The Brain Behavior of Adolescents With Conduct Problems

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THE BRAIN BEHAVIOR OF ADOLESCENTS WITH CONDUCT PROBLEMS

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Abstract
A review of the empirical research on the brain behaviors of adolescents with conduct problems. Current understanding of the long term effects delinquent behavior has on the individual and implications for early diagnosis and prevention. Historical and current publications of this research are cited. The general conclusion of this review was, early diagnosis is possible and prevention of worsening of symptoms can reduce the social, psychological, and physical impact of these behaviors.
A troubling phenomenon in modern culture is the number of juvenile delinquents in the criminal justice system. Approximately 25% of the crime in the United States is committed by individuals under the age of 18 (U.S. Code 42, 5601). Of these juvenile offenders, the majority have a behavioral disorder diagnosis that includes Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and/or Conduct Disorder (CD). Symptoms of these disorders typically include rule-breaking, academic difficulties, substance use, and violence; co-occurrence is common and the majority of the population is male (Clark, Prior, & Kinsella, 2000). Adolescent males who exhibit symptoms of both ADHD and CD are often found to exhibit extreme delinquent behaviors. Research has indicated the diagnosis of ADHD and CD together is 40-90% (Clark et al. 2000). The cost of treatment averages over $20,000 per person each year and the rate of recidivism is quite high (Foster & Jones, 2005). Taken together, these facts present a troublesome picture for adolescents with this degree of pathology. The social, psychological, and financial implications of these disorders present a need for understanding of the causality of these disorders and methods of early prevention or treatment.

Given the severe consequences of delinquency for victims and perpetrators, it is important to investigate the determinants of such behavior. Research suggests that a number of factors contribute to delinquency. For example, researchers have found a correlation between delinquent behaviors and verbal deficits (Clark, Prior, & Kinsella, 2000). Verbal functioning can be defined as the ability to communicate in an age appropriate manner and includes processing of verbal information such as the emotional meaning behind words and the ability to demonstrate mental flexibility (i.e., abstract
thinking and expansion of vocabulary appropriate to age; Lynam, Moffitt, & Stouthammer-Loeber, 1993). Deficits in verbal functioning are associated with impulsive behavior and poor understanding of other’s social cues. Basically, a lack of information can potentially lead to high levels of frustration and eventual aggression. Executive functions are loosely defined as the capacity for the process of starting and maintaining goals and include cognitive abilities such as planning, modifying behaviors, preparation, limiting responses, using feedback cues, flexibility as opposed to perseveration, abstract reasoning, problem solving, sustaining attention, and concentration (Séguin, Pihl, Harden, Tremblay, & Boulerice, 1995). Family dynamics are an example of a social context that can be affected by a child with lower verbal intelligence. A child, who demonstrates difficulty in social situations, including the family context, may get more negative responses from parents. Also, the child may lack successes in other social circumstances like school (Moffitt, 1990); thus, the number of frustrating and negative responses to a child with verbal deficits can be greatly outweighing positive responses.

Further exploration of the correlation between delinquency and cognitive deficits has linked criminal involvement during adolescence with early childhood diagnosis of verbal and executive function deficits and often, an early diagnosis of ADHD. When diagnosed in early childhood, ADHD can be predictive of the severity and longevity of delinquent behaviors. Thus, knowledge of a child’s history of ADHD can aid in determining the stability of delinquent characteristics. A higher rate of criminal convictions for boys with ADHD and CD supports this prognosis (Moffitt, 1990). How do these diagnoses negatively affect a child’s behavior? What can be done to address issues of cognitive deficits and symptoms of ADHD?
A number of theories exist as to why a verbal deficit may contribute to behavioral impairments associated with CD. Moffitt (1990) presented a number of causal hypotheses for this occurrence. First, a behavioral manifestation of verbal ability is the capacity to delay gratification and to anticipate consequences of actions. As stated above, a behavioral aspect of verbal abilities is impulsive behavior; children with poor verbal abilities do not have the capacity to manage impulses. Children with verbal deficits demonstrate poor self-control strategies, or a more impulsive pattern of behaviors due to a developmental delay in these abilities. More general abilities, including learning acceptable behaviors and generalizing this learning, is also affected by lower verbal intelligence. These self-control strategies are mediated by areas of the brain associated with executive functions. Thus, verbal deficits can have a broader effect on behaviors than vocabulary or communication. If a child is unable to generalize stimuli based on previous learning due to lower verbal intelligence, the ability to respond appropriately to ambiguous social situations is affected, often leading to an aggressive reaction. It is important to emphasize that many children with verbal or executive function deficits do not demonstrate extreme levels of problematic behavior but this paper will focus on the subpopulation of these children who exhibit severe and delinquent behavior problems.

