited adult offenders (mean age 33.1 years, SD 11.9 years, male/female: $N = 118/9$) who had committed violent offences participated in the study after given informed consent. The study was part of a research program on the neurobiology of violent behavior. The investigation was approved by the Saarland ethic committee. All participants were referred to the Forensic-Psychiatric Institute of the University of Saarland Homburg/Saar, Germany for a forensic examination due to violent-aggressive offences. Each participant had committed at least one violent offence defined as overt physical aggression against another person. Some subjects were also convicted for non-violent offenses like theft or traffic violations in addition to one or more violent acts. Offences of the participants of the study comprised criminal assault ($N = 43$), sex crimes ($N = 37$), robbery ($N = 29$), homicide ($N = 16$), traffic offences ($N = 16$), property crimes ($N = 5$), arson ($N = 6$), theft ($N = 9$) and others ($N = 5$).

Each subject underwent comprehensive psychiatric and neurological evaluations and standardized psychometric tests. Psychiatric disorders were assessed according to ICD-10 criteria, using modified, standardized checklists (Hiller et al. 1990) by psychiatrists, who have been trained for the use of all standardized instruments before the study was started. Subjects with a diagnosis of current substance dependence, acute psychotic disorder, major depression/bipolar disorder, IQ < 80 or any other severe Axis-I diagnosis were excluded from the study. However, since we investigated a typical forensic population, a high prevalence of lifetime substance use disorders (SUD) was unavoidable. In this sample, 66 (52%) subjects fulfilled the diagnostic criteria for any lifetime SUD.

Assessments

As the concept of "Hyperkinetic Disorders" according to the ICD profoundly differs from the widely accepted DSM

concept of ADHD and in order to make the results comparable to international research in this field, DSM-IV criteria were used for the diagnosis of ADHD. ADHD was assessed by the use of standardized instrument, which have been described in detail elsewhere (Rösler et al. 2006), and was diagnosed by well-trained psychiatrists according to the DSM-IV diagnostic criteria (ADHS-DC; Rösler et al. 2008). In addition to expert ratings of ADHD, self-rating instruments were used to improve the correctness of diagnosis. Only those subjects were classified as ADHD cases if they had a WURS-k score ≥30 and if they also fulfilled the DSM-IV criteria of ADHD on the ADHD self-report (ADHS-SB; Rösler et al. 2008) in addition to the expert-based diagnosis.

The German short form of the Wender Utah Rating Scale (WURS-k) was used for the assessment of ADHD-related symptoms in childhood (Retz-Junginger et al. 2002). The WURS-k is a 25-item retrospective, dimensional measure of symptoms associated with childhood ADHD, based on the widely used Utah criteria for the diagnosis of ADHD and the original version of the Wender Utah Rating Scale (Wender 1995). Sensitivity and specificity of the WURS-k for detection of childhood ADHD in males were estimated with 85 and 76%, respectively, in males and with 93 and 92%, respectively, in females, when a cut-off score of 30 was used (Retz-Junginger et al. 2003, 2007). The ADHS-SB includes 18 psychopathological items of ADHD according to DSM-IV criteria, which are rated on a 0–3 Likert scale. Offenders with childhood ADHD symptoms (WURS-k ≥30) who did not meet the criteria of full ADHD according to DSM-IV were diagnosed as ADHD partially remitted.

Proactive and reactive features of the violent offences committed by the probands were rated by an independent investigator (E.S.) using a standardized 12-item rating scale (Retz and Rösler 2007; Table 1). A substantial interrater reliability was found regarding the total rating scores (ICC [95% IC]: 0.98 [0.94–0.99]). Ratings of proactive and reactive features of the violent act were based on court records and information obtained from interview with the offender. The rater was blind to ADHD status. Each item was rated from 0 (not at all) to 3 (very much). The reactive violence subscale comprised "provocation prior to violent act", "affective symptoms during violent act", "short duration of affective symptoms", "reduced responsiveness to stimuli during violent act", "dissociation from violent act shortly after", "reduction in tension during violent act", and "prior reactive violence" according to court records (0–1 charges = 0, 2 charges = 1, 3–4 charges = 2, >4 charges = 3), resulting in a maximum score of 21. The proactive violence subscale consisted of five items resulting in a maximum score of 15. The items were "planning of violent act", "goal-directedness of violent act", "adaptation of behavior during violent act", "justification of behavior after violent act", and "prior proactive violence" according to court records (0–1 charges = 0, 2 charges = 1, 3–4 charges = 2, >4 charges = 3).

Statistics

Descriptive statistics were performed by univariate analyses of variance (ANOVA). Correlations of two continuous variables were assessed by the Pearson correlation coefficient.

