Adolescents with Childhood ADHD and Comorbid Disruptive Behavior Disorders: Aggression, Anger, and Hostility

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Abstract

This study examined the self-reported expression of overt aggressive behaviors and covert emotional and cognitive processes in adolescents diagnosed with ADHD and comorbid disruptive behavior disorders (DBDs) during childhood.

Methods—Participants were a clinically referred sample of 85 individuals diagnosed with ADHD, initially recruited in the early to mid 1990's when they were 7–11 years of age. At that time, 44 (52%) met criteria for a comorbid diagnosis of ODD and an additional 22 (26%) met criteria for a comorbid diagnosis of CD. Approximately 10 years later, these youth, along with an age-matched comparison sample (n = 83), were re-evaluated to assess a wide array of outcomes including physical and verbal aggression, anger, and hostility.

Results—Individuals diagnosed with ADHD+CD in childhood reported elevated levels of physical aggression when compared to Controls and the ADHD-only group. Individuals diagnosed with ADHD+ODD had elevated levels of verbal aggression compared to Controls. Additionally, both comorbid groups experienced significantly greater amounts of anger, but not hostility, as compared to Controls. Importantly, the persistence of ADHD symptoms into adolescence accounted for most group differences in verbal aggression and anger at follow-up, but not physical aggression, which was accounted for by childhood CD.

Conclusion—Adolescents diagnosed with ADHD and comorbid disruptive behavior disorders during childhood report high levels of aggression associated with increased emotionality in the form of anger, but not hostile cognitions. These findings suggest that in addition to inattention and hyperactivity/impulsivity, emotional dysregulation may be an important component of ADHD, particularly as it presents in adolescence.

Keywords

ADHD; Aggression; Anger; Hostility; Longitudinal research

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is among the most commonly occurring childhood psychiatric disorders, estimated to affect 3–7% of school-age children [1]. ADHD

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is predictive of a wide array of poor outcomes, including later impairment in educational [2], cognitive [3], and social [4,5] development. Further, ADHD symptoms persist in a substantial proportion of those diagnosed during childhood [6,7]. Childhood ADHD has also been associated with later antisocial behaviors [7] including adolescent and young adult criminality [8,9], oppositional-defiant behaviors [10], and Antisocial Personality Disorder [11].

While it is clear that many children with ADHD experience significant difficulties as they develop into adolescence, the specificity of the association between childhood ADHD and adolescent aggressive behavior remains unclear, in part due to the high rates of comorbid conditions commonly seen in these children, which may account for many poor outcomes. Chief among these comorbid diagnoses are the disruptive behavior disorders (DBDs): Conduct Disorder (CD) and Oppositional Defiant Disorder (ODD). A review of 29 epidemiologic and clinical studies of children and adolescents diagnosed with ADHD, reported the co-occurrence of ODD in 35% and CD in 30%–50% of subjects [12]. As such, issues of comorbidity are salient obstacles to gaining an understanding of the expression of aggression in adolescence and young adulthood as it specifically relates to ADHD.

Several studies have concluded that early aggressive behaviors associated with childhood CD, and not hyperactivity, are the primary predictors of adolescent aggressive and antisocial behavior [13–15]. Alternatively, it has been suggested that an ADHD x CD symptom interaction most clearly predicts later antisocial behavior [16]. Additionally, some investigators have found that early ADHD, even after controlling for CD, predicts poor outcome [5], while other results suggest that persistence of ADHD into adolescence predicts later antisocial behavior [17] irrespective of childhood status.

While the focus of most longitudinal research examining the outcome of children diagnosed with ADHD has been on comorbid CD during childhood, a comorbid diagnosis of ODD also portends greater psychosocial difficulties in children with ADHD [18]. One study [19], examining the developmental trajectories among a clinically referred sample of 177 adolescents diagnosed with childhood disruptive behavior disorders, reported a developmental pathway where ADHD, ODD, and CD all showed continuity from childhood to adolescence. Additionally, DBDs displayed escalating trajectories such that early ADHD was found to predict the development of ODD in many individuals, while ODD was found to oftentimes predict later CD, anxiety and depression. Thus, it appears that ADHD is associated with the development of the often verbally expressed, temperamental difficulties associated with ODD, which, in turn, are associated with the emergence of more severe maladaptive behavioral difficulties associated with CD. According to this model ODD increases the risk for the development and expression of later aggressive behaviors associated with a diagnosis of CD.

Most longitudinal studies following children with ADHD have focused on overt aggressive and antisocial behaviors [5,8,10,15,16,20,21]. While aggression is an overt behavior with physical and verbal forms of expression, the tendency to aggress is often influenced by the underlying emotional and cognitive processes of anger and hostility [22]. Elevations in anger, the emotional or affective aspect of aggressive behavior, and hostility, a negative evaluation of persons and things, have been correlated with increased expressions of physical and verbal aggression [23,24]. Yet, the emotional and cognitive factors that often underlie aggressive behavior have largely been overlooked in the ADHD literature. In part, this may be attributed to the lack of distinction among the behavioral, emotional, and cognitive factors often associated with the trait of aggression.