Because social and behavioral deficits can begin early in a child's life, often before any diagnosis is made, early diagnosis of behavioral disorders is essential for efficient treatment and prevention of antisocial behaviors. Researchers including Moffitt (1990) have cited a correlation between impaired brain functioning and antisocial behaviors in children. A review of the literature indicates antisocial behaviors are linked with brain dysfunction in early infancy and the overall lower intelligence of children with
behavior problems can be detected prior to beginning school (Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999). The studies cited here explore the causal theories of Conduct Disorder and the legal, academic, and social ramifications this illness has on children before and during adolescence. The purpose of this review is to describe how the behavioral deficits are related to causes by brain impairments and what this means for an individual's functioning.

Literature Review

*Life-course versus Adolescence-limited Antisocial Behavior*

In the course of researching and understanding juvenile delinquency, it is important to note the rate of criminal offending has a surge of activity during adolescence, with a peak around age 17 (Moffitt, 1993). To some degree, delinquency may be a normative developmental experience for many teens. Because of this phenomenon, making a diagnosis of CD in adolescence can be difficult. The majority of adolescents who commit crimes do not continue this behavior into adulthood; however, a small portion does. Distinguishing between those adolescents who will continue to offend and those who will cease criminal activity can theoretically occur in early childhood. Those individuals who demonstrate antisocial behaviors starting in early childhood are more likely to be life-course persistent offenders (Moffitt, 1993) offenders, with ongoing criminal activity well into adulthood. Those who demonstrate antisocial behaviors beginning and ending in adolescence are thus referred to as adolescence-limited offenders.

According to Moffitt (1993), children between the ages of 8 to 9 who commit extreme acts of delinquency (e.g., fighting, fire setting) are more likely to continue these
behaviors into adolescence and beyond. This finding is not entirely consistent, yet a strong correlation exists. Life-course persistent antisocial behavior may be captured by early diagnosis of CD and is a required indicator for diagnosis of adult Antisocial Personality Disorder (Diagnostic and Statistical Manual of Mental Disorders, Text Revision; DSM-IV-TR). For the purposes of prevention however, it is vital to detect behavioral problems early on. By the age of 15, it is difficult to distinguish between adolescence limited and life-course persistent delinquency as both groups are committing a roughly equal number of criminal offenses (Moffitt, 1993). In general, for the purpose of prevention, it is more important to assess the significance of a child's delinquent behaviors than to examine potentially inaccurate historical information (i.e., an adult's recollection of childhood behaviors). A child demonstrating delinquent behaviors is a more likely candidate for preventing long term criminal activity than adult reporting behavioral problems from early childhood.

Why do some children demonstrate delinquent behaviors so early? Moffitt (1993) suggests a disruption in neural development in utero or during early infancy that, while minor, is correlated with later antisocial personality traits and violence. Because executive functioning and verbal abilities are associated with "higher functioning" areas of the brain, they are more sensitive to disruptions in development than areas that control survival behaviors (i.e., areas of the brain responsible for the maintenance of breathing, blood circulation, movement). Higher function areas of the brain are still developing in infancy and early childhood; this is why a 9 month old cannot recite multiplication tables. Because executive functions and verbal abilities are still developing, these areas are more susceptible to disruptions from the environment that can impair optimal functioning.
Developmental impairment of neurons can be caused by maternal drug use, poor prenatal or childhood nutrition, pre- or post-natal exposure to toxic agents, complications during delivery, heritability, or lack of affection (Moffitt, 1993). As these potentially damaging events co-occur, the likelihood of developmental delays and subsequently, antisocial behavior increases. It is hypothesized that early dynamic indicators of delinquency can be targeted for intervention with the aim to prevent delinquency and its negative ramifications. The majority of the developmentally impairing events listed above are either preventable or reversible with intervention.

**Verbal IQ and Delinquency**

An often-cited and researched phenomenon (e.g. Wechsler, 1949) in adolescents with CD is the discrepancy in their intelligence scores in which the verbal IQ (VIQ) is significantly lower than the performance IQ (PIQ), sometimes by a full standard deviation or more. However, more recent studies (Kennedy, Richardson, Dixon, & Kelly, 2003) yield results inconsistent with Wechsler's findings. Wechsler intelligence tests results were examined for 249 adolescents involved in juvenile justice system in the United Kingdom. Participants in this study did not have a statistically significant difference between the VIQ and PIQ measures; rather participants had overall lower IQ than previous studies have cited. The VIQ performance was slightly lower than PIQ, but not to the same degree found in previous studies. Thus, there is little agreement among researchers about the nature of the VIQ-PIQ relationship as it relates to delinquency.