Table 1 Rating scale for proactive and reactive violence (PROREA) (39)

		Not at all	Little	Much	Very much
Reactive violence					
Provocation prior to violent act		☐	☐	☐	☐
Affective symptoms during violent act		☐	☐	☐	☐
Short duration of affective symptoms		☐	☐	☐	☐
Reduced responsiveness to stimuli during violent act		☐	☐	☐	☐
Dissociation from violent act shortly after		☐	☐	☐	☐
Reduction in tension during violent act		☐	☐	☐	☐
Prior reactive violence	Number of charges	0–1	2	3–4	>4
		☐	☐	☐	☐
Proactive violence					
Planning of violent act		☐	☐	☐	☐
Goal-directedness of violent act		☐	☐	☐	☐
Adaptation of behavior during violent act		☐	☐	☐	☐
Justification of behavior after violent act		☐	☐	☐	☐
Prior proactive violence	Number of charges	0–1	2	3–4	>4
		☐	☐	☐	☐

Table 2 Mean age, IQ and scores of the rating scales of the three diagnostic groups

	No ADHD mean (SD) (N = 76)	ADHD in partial remission mean (SD) (N = 30)	Full ADHD mean (SD) (N = 21)	ANOVA (F; P)
Age (years)	36.3 (12.4)	29.9 (10.1)	25.8 (7.6)	8.7; 0.000
IQ	98 (16)	91 (13)	92 (13)	1.4; n.s.
WURS-k	15.5 (4.8)	40.1 (9.2)	44.9 (10.4)	149.8; 0.000
ADHS-SB total score	7.5 (6.4)	10.7 (5.7)	26.9 (6.6)	72.7; 0.000
Inattention	3.7 (4.2)	5.1 (3.2)	12.8 (4.5)	38.2; 0.000
Hyperactivity/impulsivity	3.9 (3.3)	5.7 (3.2)	14.1 (3.8)	68.9; 0.000
REPRO subscore "Proactive violence"	5.4 (4.8)	2.6 (2.7)	3.0 (3.1)	5.5; 0.005
REPRO subscore "Reactive violence"	6.4 (5.8)	11.7 (4.5)	12.7 (5.2)	15.8; 0.000

SD standard deviation; *WURS-k* Wender Utah Rating Scale, German version; *ADHS-SB* ADHD self-rating scale; *REPRO* Reactive and proactive violence rating scale

Multivariate analyses of covariance (MANCOVA) were calculated with the dimensional scores of proactive and reactive violence as dependent variables. Two models were calculated. One included WURS-k scores reflecting childhood ADHD symptom severity, the other the current diagnostic state regarding ADHD according to DSM-IV (no ADHD/ADHD partially remitted/full ADHD) besides age, gender and presence of lifetime SUD as covariates.

Results

Twenty-one subjects (16.5%) fulfilled the diagnostic criteria for ADHD according to DSM-IV (ADHD combined type $N = 10$, ADHD inattentive type $N = 5$, ADHD hyperactive-impulsive type $N = 6$). Further 30 subjects (23.6%) were diagnosed with ADHD in partial remission. They displayed symptoms of childhood and current ADHD and showed WURS-k scores of ≥ 30, but did no longer meet the full definition of the disorder according to DSM-IV. WURS-k scores and ADHD symptom self-ratings (ADHS-SB) of the study subgroups are given in Table 2. The three groups did not differ regarding mean IQ (Table 2).

Univariate analyses

Explorative data analyses revealed significant different proactive and reactive violence ratings between the study groups (ANOVAs, Table 2, Fig. 1). Reactive violence ratings were higher in both ADHD groups when compared to subjects without ADHD, whereas the opposite was found regarding proactive violence ratings. Also, age significantly differed between the diagnostic groups, indicating that subjects with full ADHD were younger than those with ADHD partially remitted and subjects without ADHD were older than both other groups (Table 2). Female subjects
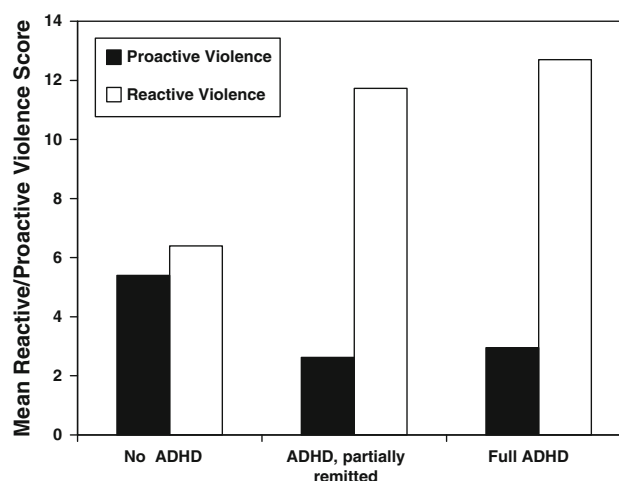
Fig. 1 Mean reactive and proactive violence scores in violent offenders without ADHD, ADHD partially remitted and full ADHD according to DSM-IV