However, research in social cognitive learning theory has provided some insights into the emotional and cognitive processes involved in aggressive behavior that can be applied to individuals diagnosed with ADHD to further our understanding of aggressive outcomes in

these individuals. In their landmark paper, Dodge and Coie [25] showed that hostile attributional bias, the likelihood of interpreting hostile intent in another's actions, was found in children primarily exhibiting reactive, impulsive/provoked, but not proactive, instrumental/ unprovoked, aggressive behaviors. According to these authors, this perception of hostile intent and the experience of anger that stems from this perception result in aggressive behavior.

This study examined in adolescents diagnosed with ADHD with and without comorbid DBD diagnoses during childhood, self-reported overt aggression and the covert emotional and cognitive processes that presumably influence these behaviors. Additionally, we assessed the degree to which the persistence of ADHD symptoms into adolescence accounted for aggression and associated emotional and cognitive processes. It was hypothesized that, compared to never-ADHD Controls and those with childhood ADHD without a comorbid DBD, adolescents with comorbid ODD during childhood would be characterized by elevated levels of verbal aggression while adolescents with comorbid CD during childhood would have elevated levels of physical aggression. Additionally, adolescents diagnosed with ADHD would differ on measures of anger and hostility when compared to Controls and the differences in physical, emotional, and cognitive measures of aggression would be accounted for, in part, by the persistence of ADHD symptoms into adolescence.

Method

Participants

Participants were a clinically referred sample of 85 children (75 males) diagnosed with ADHD who were initially recruited as part of a larger study (n = 169) in the early to mid 1990's when they were 7–11 years of age. Because the original study was not designed as a longitudinal investigation, ongoing sample maintenance procedures were not in place until a later date. Of these 169 participants, 18 refused participation in the follow-up, one was known to be deceased, seven were incarcerated, and 58 were lost to follow-up at the completion of this study. Those who did and did not participate in the present study did not differ significantly (p > .10) on any parent or teacher behavioral ratings during childhood. Thus, the included sample is likely to be representative of the original group.

Among these 85 children, 44 (52%) met criteria for a comorbid diagnosis of ODD and an additional 22 (30%) met criteria for a comorbid diagnosis of CD (20 of whom also met symptom criteria for ODD). There was no significant difference (p > .10) in the distribution of males and females across the diagnostic subgroups. The sample was reevaluated on average 9.11 (SD=1.5) years later at a mean age of 18.23 (SD=1.36) years. Exclusionary criteria at entry during childhood included having a chronic medical condition that required systematic medication, schizophrenia, a pervasive developmental disorder, Tourette's disorder, or having a Full Scale IQ less than 70.

A comparison group of 83 adolescents (73 males), with a mean age of 18.63 (SD=1.64), who never had ADHD was recruited at the time of follow-up. The control sample was recruited through online advertisement and the distribution of informative flyers in proband-matched socio-economic neighborhoods. Exclusionary criteria for controls were consistent with those for probands, but they could not have a prior history of ADHD or treatment for ADHD-related symptoms. Other disorders were not considered exclusionary, in order for this group to be representative of non-ADHD youth in the community. As indicated in Table 1, the groups were highly similar with respect to age and socio-economic status (SES), as determined by Nakao and Treas' [26] measure of socio-economic prestige, and did not differ in sex distribution. However, those in the ADHD+CD group had lower Verbal and Full Scale IQ scores as compared to Controls and those in the ADHD-only group. Participants in this study were ethnically diverse: 32% Hispanic or Latino, 23% Non-Hispanic Caucasian, 26% African

American, 1% Asian, and 18% of mixed or other ancestry. This study was conducted in a large metropolitan area. Nearly all participants were urban dwellers. All participants and contributing parents were proficient in English. All procedures were approved by the Institutional Review Boards of the participating institutions. Written informed consent was obtained from all adolescents above the age of 18 years and the parents of those under the age of 18 years. Assent was obtained from youth under 18 years old.

Childhood Evaluation Measures

At baseline, participants were administered a comprehensive assessment battery that evaluated general cognitive and psychiatric functioning. Cognitive functioning was measured with either the Wechsler Intelligence Scale for Children Revised (WISC-R) or the Wechsler Intelligence Scale for Children Third Edition (WISC-III), depending upon when the child entered the study. The Child Behavior Checklist [CBCL; [27]] and the IOWA Conners Teacher questionnaire [IOWA; [28]] were used to measure behavioral functioning.

Diagnoses of ADHD, ODD, and CD were determined during childhood using the NIMH - Diagnostic Interview Schedule for Children (DISC). This highly structured psychiatric diagnostic interview has been shown to be highly reliable when administered to parents, although reliability, when administered to children under the age of 11 years has been questioned [29] . Participants were assessed by administering to their parent either the DISC version 2.3 [29] which reflects the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders Third Edition Revised (DSM-III-R) [30] or with the DISC version 3.0 which reflects the diagnostic criteria of the DSM-IV [1], again, depending upon when they entered the study. Those diagnosed using DSM-IV all met criteria for ADHD – Combined Type, and they did not significantly differ from those diagnosed using DSM-III-R criteria on any behavioral measures. Table 2 shows the childhood characteristics of the ADHD, ADHD +ODD and ADHD+CD groups and indicates significant elevations among the comorbid groups on measures of aggression and delinquency.