Research indicates deficits in IQ measured as young as the age of 5 will continue throughout childhood (Moffitt, 1990). Adolescents with delinquent behavior generally have overall lower IQ than other groups (Lynam, Moffitt, & Stouthammer-Loeber, 1993).
This does not occur exclusively in adolescence however. In a study measuring the IQ of boys at ages 9 to 10 and again at 12 to 13, researchers found lower IQ at both ages in the participants who reported committing delinquent acts at ages 12 to 13. This finding remained consistent even after other variables thought to impact IQ scores, such as socioeconomic status and race, were factored out. Is low IQ the determining factor in predicting CD? Such a statement cannot be made due to numerous children with low IQ scores who do not engage in delinquent behaviors. Information about IQ is helpful in studying and understanding CD, but can only provide some information. Further measurements and study of the brain behaviors of children with delinquent tendencies is necessary.

Neuropsychological Measures and Delinquency

Though researchers have consistently found evidence to support the correlation between lower IQ and delinquent adolescents, it is neither definitive nor causative. Other correlations and patterns of developmental impairments become necessary to measure as people with identical IQ scores have very different patterns of mental strengths and weaknesses. For example, a person with poor math skills may have the same IQ score as a person with poor spatial relation skills. Measuring the neuropsychological functioning of an individual can help identify those strengths and weaknesses. Neuropsychological functions are defined as the “anatomical structures and physiological processes within the nervous system influence psychological characteristics such as temperament, behavioral development, and cognitive abilities” (Moffitt, 1993, p. 681). Neuropsychological batteries measure functions besides verbal skills and spatial perception; these batteries
provide interpretable scores of memory, motor skills, and mental self-control to name a few (Moffitt, Lynam, & Silva, 1994).

The pattern of results from a neuropsychological battery corroborates with behavioral activation measured by brain scans (Moffitt et al, 1994); that is, while performing a reading task, an individual’s MRI scan will show more activation in areas of the brain associated with word comprehension. Neuropsychological batteries are purported to measure abilities beyond what IQ tests can measure and some deficits found in early childhood are not measured well by IQ (Moffitt, Lynam, & Silva, 1994). For example, motor skill deficits before the age of 5 have been associated with early childhood behavioral difficulties including ADHD and CD; however this is a deficit is not measured well by IQ tests. Other behavioral characteristics indicative of early childhood problems include high levels of motor activity, aggression, non-compliance, tantrums at inappropriate ages, and inattention, all of which are mediated by executive functioning (Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999). Verbal deficits (receptive listening and reading, problem solving, expressive reading and writing, and memory) and executive functions are two neuropsychological deficits empirically associated with antisocial behaviors (Déry, Toupin, & Pauzé, 1999).

Based on the association between the above mentioned neuropsychological impairments and the diagnostic characteristics of Conduct Disorder, it is hypothesized that poor neuropsychological functioning in early childhood can predict delinquency beginning before age 13. Furthermore, delinquency beginning early on is more likely to continue at a high rate and the child with severe, early onset CD will demonstrate a specific pattern of executive function deficits. Moffitt et al. (1994) found that participants
who began committing delinquent acts in adolescence did not have evidence of poor neuropsychological functioning in early childhood. Those participants whose delinquency began before adolescence had a distinct pattern of neuropsychological impairment including impaired verbal skills and poor management of executive functions. Continued research in this area may help differentiate children at risk for life-course persistent CD, who can then be targeted for specific interventions.

Cognitive and behavioral similarities exist between individuals with frontal lobe damage and antisocial behaviors (Lueger & Gill, 1990). This is important to note because areas of the brain responsible for the executive functions are primarily located in portions of the frontal lobe. If frontal lobe functioning is impaired, executive functioning may also be affected such that restraining from impulsive, aggressive behavior may be difficult. Adolescents with CD may, in fact, have mild damage that combined with other environmental circumstances results in impulsive, delinquent behaviors. A review of the literature provides evidence to support this.

Summation of Relevant Studies

Between 1972 and 1973, a group of participants was recruited for the Dunedin Multidisciplinary Health and Development Research, called the Dunedin study for short (Silva, 1976). This is an ongoing, longitudinal study of approximately 1,000 children born in Dunedin, New Zealand. Participants have been assessed at birth and again about every two to five years. The most recent report was completed in 2004, when the participants were 32 years of age. These participants are the resource for many studies included in this review and provide a consistent sample measured at critical ages. The
participants are relatively equivalent to U.S. participants in socioeconomic status, ethnicity, and gender.

Using only those participants in the Dunedin study who had been identified as having conduct problems (18.3% of 678 available participants) Moffitt and Silva (1988), examined the degree of comorbidity between conduct problems and ADHD. Delinquency was identified by self-report and corroborated with another source such as parent, teacher, and/or police file. ADHD was assessed via a neuropsychological battery. Conduct problems were distributed by theft (42.2%), minor assault (24.7%), vandalism (10.7%), and substance abuse (9.9%). Results of testing indicated 18% of the participants in the delinquency group also met criteria for ADHD compared to only 2% of a nondelinquent comparison group. Among all participants with a diagnosis of ADHD in either the comparison or experimental group, significant neuropsychological impairments were found with the most severely impaired participants having both ADHD and conduct problems. The participants who had the highest frequency of delinquent behaviors had both ADHD and CD diagnoses. The results from this study indicate a higher risk of serious delinquent behaviors in adolescents with this comorbid diagnosis. These findings are disturbing when compared with the types of delinquent activities reported in this study.