showed similar ratings of reactive violence ratings when compared to male subjects (mean 9.1, SD 3.6 vs. mean 8.7, SD 6.2; ANOVA $F = 0.04$, $P = 0.85$) and proactive violence ratings were somewhat lower in female subjects when compared to males (mean 1.6, SD 2.8 vs. mean 4.5, SD 4.4; ANOVA $F = 3.4$, $P = 0.066$). No differences were found between subjects with substance use disorders and without regarding ratings of proactive (with/without SUD: mean 4.1, SD 4.2 vs. mean 3.3, SD 4.4; ANOVA $F = 0.0$, $P = 0.846$) and reactive violence (with/without SUD: mean 9.5, SD 6.4 vs. mean 8.3, SD 5.4; ANOVA $F = 1.2$, $P = 0.274$). Proactive and reactive violence ratings were negatively correlated ($r = -0.54$; $P = 0.000$). WURS-k scores were positively correlated with reactive violence ratings ($r = 0.48$; $P = 0.000$), whereas a negative correlation was found regarding proactive violence ratings ($r = -0.28$; $P = 0.002$). Moreover, significant correlations were found

between age and WURS-k scores ($r = -0.39$; $P = 0.000$), age and reactive violence ratings ($r = -0.21$; $P = 0.025$), but not between age and proactive violence ratings ($r = 0.13$; $P = 0.16$).

Multivariate analyses

Multivariate analyses were calculated to estimate the impact of childhood ADHD symptoms (model 1) and the diagnostic state regarding ADHD (model 2) on reactive and proactive violence ratings with gender, age and substance use disorders as covariates. In model 1, significant effects of WURS-k scores on proactive and reactive violence ratings and of gender on proactive violence were found. Parameter estimates (regression coefficients) were 0.17 and −0.08, suggesting a positive correlation between WURS-k score and reactive violence and a negative correlation with proactive violence, respectively. As in univariate analysis, proactive violence ratings were lower in females than in males. In model 2, a significant effect of the diagnosis of ADHD was found, but not of gender or age (Table 3). In both models, substance use disorders did not significantly influence rating scores of proactive or reactive violence.

Discussion

In this investigation, we found a high prevalence of childhood and persisting ADHD in a sample of adult violent offenders. The prevalence of 16.5% of full ADHD according to DSM-IV and 40.1% of lifetime ADHD in the entire group are in line with findings of high prevalence of this disorder in male and female offender populations from prior cross-sectional studies (Vermeiren 2003; Rösler et al. 2004, 2009). This finding underlines the notion that ADHD might be involved in the development and the presentation of antisocial behavior in later life (Retz and Rösler 2009).

More specifically, we found significant effects of childhood ADHD symptoms and persisting ADHD according to DSM-IV on proactive and reactive violent behavior in adult offenders. In particular, a positive correlation of childhood ADHD symptoms with reactive violence and a negative correlation with proactive violent behavior have been revealed. Specifically, reactive violence was increased in subjects with full ADHD, and to some lesser extent in subjects with partially remitted ADHD. In contrast, lower ratings of proactive violent behavior were found in subjects

Table 3 Multivariate analyses of covariance (MANCOVA) with proactive and reactive violence rating scores as dependent variables and age, gender, substance use disorders (SUD) and scores of the Wender Utah Rating Scale (WURS-k), reflecting severity of ADHD symptoms in childhood (model 1) or current diagnostic status regarding ADHD according to DSM-IV (model 2) as covariates

Dependent variable	Parameter	Regression coefficient B (95% CI)	F	df	P
Model 1					
Proactive violence	WURS-k score	−0.08 (−0.14−−0.03)	8.1	1	0.005
	Age		0.1	1	0.792
	Gender (male vs. female)	3.16 (0.11–6.20)	5.6	1	0.019
	SUD (present vs. not present)		0.0	1	0.936
Reactive violence	WURS-k score	0.17 (0.10–0.24)	22.2	1	0.000
	Age		0.6	1	0.438
	Gender (male vs. female)		0.1	1	0.331
	SUD (present vs. not present)		1.1	1	0.288