Adolescent Evaluation Measures

As part of the follow-up evaluation, all participants completed the Buss-Perry Aggression Questionnaire (AQ) [22], which is a revision of the Buss-Durkee Hostility Inventory [31]; the State-Trait Anger Expression Inventory-2 (STAXI-2) [32]; and an ADHD symptom checklist that is analogous to the SNAP-IV [33] and consisted of all 18 DSM-IV Inattentive and Hyperactive-Impulsive items. The AQ is a 29-item self-report questionnaire that measures four factors or subtraits of aggression: Physical Aggression, Verbal Aggression, Anger, and Hostility. It has been shown to be a reliable and valid measure of aggression cross culturally [34,35] and among the general population [35]. For each item, respondents rate themselves on a 5-point Likert scale, with a rating of 1 being extremely uncharacteristic and a rating of 5 being extremely characteristic of the respondent. Buss and Perry [22] defined these 4 measures of aggression into 3 domains of behavior: Physical and Verbal Aggression represent the overt or motor component of behavior as they involve hurting or harming others. Anger, which represents the emotional or affective aspect of behavior, is defined by physiological arousal and preparation to aggress. Hostility is defined by feelings of ill will and injustice and represents the cognitive component of aggressive behavior.

The STAXI-2 is a 57-item self-report questionnaire that measures state and trait experience of anger as well as the expression and control of anger. To date, it has been used in over 400 published empirically based research studies ranging from anger management to coronary heart disease and has been shown to be a valid and reliable measure of state and trait anger [32]. The STAXI-2 is divided into 3 scales and 9 subscales. The state anger scale (S-Ang) is characterized by current feelings ranging from mild irritation to rage. The overall S-Ang scale consists of

three subscales: Feeling Angry (S-Ang/F), measures current experience of anger, Feel Like Expressing Anger Verbally (S-Ang/V) measures current angry feelings related to verbal expression, and Feel Like Expressing Anger Physically (S-Ang/P) assesses current angry feelings related to physical expression. The trait anger scale (T-Ang) measures the experience of angry feelings over time and is comprised of two subscales: Angry Temperament (T-Ang/T) assesses the likelihood of experiencing anger without being provoked and Angry Reaction (TAng/R) measures the experience of anger with provocation. Additionally, the STAXI-2 provides an overall index (AX Index) of anger expression based on 4 measures of anger expression and control. Anger expression is comprised of Anger Expression-Out (AX-O), anger expressed toward persons or objects, and Anger Expression-In (AX-I), anger experienced, but not expressed. Anger control is comprised of Anger Control-Out (AC-O), the ability to prevent the expression of anger toward others or objects and Anger Control-In (AC-I), the degree to which one can effectively deal with feelings of anger.

Severity of ADHD symptoms was determined by adolescent self-reports and parent ratings on a DSM-IV ADHD symptom checklist which consisted of all 18 DSM-IV Inattentive and Hyperactive-Impulsive items. This scale was independently completed by parents and adolescents and measures the presence and severity of 9 hyperactive-impulsive and 9 inattentive ADHD symptoms as they apply to the adolescent. Individual symptoms were rated on a 4-point Likert scale, with a rating of 0 being extremely uncharacteristic and a rating of 3 being extremely characteristic of the adolescent. Analogous DSM-IV ADHD checklists have been used by a number of investigators and have been consistently found to have adequate reliability [36]. In our hands, reliability of the scale was quite strong with coefficient alpha values for the adolescent report of inattention and hyperactivity/impulsivity being .92 and .90, respectively. For parent ratings, the alpha levels for those domains were .95 and .94.

Statistical Analyses

To examine the relationship of childhood comorbid diagnoses to outcome, two multivariate analyses of variance (MANOVA), followed by one-way analyses of variance (ANOVA), and Tukey HSD Post Hoc tests were conducted. Bonferroni corrections were employed on all follow-up ANOVAs. Childhood status (Control, ADHD, ADHD+ODD, ADHD+CD) was entered as the independent variable and the four AQ factor scores constituted the dependent variables for one MANOVA. The three STAXI-2 scale scores were entered as the dependent variables for the second MANOVA. Subscale analyses for the STAXI-2 were only conducted if the broader scale differed significantly across the groups. To examine the degree to which outcome on these dependent measures was accounted for by the persistence of ADHD symptoms into adolescence, these analyses were repeated using self- and parent-report of adolescent ADHD symptoms as covariates. Because of previously mentioned group differences, MANOVAs were reanalyzed, controlling for Verbal IQ. These reanalyses did not appreciably affect findings on any dependent measures, therefore they are no longer discussed. For all analyses, effect sizes are reported as partial eta squared (ηp^2).

Results

The Aggression Questionnaire (AQ)

The MANOVA omnibus test looking at AQ scores as a function of childhood diagnosis generated a significant Wilks' Lambda value ($p < .001$; $\eta p^2 = .09$). Follow-up one-way ANOVAs generated significant group effects for Physical Aggression {$F(3,164) = 7.03$, $p \leq .001$; $\eta p^2 = .11$}, Verbal Aggression {$F(3,164) = 6.1$, $p \leq .001$; $\eta p^2 = .10$}, and Anger {$F(3,164) = 9.67$, $p \leq .001$; $\eta p^2 = .15$}. Significant group effects were not found for the Hostility factor {$F(3,164) = 1.95$, $p = .12$; $\eta p^2 = .04$}.