Another study of the Dunedin sample examined the neuropsychological patterns that accompanied childhood and adolescent disorders of ADHD, CD, childhood anxiety disorders, and depression at the age of 13 (Frost, Moffitt, & McGee, 1989). The most significant finding was that children diagnosed with multiple disorders, regardless of the combination, demonstrated poorer performance on neuropsychological measures than
any other group. No particular pattern of test performance emerged more strongly than
another for these comorbid participants, but results were significant. An interesting and
significant finding within this study showed the participants with the most severe
hyperactivity were more likely to be diagnosed with a comorbid disorder. Examination of
previous data collected from this sample at age 11, indicated that participants with
ADHD and/or CD had the most severe problems with verbal, visuospatial, verbal
memory, and visual-motor integration. The authors speculated that the lack of specific
neuropsychological patterns was due in part to the use of a general population sample.
That is, adolescents in this study had little or no previous psychological treatment,
academic, social, or legal problems. The authors’ speculated that if they had used a more
selective population of delinquent adolescents the results may have been more definitive.

Moffitt (1993) examined the developmental trajectories of 13 year old boys
within the Dunedin cohort determined to have both juvenile delinquent behaviors and a
diagnosis of ADHD. The purpose of this study was to examine the stability of
characteristics thought to be related to delinquency. Among other tests, the participants
were assessed for childhood antisocial behavior, low verbal intelligence, reading
difficulty, and family adversity from the ages of 3 to 13. Follow up at age 15 was
conducted to measure the outcome of delinquent behaviors. The results suggest
"adolescent delinquency combined with ADHD presents a greater risk for serious, long-
term offending as evidenced by higher rates of conviction for boys with ADHD and CD"
(p. 895). Trajectories in this study indicate the boys with both ADHD and early
delinquent behaviors had higher incidences of later antisocial behavior than any other
comparison group including CD-only, ADHD-only, and non-disordered.
Moffitt (1990) continued to study the Dunedin cohort in an effort to explain and predict antisocial behavior. Using adolescent males diagnosed with ADHD or CD, she attempted to differentiate between those participants whose delinquency would be limited to adolescence and those who would likely continue to commit delinquent acts in adulthood. The neuropsychological characteristics of the participants were measured and examined. Both the participants with ADHD and the participants with CD had statistically lower scores on neuropsychological and IQ measures starting in early childhood. Boys with only ADHD or CD did not show the same stability of behavioral problems and did not have the same pattern of neuropsychological deficits as those with CD and ADHD. Thus, it was concluded that participants with a comorbid diagnosis had a pattern of neuropsychological deficits that was most consistent with life-course delinquency. Boys with a single diagnosis were more likely to limit delinquent behaviors to adolescence.

A longitudinal study conducted with adolescent boys in Pittsburgh (Farrington, Loeber, & Van Kammen, 1990) similar to the Dunedin study, showed patterns consistent with Moffitt’s results. Both the Dunedin study and the Pittsburgh Youth Study found evidence that children with high rates of delinquency between the ages of 10 to 13 showed higher rates of impulsivity than other participants. In addition, inconsistent parenting style and rejection by peers were also highly correlated with delinquency. This corroborates with Moffitt’s previously reported theory that environmental factors exacerbate existing brain conditions. That is, a pattern of potentially harmful environmental factors exists that reinforces behaviors associated with impaired neuropsychological functioning.
The above studies have consistently demonstrated that lower scores of certain neuropsychological functions, such as poor verbal abilities and ability to express age-appropriate inhibitory behaviors, are related to later, chronic delinquent behaviors. A number of the studies have results indicating a comorbid diagnosis of ADHD and CD puts the adolescent at high risk of continually committing delinquent behaviors. Some researchers have suggested neuropsychological measurements exists that can predict whether a child’s delinquent behavior is a temporary or long-term trait. Does a pattern of neuropsychological scores exist that support this suggestion? Some research indicates yes, it is possible to predict if a child is at risk for life-course delinquency.