Dependent variable	Effects	Regression coefficient B (95% CI)	F	df	P
Model 2					
Proactive violence	ADHD according to DSM-IV (no ADHD vs. ADHD partially remitted vs. full ADHD)	−1.57 (−2.68−−0.46)	7.8	1	0.006
	Age		0.1	1	0.783
	Gender (male vs. female)	3.44 (0.37–6.50)	4.9	1	0.029
	SUD (present vs. not present)		0.0	1	0.905
Reactive violence	ADHD according to DSM-IV (no ADHD vs. ADHD partially remitted vs. full ADHD)	3.24 (1.78–4.70)	19.4	1	0.000
	Age		0.7	1	0.405
	Gender (male vs. female)		0.7	1	0.419
	SUD (present vs. not present)		0.4	1	0.352

suffering from ADHD as a full or partially remitted syndrome when compared to violent offenders without ADHD. These results resemble findings from studies with ADHD children and adolescents, which have reported a closer relation of ADHD with reactive aggression than with proactive aggression (Bennett et al. 2004; Waschbusch and Willoughby 2007). Likewise, Dowson and Blackwell (2010) recently reported findings from a study with adults with ADHD, which indicate that ADHD is a predictor for comorbid impulsive aggression.

The results provide also further evidence for a distinction between proactive and reactive aggression. It has been argued that due to the co-occurrence of reactive and proactive aggression in offenders, the distinction of these two forms might not be meaningful (Bushman and Anderson 2001). Moreover, aggressive acts are not always unequivocally proactive or reactive, but might present aspects of both types of aggression at the same time. However, there are now several lines of evidence to confirm this differentiation of aggressive behavior. First, exploratory and confirmatory analyses have shown that reactive and proactive aggression is factorially distinct (Brown et al. 1996; Crick and Dodge 1996; Salmivalli and Nieminen 2002). In accordance with this finding, we found a negative correlation between proactive and reactive features of violent behavior in this study. Second, differential heritable influences on reactive and proactive aggression were reported in genetic studies (Baker et al. 2008; Brendgen et al. 2006; Tuvblad et al. 2009). Third, different correlates of reactive and proactive aggression were shown in several studies. For example, proactive aggression has been found to be linked to psychopathic traits and leadership qualities (Dodge and Coie 1987; Raine et al. 2006), whereas reactive aggression was associated with physical abuse, peer rejection and victimization (Dodge et al. 1997; Lamarche et al. 2007; Salmivalli and Helteenvuori 2007). The findings of this study add correlation of ADHD psychopathology with reactive but not proactive violent aggression to these prior findings.

The findings are also consistent with results from studies, which have investigated the association between ADHD and psychopathy according to Hare et al. (1996). Psychopathy can be measured with the psychopathy checklist (PCL; Hare et al. 1990) and includes a liability to aggressive behavior and instrumental, proactive aggression in particular (Swogger et al. 2010). Fowler and colleagues recently reported elevated total psychopathy and emotional-dysfunction scores according to norms in ADHD adolescents, but none scored in the clinical range of psychopathy (Fowler et al. 2009). More specifically, Eisenbarth et al. (2008) could show an increase in behavioral features of psychopathy in adult ADHD patients, but a reduction in emotional features like coldheartedness and stress immunity when compared to controls. It appears apparent from these findings that the relation between ADHD and psychopathy is only weak and does not depend on impulsive traits, interpersonal problems and social maladaptation, which are part of ADHD and psychopathy, but not on personality traits associated with instrumental aggression.

Some additional effects of potential variables like age, gender and substance use disorders have been revealed in this study. Not unexpectedly, proactive violence was more prevalent in male than in female offenders. However, the small number of women in this study, which was due to the low proportion of women in the group of violent offenders in general, requires further investigations to confirm this finding. Moreover, the data give some support to the suggestion that reactive but not proactive violence declines with age, although this finding was not corroborated by multivariate analyses and also needs further verification in following studies in ADHD and non-ADHD populations.

Some limitations of this study have to be mentioned. First, as this is a cross-sectional study in adult offenders and diagnosis of ADHD requires the appearance of ADHD symptoms in early life, the retrospective assessment of childhood ADHD symptoms and a corresponding recall bias was unavoidable. In order to minimize this problem, we used a standardized self-rating instrument with sufficient psychometric properties. Moreover, various factors may confound generalization of the findings, such as the heterogeneity of the constructs violence and ADHD (Steinhausen 2009), selection criteria, previous treatment, IQ and other biological and environmental variables, which have influence of the development of violent behavior. Further, it has to be emphasized that this study was performed in a forensic population with severe conduct problems and a high prevalence of substance use disorders. Therefore, one should be cautious about generalizing of the results to the entire group of adults with ADHD.

In summary, the results of this study give additional support to the notion that childhood and adult ADHD are moderators of violent behavior in adult life. The results of this study go beyond prior findings of an association between ADHD and violence in so far, as a specific relation of ADHD to reactive violence is suggested, whereas proactive features of violent behavior are less common in offenders with ADHD when compared to offenders without ADHD.

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