As indicated in Table 3, Tukey HSD post hoc tests revealed that those with childhood ADHD + CD had significantly elevated levels of Physical Aggression relative to Controls (p < .001, ηp^2 = .15) and ADHD probands without comorbid DBD diagnoses (p = .01, ηp^2 = .24), but not those with ODD. Only, the ADHD + ODD group was found to have significantly (p ≤ .001, ηp^2 = .12) elevated levels of Verbal aggression as compared to Controls. Both the ADHD + CD (ηp^2 = .18) and ADHD + ODD (ηp^2 = .14) groups had significantly (p ≤ .001) higher levels of Anger as compared to Controls.

STAXI-2

The MANOVA omnibus test examining STAXI-II scores as a function of childhood diagnosis generated a significant Wilks' Lambda (p ≤ .05; ηp^2 = .05). As shown in Table 4, individual one-way ANOVAs generated significant group effects on the measure of trait anger (T-Ang) {$F_{(3,164)}$ = 5.75, p = .001; ηp^2 = .20}, and expression and control (AX Index) {$F_{(3,164)}$ = 6.55, p ≤ .001; ηp^2 = .11}, but not state anger (S-Ang) {$F_{(3,164)}$ = 2.64, p = .05; ηp^2 = .05}. Follow up analyses of T-Ang subscales revealed significant effects for the angry temperament (T-Ang/T) subscale {$F_{(3,164)}$ = 5.58, p = .001; ηp^2 = .09}, but not the angry reaction (T-Ang/R) subscale {$F_{(3,164)}$ = 2.08, p = .11; ηp^2 = .04}. Additionally, follow up analyses of the AX Index generated significant group effects for the anger expression out (AX-O) subscale {$F_{(3,164)}$ = 7.60, p ≤ .001; ηp^2 = .12}, and the anger control out (AC-O) subscale {$F_{(3,164)}$ = 5.95, p ≤ .001; ηp^2 = .10}. Significant group effects were not found for the anger expression in (AX-I) subscale {$F_{(3,164)}$ = 1.30, p = .276; ηp^2 = .02} or the anger control in (AC-I) subscale {$F_{(3,164)}$ = 2.09, p = .10; ηp^2 = .04}.

Post Hoc tests revealed that, relative to Controls, both comorbid groups expressed significantly higher levels of trait anger reflected in significant elevations on measures of angry temperament (T-Ang/T) (both p < .01, ηp^2 = .09–.12). Similarly, the ADHD+ODD (p ≤ .001, ηp^2 = .11) and ADHD+CD (p < .05, ηp^2 = .11) groups significantly differed from Controls on a general measure of anger expression and control (AX-Index). While the ADHD+ODD and ADHD +CD (both p ≤ .01, ηp^2 = .08–.10) groups differed from Controls on a measure of outward control of anger (AC-O), only the ADHD+ODD group (p ≤ .001, ηp^2 = .16) was found to significantly differ from Controls on outward expression of anger towards others and objects (AX-O).

Adolescent ADHD Symptoms

One-way ANOVAs examining adolescent ADHD symptomatology as a function of childhood group status revealed significant differences on parent {$F_{(3,160)}$ = 43.33, p ≤ .001, ηp^2 = .44} and adolescent {$F_{(3,167)}$ = 24.99, p ≤ .001, ηp^2 = .31} report. Not surprisingly, post hoc tests indicated that all three groups with ADHD in childhood displayed significantly higher rates of adolescent ADHD symptoms when compared to Controls, but importantly, severity of ADHD symptoms did not differ significantly among the probands as a function of childhood comorbid status. Reanalysis of previous findings, controlling for adolescent ADHD severity, indicated that ADHD symptom persistence accounts for differences previously seen on all measures of anger (AQ and STAXI-II) and verbal aggression. After controlling for adolescent ADHD symptom severity, childhood status was only related to adolescent physical aggression. This was the case irrespective of whether ADHD ratings were completed by the parent {$F_{(3,153)}$ = 3.04, p = .031; ηp^2 = .06} or adolescent {$F_{(3,161)}$ = 2.92, p = .036; ηp^2 = .06}.

Discussion

To further clarify the relationship between childhood ADHD and adolescent aggression, this study sought to compare overt aggression, anger, and hostility in adolescents initially diagnosed with childhood ADHD-only, ADHD + ODD, and ADHD + CD. These three groups were compared to each other and to a non-ADHD control group recruited in adolescence. This study

further examined adolescent aggression, anger, and hostility as a function of the persistence of ADHD into adolescence as rated by parents and adolescents.

Initial analyses indicated that, in individuals diagnosed with ADHD, the presence of a comorbid DBD in childhood is associated with differences in overt aggression in adolescence. Individuals diagnosed with ADHD+CD were found to have significant elevations on a measure of physical aggression when compared to Controls and those who had ADHD only, while individuals diagnosed with ADHD+ODD displayed significant elevations on a measure of verbal aggression compared to Controls. Additionally, both comorbid groups differed from Controls on multiple measures of anger. Reanalysis of the data controlling for differences in Verbal IQ did not affect findings on any dependent measures. This study did not find significant group differences on a measure of hostility, suggesting that the elevated rates of overt aggression were more related to underlying emotional rather than cognitive processes.