Certain neuropsychological deficits are related exclusively to delinquency; problematic behaviors beginning in adolescence, that is, no previous indication of deviant behavior may also show evidence of poor neuropsychological functioning. Moffitt et al (1994) concluded that participants from the Dunedin cohort with delinquent behavior in adolescence, regardless of what age they began committing illegal behavior, had consistently lower scores on a neuropsychological battery than those participants with no delinquent behaviors. A factor analysis revealed five areas of neuropsychological functioning that were lower in adolescents with delinquent behaviors: verbal measured word comprehension, visual-spatial measured deductive reasoning, verbal memory, visual-motor integration, and mental flexibility. At the age of 13, the first three of these factors could be used to differentiate between delinquents and non-delinquents, even when SES was statistically controlled. A modest correlation occurred between all five factors and delinquency; verbal and verbal memory factors correlated most strongly with delinquency (r = .15). A moderate correlation existed indicating males with poor verbal
functioning began committing delinquent acts prior to adolescence. A follow-up was completed when the participants were 18 years of age where criminal records were examined for the previous twelve months. A pattern similar to other studies (e.g., Moffitt, 1993) was found in which a surge of offending behaviors occurred around age 17 for a large number of the participants regardless of neuropsychological status (Moffitt, Lynam, & Silva, 1994). This is consistent with the theory of adolescence-limited delinquency posited by Moffitt (1990).

The neuropsychological deficit pattern thought to be indicative of delinquency (e.g., verbal deficits) was only found in those participants who had conduct problems starting before age 13 and continuing at a high rate into adulthood. While an increase in the number of participants with criminal activity occurred at age 17, the participants with neuropsychological deficits at a younger age were the participants most likely to exhibit delinquent behaviors early on and to continue with these behaviors. This study failed to account for ADHD diagnosis, which would have provided more information such as behavioral problems outside of CD or assessing whether participants who began committing delinquent behaviors in adolescence demonstrated hyperactivity or attentional issues prior to the onset of criminal behaviors. The results cited here corroborate with the notion that environmental and neuropsychological factors are correlated with delinquent behavior. Those children who act out in socially delinquent ways are physically different than their non-offending peers. Finding the exact nature of these physical changes stimulates research to continue in the area of neuropsychological functioning and CD as well as IQ and CD.
Some research has refuted the statistically significant VIQ < PIQ split (e.g., Kennedy et al., 2003), however, even these researchers reported some discrepancy between VIQ and PIQ. One rationale for continued research in this area is the rate of recidivism among adolescents with conduct problems is quite high (Wong & Cornell, 1999) and a discrepancy between VIQ and PIQ, often found among adolescents with conduct problems, and is correlated with recidivism. Adolescents with lower verbal IQ demonstrate impairments in understanding social situations, knowledge of social conventions, and the ability to draw upon past experience. This inability to comprehend social cues often leads to low frustration tolerance and may increase the likelihood of inappropriate or hostile responses. These researchers re-examined previous findings in an attempt to show the VIQ < PIQ discrepancy was related to aggressive behavior. The researchers attempted to identify the social and behavioral deficits associated with this discrepancy which they suggested included problems of hostile attribution meaning the person interprets ambiguous stimuli as threatening, response access which is a limited capacity for reactions to social situations, and response evaluation, meaning the justification of behaviors (Wong & Cornell, 1999). Participants in this study were males between the ages of 13 and 18 incarcerated in a juvenile detention facility in Virginia. Participants were administered the Wechsler Intelligence Scale for Children Revised (WISC-R) and a social problem solving measure. The results indicated a consistent VIQ < PIQ discrepancy among the participants. A discrepancy of twelve points or more was found in 25.3% of participants, but 41.1% had a VIQ greater than or equal to PIQ. Those participants whose VIQ was lower than PIQ showed higher levels of hostile attribution in the social problem solving measure than other participants. The authors suggested that for
participants with delinquency and VIQ<PIQ, the lack of comparative verbal skills lead to inability to interpret social stimuli properly. These individuals may be at greater risk for resorting to frustrated and hostile reactions.

Wong and Cornell (1999) note that the social problem solving measure was fairly simplistic and participants could have been attempting to demonstrate how tough they are to the examiner given the living situation they were in. The social situations presented were circumstances that these boys may have never encountered as they were incarcerated and likely had poor histories of social engagement. Because all participants were in a juvenile detention facility, the researchers speculated social problem solving was more affected by the lower VIQ.

Another hypothesis about the relationship between VIQ and delinquency is that lower verbal intelligence interrupts the child’s ability to learn and generalize new information of all types, which would include both scholastic and social (Moffitt, 1990). An inability to accept ambiguity can lead to a higher frequency of hostile interactions where aggressive, antisocial responses become the only behavioral response rather than a reasoned choice. However, there is a need for further research into the causal basis of juvenile delinquency as many of the participants did not evidence the VIQ < PIQ discrepancy. Perhaps adolescents with the VIQ < PIQ discrepancy and the poorest social judgment are those that fit Moffitt’s life-course persistent profile of delinquency whereas the other participants are among the adolescence-limited cohort.

Verbal deficits are not exclusively correlated with Conduct Disorder. Rather, a number of childhood emotional and behavioral problems are correlated with verbal deficits such as poor development of speech, a lack of vocabulary to label emotions of
self and others, and lack of ability to anticipate consequences and determine right from wrong (Loney, Frick, Ellis, & McCoy, 1998). These authors speculated verbal deficits would be apparent in a sub-group of children with conduct problems, specifically and would be found exclusively in children who demonstrated callous and unemotional behavior. Lack of remorse is a characteristic of Antisocial Personality Disorder (ASPD) (Diagnostic and Statistical Manual of Mental Disorders, Text Revision; DSM–IV–TR). As a diagnosis of CD in childhood is criteria for ASPD in adults, perhaps this pattern of unemotional behavior can be detected early enough in childhood to prevent serious infractions in adulthood. Participants in this study were children ages 8 to 10 with a diagnosis of CD who were referred by a mental health clinic. The children were divided into two groups: those who demonstrated callous and unemotional traits and those who did not. WISC-R intelligence measures were administered to each group. Of the two groups with CD, only the participants with callous and unemotional traits evidenced the VIQ < PIQ discrepancy. The evidence from this study indicates subgroups of CD exist and can be detected at young ages. However, the implications regarding future delinquent behavior of these children is unknown. Further research, such as longitudinal studies or criminal records checks would be informative.

Nigg and colleagues compared the neuropsychological patterns of 171 boys’ ages 6 to 12 with a diagnosis of ADHD-only, ADHD and ODD, ADHD and CD, or no diagnosis (Nigg, Hinshaw, Carte, & Treuting, 1998). The authors hypothesized that the boys with comorbid ADHD and CD were at greatest risk of serious behavioral problems stemming from neuropsychological deficits. Results indicated those participants with a comorbid diagnosis of ADHD and CD had significantly lower verbal abilities, as
measured by the WISC-R Verbal IQ measures, than any other group. In addition, participants with a diagnosis of ADHD, regardless of the presence or absence of other diagnoses, had poorer results on tests of executive functioning. In other words, there was no difference between ADHD/CD children and ADHD-only children. These results imply that ADHD has a significant impact on the behaviors of all children, including those with CD. Being impulsive, lacking mental flexibility and having poor planning skills likely exacerbates any co-existing pathology. Antisocial behaviors that do not meet the full criteria for a diagnosis of CD appear to be caused in part by early onset of ADHD (Nigg et al, 1998).

Séguin, Pihl, Harden, Tremblay, and Boulerice (1995) measured 171 boys recruited through the Canadian public school system over a seven year period starting at age 6 to evaluate the neuropsychological processes associated with physical aggression. The researchers hypothesized early life deficits in neuropsychological functioning are thought to contribute to impulsivity, which affects social maturity. Based on the level of aggression, participants were divided into three subgroups, those who were consistently aggressive beginning at age 6 (stable aggressive), those who demonstrated aggressive behavior at a later age (unstable aggressive), and those who had little or no aggression (non-aggressive). Of these three groups, the stable aggressive boys had statistically significant overall lower scores on tests of executive function and verbal abilities. Participants in the unstable aggressive group had lower scores on the tests administered than the non-aggressive group but no consistent pattern of performance was found. These results reinforce the hypothesis that lower verbal abilities and poor executive functioning is correlated with early onset of aggression.
The research reviewed here indicates that neuropsychological impairments, such as deficits in verbal and/or executive functioning, can result in behavioral difficulties. Using only adolescents who met criteria for CD, Déry and colleagues examined the neuropsychological pattern that could be particular to individuals with CD (Déry, Toupin, Pauze, Mercier, & Fortin, 1999). Participants were also evaluated for the presence of ADHD. Results of this study show no significant difference on scores of executive functions between CD-only and CD+ADHD adolescents. On tests of verbal ability, participants with CD+ADHD had the overall lowest scores. This corroborates the above stated hypothesis that ADHD exacerbates symptoms of other diagnosis (e.g., Moffitt, 1993). No consistent pattern was found that distinguished between the CD-only and the CD+ADHD participants although the CD+ADHD group had generally lower, though not significant, scores on all tests within the battery. These results are similar to above cited studies (e.g., Nigg et al, 1998, Moffitt et al, 1994).