As expected, those with childhood ADHD had significantly higher levels of ADHD symptoms in adolescence as compared to Controls. However, the ADHD-only, ADHD+ODD and ADHD +CD groups, as defined during childhood, did not differ significantly in severity of ADHD symptoms during adolescence. Reanalysis of the data controlling for adolescent ADHD symptom severity (or persistence), did not affect findings with regard to physical aggression, which was still elevated in those with childhood CD. However, adolescent ADHD status accounted for group differences on measures of verbal aggression and anger.

The results of this study support previous findings in the literature that among individuals diagnosed with ADHD in childhood, later physical aggression is best explained by comorbid CD. However, our results also indicate that elevations in verbal aggression and anger are best explained by the persistence of ADHD symptoms and not childhood comorbidity.

That persistence of ADHD symptoms explained significant differences initially seen among comorbid groups on measures of anger on both the AQ and STAXI-2 strengthens the argument that ADHD is associated with increased emotionality. While this is not considered a core symptom of the disorder, it is frequently noted to be present, and is often a target of treatment in older patients with ADHD [37]. Such interventions range from treatment with anti-epileptic and antipsychotic medications targeting mood regulation to an array of cognitive-behavioral/ psychotherapeutic treatments [38,39]. Further, the experience of angry feelings in adolescents with ADHD appeared to be stable and persistent, suggesting that anger in adolescents with persistent ADHD is a trait behavior, rather than an acute, or intermittent state. Consistent with these findings of emotional dysregulation in adolescents with childhood ADHD, recent data suggest elevated rates of Cluster B personality disorders among adults with ADHD [40,41]. As such, it is possible that this emotional dysregulation contributes to the well-documented functional impairment that characterizes the adult outcome of so many individuals with ADHD [42,43].

Interestingly, significant group differences were not seen on measures of hostility. This is surprising given that research in social cognitive learning theory has shown hostile attributional biases to exist in children displaying reactive but not proactive aggressive behaviors. While this study did not distinguish between proactive and reactive aggressive behaviors, it is likely that both forms of aggression were represented in our sample. Waschbusch and colleagues [44] showed that boys diagnosed with multiple DBDs were more highly reactive to provocation when compared to normal and non-comorbid peers. However, other studies have not found significantly high levels of hostility in boys meeting criteria for ODD or CD [45,46] As these relationships are currently unclear, future studies may wish to further explore the association between reactive and proactive aggression, hostility, and their association with childhood disruptive behavior disorders.

These findings must be viewed within the context of some study limitations. Perhaps most importantly, is the disparity in sample size that existed between groups. The relatively low number of individuals diagnosed with ADHD alone limited the power to detect differences specifically related to this group. Additionally, that this study was conducted in a large metropolitan area with most participants being male, may limit the generalizability of these findings. Due to the small number of females in the sample, it is likely that our findings primarily reflect the emotional dysregulation associated with ADHD and aggression in males. Our sample was not adequate for a systematic evaluation of gender effects. It is quite possible that findings would be different in females in that several studies have suggested that females express their aggression differently from males. Whereas young boys and adolescents are often described as impulsive and physically aggressive, aggression in girls is more typically described as less direct and more socially ostracizing and isolating [47]. Finally, it is notable that all of our primary dependent measures were in the form of self-report. Had parental or spousal report been used, it is possible that findings would not be identical. Finally, the fact that many of the original participants were lost to follow-up is potentially problematic; however, because the included sample did not differ on any childhood ratings from those that were lost to follow-up, it is likely that they are representative of the original group.

Overall, this study examined the self-reported expression of overt aggressive behaviors, covert emotional and cognitive processes, and the influence of the progression of ADHD symptoms in adolescents diagnosed with ADHD and comorbid disruptive behavior disorders during childhood. A systematic progression of analyses resulted in significant differences among both comorbid groups on measures of physical and verbal aggression and anger when compared to Controls. Adolescent ADHD symptomatology was found to account for differences in verbal aggression and anger, but not physical aggression, which was significantly associated with a comorbid diagnosis of CD. These results indicate that, in adolescents diagnosed with ADHD during childhood, aggression is not purely a function of comorbidity, but is mediated, in part, by the emotional experience of anger, which is associated with the persistence of ADHD symptoms into adolescence. These findings suggest that in addition to inattention and hyperactivity/impulsivity, emotional dysregulation may be an important component of ADHD and should be considered when making diagnoses. Additionally,findings further indicate that treatments targeting emotional liability may be appropriate for those with and without comorbid DBDs.

Summary

In summary, this study examined the self-reported expression of overt verbal and physical aggressive behaviors, covert emotional feelings of anger, and the cognitive process of hostility in adolescents diagnosed with ADHD and comorbid ODD and CD during childhood. Participants were longitudinally followed and re-evaluated about 10 years later along with an age-matched comparison sample. Those diagnosed with ADHD+CD in childhood reported elevated levels of physical aggression when compared to Controls and the ADHD-only group. Individuals diagnosed with ADHD+ODD had elevated levels of verbal aggression compared to Controls. Additionally, both comorbid groups experienced significantly greater amounts of anger, but not hostility, as compared to Controls. Importantly, the persistence of ADHD symptoms into adolescence accounted for most group differences in verbal aggression and anger at follow-up, but not physical aggression, which was accounted for by childhood CD. These data suggest that adolescents diagnosed with ADHD and comorbid DBDs during childhood report high levels of aggression associated with increased emotionality in the form of anger, but not hostile cognitions. These findings suggest that in addition to inattention and hyperactivity/impulsivity, emotional dysregulation may be an important component of ADHD, particularly as it presents in adolescence.