The authors repeated their study with 57 seven to twelve year old boys recruited from a treatment facility for conduct problems and 35 children recruited from the same schools the children with conduct problems attended to serve as controls (Toupin, Déry, Pauze, Mercier, & Fortin, 2000). These authors speculated a younger participant group might have a lower frequency of potentially confounding variables such as head injury caused by fights or substance use. A neuropsychological battery equivalent to the study using the older participants was administered. The researchers again hypothesized only those participants with both CD and ADHD would have neuropsychological deficits. Results of this study indicated participants with a diagnosis of CD+ADHD scored significantly lower on executive function tests measuring perseveration. No consistent
verbal ability deficit was found within any of the participant groups. Participants with CD did show overall lower scores, even when ADHD was factored out; however, results were not statistically significant. Thus, the results differed from the younger to older participants where younger children with CD did not evidence the same neuropsychological dysfunctions that adolescents with CD did. Does something change with age? Is verbal ability affected later in life? Little was said about this discrepancy but perhaps this finding warrants more study. Is it possible that head injuries, the justification for using a younger cohort, have more of an impact than previously thought? Further research would potentially answer some of these questions.

Some research has used even younger participants with the intent of avoiding the above cited confounds and studying the early childhood effects of neuropsychological impairment. A group of 80 preschool age boys were recruited through an outpatient clinic, and all of whom were previously diagnosed with Oppositional Defiant Disorder (ODD) with or without ADHD (Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999). It was hypothesized that these boys would have a neuropsychological profile similar to older children with antisocial behavior problems such as lower full scale IQ, VIQ < PIQ discrepancy, and lower scores on measures of executive functions. Cooperation, affect, and attention were measured and controlled for as these behaviors may impact some test results. Results of this study supported the hypothesis; these young participants showed a pattern similar to the neuropsychological profiles of adolescents with CD including lower IQ and lower scores on tests of executive functions. However, a VIQ < PIQ discrepancy was not found. The patterns of results indicate this discrepancy was likely to occur as the boys grew older. Those boys with both ODD and ADHD had the overall lowest scores on
measures of full scale IQ, verbal IQ, motor planning, and verbal fluency. Results of this study suggest the neuropsychological profile of lower IQ and poorer executive functioning associated with aggressive, defiant, and delinquent behaviors common in children with ODD or CD is apparent as early as 5 years of age (Speltz et al., 1999). For the purposes of detection and early prevention, this is promising.

Another study found lower IQ at age 3 was associated with later criminal behavior (Stattin & Klackenberg-Larsson, 1993). Every three years, participants were administered the age appropriate intelligence measures using the Terman-Merrill Intelligence Test—Revised (Terman & Merrill, 1937) and the Westrin Intelligence Test III (Westrin, 1967) starting at age 3 through ages 17. Overall lower IQ scores were consistently found among the 17 year olds who also had the highest occurrences of criminality. The boys with lower IQ, even at age 3, were the most likely to have criminal records during the course of this study. These participants also had the lowest reported rate of pre-verbal vocalizations. The results of this longitudinal study would indicate that low IQ early in life is a predictive factor of later delinquent behavior. Only full scale IQ was presented in this study with the mean score over the years for frequently offending participants being 91.4.

A more recent study of recidivism in delinquent adolescents helps confirm results from previous studies (e.g., Wong & Cornell, 1999). Adolescents age 14 to 17 were recruited at juvenile court to be tested on neuropsychological measures. Criminal records for each participant were checked two years after testing. Results from these participants could be divided into three categories: Early recidivists who were involved in further criminal behavior shortly after testing and continuing in the two year follow up period,
late recidivists who were charged with further criminal behavior towards the end of the two year follow up, and non-recidivists who had no further criminal involvement (Vermeiren, DeClippele, Schwab-Stone, Ruchkin, & Deboutte, 2002). Participants in the early recidivist category had significantly lower IQ, memory deficits, and self-control problems than the other two groups, even after substance abuse was ruled out.

A hallmark of executive function is an individual's capacity for adaptability and mental flexibility. Because these abilities are so central to other aspects of executive functioning, some researchers argue that usage of neuropsychological tests that measures these abilities specifically are more appropriate than popular measures that assess them indirectly. With this in mind, Clark, Prior, and Kinsella (2000) examined whether executive function deficits were specific to ADHD or comorbid ADHD+CD and to determine the capacity for self-regulation of these participants. These authors suggested that participants with ADHD would have the lowest performance scores on the two measures regardless of comorbid diagnosis. Results show support for this hypothesis: those participants with a diagnosis of ADHD performed the worst on both tasks. The results indicate ADHD presents different deficits than CD in regards to executive functions. This inability to plan effectively and use mental flexibility can lead to difficulties in everyday functioning and interpersonal relationships. It was noted that the pattern of performance for the ADHD and ADHD+CD groups were similar; these results imply an executive function deficit is a neuropsychological symptom of ADHD, and CD-only would present with a different pattern of performance. The researchers replicated this study two years later and found similar results (Clark, Prior, & Kinsella, 2002).

Scores on tests measuring adaptive communication skills and social competence, both
behavioral aspects of executive functioning, were significantly lower among the
adolescents with a diagnosis of ADHD. Those participants with comorbid ADHD and
ODD or CD showed similar results. Thus, the authors concluded the executive
functioning impairments found in these two studies were correlated with ADHD, not CD
or ODD.