Acknowledgements

Reference List

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. American Psychiatric Association; Washington DC: 2000. text revision

2. Mannuzza S, Klein RG, Bessler A, Malloy P, Hynes ME. Educational and occupational outcome of hyperactive boys grown up. J Am Acad Child Adolesc Psychiatry 1997;9:1222–1227. [PubMed: 9291723]

3. Fischer M, Barkley RA, Edelbrock CS, Smallish L. The Adolescent Outcome of Hyperactive-Children Diagnosed by Research Criteria .2. Academic, Attentional, and Neuropsychological Status. J Consult Clin Psychol 1990;5:580–588. [PubMed: 2254504]

4. Lambert NM, Hartsough CS, Sassone D, Sandoval J. Persistence of hyperactivity symptoms from childhood to adolescence and associated outcomes. Am J Orthopsychiatry 1987;1:22–32. [PubMed: 3826314]

5. Taylor E, Chadwick O, Heptinstall E, Danckaerts M. Hyperactivity and conduct problems as risk factors for adolescent development. J Am Acad Child Adolesc Psychiatry 1996;9:1213–1226. [PubMed: 8824065]

6. Barkley RA, Fischer M, Smallish L, Fletcher K. The persistence of attention-deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. J Abnorm Psychol 2002;2:279–289. [PubMed: 12003449]

7. Biederman J, Monuteaux MC, Mick E, Spencer T, Wilens TE, Silva JM, Snyder LE, Faraone SV. Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. Psychol Med 2006;2:167–179. [PubMed: 16420713]

8. Hechtman L, Weiss G, Perlman T. Hyperactives as young adults: past and current substance abuse and antisocial behavior. Am J Orthopsychiatry 1984;3:415–425. [PubMed: 6331769]

9. Mannuzza S, Klein RG, Konig PH, Giampino TL. Hyperactive boys almost grown up. IV. Criminality and its relationship to psychiatric status. Arch Gen Psychiatry 1989;12:1073–1079. [PubMed: 2589922]

10. Fischer M, Barkley RA, Fletcher KE, Smallish L. The stability of dimensions of behavior in ADHD and normal children over an 8-year followup. J Abnorm Child Psychol 1993;3:315–337. [PubMed: 8335766]

11. Mannuzza S, Klein RG, Bessler A, Malloy P, LaPadula M. Adult psychiatric status of hyperactive boys grown up. Am J Psychiatry 1998;4:493–498. [PubMed: 9545994]

12. Biederman J, Newcorn J, Sprich S. Comorbidity of attention deficit hyperactivity disorder with conduct, depressive, anxiety, and other disorders. Am J Psychiatry 1991;5:564–577. [PubMed: 2018156]

13. Broidy LM, Nagin DS, Tremblay RE, Bates JE, Brame B, Dodge KA, Fergusson D, Horwood JL, Loeber R, Laird R, Lynam DR, Moffitt TE, Pettit GS, Vitaro F. Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. Dev Psychol 2003;2:222–245. [PubMed: 12661883]

14. Fischer M, Barkley RA, Fletcher KE, Smallish L. The adolescent outcome of hyperactive children: predictors of psychiatric, academic, social, and emotional adjustment. J Am Acad Child Adolesc Psychiatry 1993;2:324–332. [PubMed: 8444761]

15. Lahey BB, Loeber R, Burke JD, Applegate B. Predicting future antisocial personality disorder in males from a clinical assessment in childhood. J Consult Clin Psychol 2005;3:389–399. [PubMed: 15982137]

16. MacDonald VM, Achenbach TM. Attention problems versus conduct problems as six-year predictors of problem scores in a national sample. J Am Acad Child Adolesc Psychiatry 1996;9:1237–1246. [PubMed: 8824067]

17. Mannuzza S, Klein RG, Bonagura N, Konig PH, Shenker R. Hyperactive boys almost grown up. II. Status of subjects without a mental disorder. Arch Gen Psychiatry 1988;1:13–18. [PubMed: 3337607]

18. Harada Y, Yamazaki T, Saitoh K. Psychosocial problems in attention-deficit hyperactivity disorder with oppositional defiant disorder. Psychiatry Clin Neurosci 2002;4:365–369. [PubMed: 12109953]

19. Burke JD, Loeber R, Lahey BB, Rathouz PJ. Developmental transitions among affective and behavioral disorders in adolescent boys. J Child Psychol Psychiatry 2005;11:1200–1210. [PubMed: 16238667]

20. Barkley RA, Fischer M, Edelbrock CS, Smallish L. The adolescent outcome of hyperactive children diagnosed by research criteria: I. An 8-year prospective follow-up study. J Am Acad Child Adolesc Psychiatry 1990;4:546–557. [PubMed: 2387789]

21. Lee SS, Hinshaw SP. Severity of adolescent delinquency among boys with and without attention deficit hyperactivity disorder: predictions from early antisocial behavior and peer status. J Clin Child Adolesc Psychol 2004;4:705–716. [PubMed: 15498738]

22. Buss AH, Perry M. The aggression questionnaire. J Pers Soc Psychol 1992;3:452–459. [PubMed: 1403624]

23. Ramirez JM, Fujihara T, van Goozen S. Cultural and gender differences in anger and aggression: a comparison between Japanese, Dutch, and Spanish students. J Soc Psychol 2001;1:119–121. [PubMed: 11294147]

24. Ramirez JM, Andreu JM. Aggression, and some related psychological constructs (anger, hostility, and impulsivity); some comments from a research project. Neurosci Biobehav Rev 2006;3:276–291. [PubMed: 16081158]

25. Dodge KA, Coie JD. Social-information-processing factors in reactive and proactive aggression in children's peer groups. J Pers Soc Psychol 1987;6:1146–1158. [PubMed: 3694454]

26. Nako K, Treas J. Updating occupational prestige and socioeconomic scores: How the new measures measure up. Sociol Methodol 1994:1–72.

27. Achenbach, TM. Manual for the Child Behavior Checklist. University of Vermont; Burlington: 1991.

28. Loney JMR. Hyperactivity, inattention, and aggression in clinical practice. Adv Dev Behav Pediatrics 1982:113–147.

29. Shaffer D, Fisher, Dulcan MK, Davies M, Piacentini J, Schwab-Stone ME. The NIMH Diagnostic Interview Schedule for Children Version 2.3 (DISC-2.3): description, acceptability, prevalence rates, and performance in the MECA Study. Methods for the Epidemiology of Child and Adolescent Mental Disorders Study. J Am Acad Child Adolesc Psychiatry 1996;35:865–877. 865–877. [PubMed: 8768346]

30. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 3. Revised American Psychiatric Association; Washington DC: 1989.

31. Buss AH, Durkee A. An inventory for assessing different kinds of hostility. J Consult Psychol 1957;4:343–349. [PubMed: 13463189]

32. Spielberger, CD. STAXI-2: State-trait anger expression inventory-2. Psychological Assessment Resources; Odessa, FL: 1999.

33. Swanson JM, Kraemer HC, Hinshaw SP, Arnold LE, Conners CK, Abikoff HB, Clevenger W, Davies M, Elliott GR, Greenhill LL, Hechtman L, Hoza B, Jensen PS, March JS, Newcorn JH, Owens EB, Pelham WE, Schiller E, Severe JB, Simpson S, Vitiello B, Wells K, Wigal T, Wu M. Clinical relevance of the primary findings of the MTA: success rates based on severity of ADHD and ODD symptoms at the end of treatment. J Am Acad Child Adolesc Psychiatry 2001;2:168–179. [PubMed: 11211365]

34. Meesters C, Muris P, Bosma H, Schouten E, Beuving S. Psychometric evaluation of the Dutch version of the Aggression Questionnaire. Behav Res and Ther 1996;10:839–843. [PubMed: 8952127]

35. Gerevich J, Bacskai E, Czobor P. The generalizability of the Buss-Perry Aggression Questionnaire. Int J Methods Psychiatr Res 2007;3:124–136. [PubMed: 17849418]

36. Collett BR, Ohan JL, Myers KM. Ten-year review of rating scales. V: Scales assessing attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry 2003;9:1015–1037. [PubMed: 12960702]

37. Stevenson CS, Whitmont S, Bornholt L, Livesey D, Stevenson RJ. A cognitive remediation programme for adults with Attention Deficit Hyperactivity Disorder. Aust N Z J Psychiatry 2002;5:610–616. [PubMed: 12225443]

38. Apps J, Winkler J, Jandrisevits MD. Bipolar disorders: symptoms and treatment in children and adolescents. Pediatr Nurs 2008;1:84–89. [PubMed: 18361094]

39. Wender PH, Wolf LE, Wasserstein J. Adults with ADHD. An overview. Ann NY Acad Sci 2001:1–16. [PubMed: 11462736]

40. Miller CJ, Flory J, Miller SR, Harty S, Newcorn JH, Halperin JM. Childhood ADHD and the emergence of personality disorders in late adolescence: A prospective follow-up study. J Clin Psychiatry. 2008

41. Miller TW, Nigg JT, Faraone SV. Axis I and II comorbidity in adults with ADHD. J Abnorm Psychol 2007;3:519–528. [PubMed: 17696708]

42. Goodman DW. The consequences of attention-deficit/hyperactivity disorder in adults. J Psychiatr Pract 2007;5:318–327. [PubMed: 17890980]

43. Biederman J. Impact of comorbidity in adults with attention-deficit/hyperactivity disorder. J Clin Psychiatry 2004;3:3–7. [PubMed: 15046528]

44. Waschbusch DA, Pelham WE Jr, Jennings JR, Greiner AR, Tarter RE, Moss HB. Reactive aggression in boys with disruptive behavior disorders: behavior, physiology, and affect. J Abnorm Child Psychol 2002;6:641–656. [PubMed: 12481977]

45. Pulkkinen L. Proactive and reactive aggression as precursors to anti- and prosocial behaviors in young adults. Aggressive Behavior 1996:241–257.