Conclusion

With the available literature, it is apparent the study of Conduct Disorder and its
neuropsychological correlates continues to be an important and expanding area of
research. Of the studies cited, a myriad of consistencies and discrepancies is evident. It is
apparent that delinquent behaviors do not easily fit into one category. Some children will
continue to commit crimes and break rules for the rest of their life whereas others will
limit delinquent behavior to adolescence (Moffitt, 1993). A persistent pattern of
delinquent behaviors starting early in life and continuing at a high rate is potentially
indicative of life-course delinquency. Delinquent behavior beginning in adolescence is
likely limited to that age. Measures of cognitive and neuropsychological functioning have
shown an ability to differentiate the life-course persistent delinquent children at a young
age.

As the research has evolved, the generalization that Conduct Disorder is
associated exclusively with a VIQ < PIQ discrepancy has been refuted. In place of that
hypothesis is the belief that an overall lower IQ is commonly associated with CD
(Kennedy et al, 2003). An abundance of research has correlated behavioral aspects of CD
with the comorbid diagnosis of ADHD (e.g., Toupin, et al 2000, Clark, et al 2000, Nigg,
et al 1998). Based on the research, an early diagnosis of ADHD increases the likelihood
of future behavioral problems and a diagnosis in adolescence of CD. Those individuals with early onset of delinquent behaviors, ADHD, or both are most likely to have a pattern of neuropsychological deficits including impairments in executive functioning and verbal abilities. A comorbid diagnosis will present with the most severe neuropsychological deficits (Moffitt, Lynam, & Silva, 1994).

If a child were diagnosed with ADHD at a young age, it may be possible to implement preventative measures to avoid future criminal involvement. Behavioral programs, medication, and therapy are all effective means of treatment and prevention of future worsening of symptoms (e.g., Barkley, 2006). However, most children diagnosed with ADHD do not go on to develop CD or exhibit severe behavioral disturbances. Given the moderate chance that a child with an early diagnosis of ADHD will later be diagnosed with ODD or CD, it is probable that these diagnoses are part of a spectrum of behavioral problems and impulse control associated with differing levels neuropsychological impairment. Those individuals with mild impairments in executive function and verbal ability likely will not manifest the behaviors of delinquency whereas those with severe impairment may be unable to control impulsive thoughts or learn appropriate social skills. Thus, researchers and clinicians have an ethical duty to be cautious in labeling children with ADHD as “at risk” for delinquency, and further research is needed to determine the other related neuropsychological and environmental factors that shape delinquent behavior.

Research in this area should continue; we know some things about the development of delinquent behaviors but the picture is not complete. Equally important is the study of the prevalence of CD. Between 2 and 7 percent of children in the U.S. have a
diagnosis of CD and the cost of treatment for a child with CD is approximately $26,000 annually (Foster & Jones, 2005). It appears a complete understanding of the psychological, physical, behavioral, social, and environmental aspects of CD is critical on many levels, but still developing.

The neuropsychological basis for CD and ADHD continues to be better understood as the body of research grows and the measurements used become more refined. An area not covered in the literature reviewed and important for the social implications of delinquent behavior is research into the emotional traits of delinquent behavior. Does the level of remorse, guilt, empathy, and understanding of consequences differ between the diagnoses or the severity of neuropsychological deficits? Are children born with an inability to process complex emotional reactions that are related to future behavioral problems? Is there a lack of these emotions in life-course persistent delinquency that can be detected early in life? These questions provide areas to enrich the research and offer better understanding of the social implications and ultimately the behavioral development of children with CD.

Early research focused primarily on the IQ deficits associated with CD however the science evolved into more sophisticated measurements of other neuropsychological abilities. The current hypothesis is that a diagnosis of ADHD is associated with executive function deficits and these deficits lead to behavioral difficulties that impact social learning and adaptability. Similarly, Conduct Disorder is associated with verbal deficits and behavioral difficulties that impact communication and learning. When these disorders are combined, the pattern of deficits presents more severe difficulties in social and academic learning, and an increased potential for long-term delinquency.
Ideally, children should all be receiving IQ and neuropsychological tests at young ages and continuing throughout their education. Those whose scores represent impairments in functioning should be assisted and monitored closely in the event of worsening symptoms (e.g., poor school performance, attentional issues, and impulsivity) or the emergence of delinquent behaviors. In reality, the expense of testing every child several times throughout their life is beyond the capabilities of the educational and health systems. Rather, early diagnosis of ADHD and CD should be the current starting point for preventative measures such as behavioral modification programs, individual attention by parents and teachers, and medication when necessary. Conduct Disorder continues to affect individuals and the society at large; the duty of researchers is to continue the evolution of our understanding of how this disorder contributes to delinquency with the ultimate goals of prevention and effective rehabilitation.
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