46. Vitaro F, Gendreau PL, Tremblay RE, Oligny P. Reactive and proactive aggression differentially predict later conduct problems. J Child Psychol Psychiatry 1998;3:377–385. [PubMed: 9670093]

47. Archer JJ. An integrated review of indirect, relational, and social aggression. Pers Soc Psychol Rev 2005;3:212–230. [PubMed: 16083361]

Table 1

Adolescent Characteristics as a Function of Childhood Comorbidity

	Controls (n=83)		ADHD (n=19)		ADHD+ODD (n=44)		ADHD+CD (n=22)		F	p
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
AGE	18.56	1.65	18.06	1.20	18.15	1.46	18.40	1.34	1.06	.37
SES	40.77	16.78	48.83	20.80	45.51	19.31	38.51	12.36	1.99	.12
FSIQ	96.57	15.24	98.63	16.78	94.42	14.52	86.30*	12.77	3.64	.01
VIQ	97.65	15.65	101.05	18.19	94.78	13.83	86.50*	13.42	4.28	.01
PIQ	95.20	14.03	95.42	15.99	94.28	13.83	87.62	13.87	2.02	.11

SES = Socioeconomic status, FSIQ = Full Scale IQ, VIQ = Verbal IQ, PIQ = Performance IQ

*
= significantly less than Controls and ADHD, $p \leq .05$

Table 2

Childhood Characteristics

	ADHD (n=19)		ADHD+ODD (n=44)		ADHD+CD (n=22)		F	P
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**		
FSIQ	96.22	14.48	95.22	14.30	89.82	15.08	1.51	.23
VIQ	97.78	16.46	96.11	15.71	91.50	16.97	1.08	.37
PIQ	95.39	16.24	95.36	16.33	89.14	12.45	1.62	.20
IOWA I/O	10.24	3.75	10.61	2.30	12.48	2.65	3.69	.03
IOWA AGG	6.56	4.80	7.18	4.76	9.88	3.75	3.66	.03
CBCL ATTN	66.11	9.13	73.28*	8.98	73.35*	10.21	4.16	.02
CBCL DEL	58.78	8.52	67.41*	8.02	75.87**	7.05	23.90	<.001
CBCL AGG	57.11	7.18	71.80*	11.38	81.28**	11.16	26.38	<.001

FSIQ = Full Scale IQ, VIQ = Verbal IQ, PIQ = Performance IQ, IOWA = Iowa Conners Teacher questionnaire, I/O = Inattention/Overactivity, AGG = Aggression, CBCL = Child Behavior Checklist, ATTN = Attention, DEL = Delinquency

*
= significantly greater than ADHD, $p \leq .05$

**
= significantly greater than ADHD and ADHD+ODD, $p \leq .01$

Table 3

AQ Scores as a function of Childhood Status

AQ Scores	Controls (n=83)		ADHD (n=19)		ADHD+ODD (n=44)		ADHD+CD (n=22)		F	p
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
PA	48.30	9.26	47.33	10.37	52.94	10.88	57.75 **	8.64	7.03	≤.001
VA	47.67	10.79	52.15	9.78	56.86 *	11.09	54.00	10.76	6.08	≤.001
Anger	46.82	8.33	49.75	11.79	54.67 *	11.28	57.31 *	11.69	9.61	≤.001
Hostility	45.56	11.49	48.81	15.47	48.67	13.45	52.59	14.35	1.95	.123

AQ = Buss Perry Aggression Questionnaire, PA = Physical Aggression, VA = Verbal Aggression

*
= significantly greater than Controls, p ≤.01

**
= significantly greater than Controls and ADHD, p ≤.01

Table 4

STAXI-2 Scores as a function of Adolescent status

STAXI-2	Controls (n=83)		ADHD (n=19)		ADHD+ODD (n=44)		ADHD+CD (n=22)		F	P
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
S-Ang	47.82 6.20		50.43 7.83		52.72 13.82		51.42 12.22		2.64	.05
T-Ang	46.84 7.95		51.29 8.81		53.39* 12.35		53.17* 9.63		5.75	≤.001
T-Ang/T	5.34 1.91		6.58 2.83		7.02* 3.58		7.29* 3.00		5.58	≤.001
T-Ang/R	7.04 2.58		7.95 3.03		8.30 3.45		7.96 2.81		2.08	.101
AX-Index	46.91 8.70		49.45 11.40		53.94* 11.30		53.69* 7.04		6.51	≤.001
AX-O	15.33 3.85		16.89 5.21		19.47* 5.72		17.63 4.75		7.60	≤.001
AC-O	23.28 5.38		23.21 6.15		20.09* 5.11		19.29* 4.18		5.95	≤.001
AX-I	15.33 4.39		17.42 5.80		16.40 4.43		16.08 4.38		1.30	.28
AC-I	21.23 5.42		21.32 6.17		19.53 5.67		18.54 4.63		2.09	.10

STAXI-II = State Trait Anger Inventory, S-Ang =State Anger, T-Ang = Trait Anger; T = Angry Temperament, R = Angry Reaction, AX = Anger Expression, AC = Anger Control, O = Out, I = In

*
= significantly greater than Controls, p < .05