RISKY DRIVING IN ADOLESCENTS AND YOUNG ADULTS WITH CHILDHOOD ADHD: MEDIATION BY ADHD SYMPTOMS, IRRITABILITY, AND CONDUCT PROBLEMS AT FOLLOW-UP

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Amanda Leigh Thompson

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This thesis was presented

by

Amanda Leigh Thompson

It was defended on

July 17, 2003

and approved by

Susan B. Campbell, Ph.D.

Michael Sayette, Ph.D.

Brooke S.G. Molina, Ph.D
Thesis Director

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As driving is a task that requires vigilance and planful behavior, adolescents and young adults with a history of attention deficit hyperactivity disorder (ADHD) are an important population to study in regard to risky driving behaviors. This study provides a comprehensive examination of risky driving behaviors- beyond tickets and accidents and including alcohol-impaired driving- in a large sample of adolescents and young adults diagnosed in childhood with ADHD and demographically similar community controls without childhood ADHD. Self-report of citations and accidents, alcohol impaired driving, and risky driving behaviors (speeding, following too closely, etc.) were examined, in relation to the presence or absence of a childhood diagnosis of ADHD, potential age related interactions, and the self- and parent-report of current levels of hyperactivity-impulsivity, inattention, irritability, and conduct problems. Results indicate that probands were more likely than controls to have ever driven without a license, to receive more traffic citations, and to be involved in more accidents; there was a trend toward more license suspensions in the ADHD group. No group differences were found for the risky driving and alcohol-impaired driving scales. Multiple regression revealed that hyperactivity-impulsivity was associated with risky driving above and beyond the contribution of conduct problems, while irritability at follow-up was significantly associated with alcohol-impaired driving. In addition, exploratory mediational analyses indicated that hyperactivity-impulsivity and irritability at follow-up (when tested separately) were significant mediators of the association between childhood ADHD and number of tickets and accidents. Findings inconsistent with previous literature are explained in terms of the validity of self-report in the ADHD population, the nature of the proband sample, and potential measurement bias. The unique contributions of hyperactivity-impulsivity, inattention, irritability, and conduct problems are discussed.

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1. Introduction

Motor vehicle accidents are the leading cause of death among American teenagers, accounting for nearly half the deaths of individuals between the ages of 16 and 19 and two-thirds the deaths among individuals 15 to 24 (National Center for Health Statistics, 1980). The rate of automobile crashes is four times higher for 16-19 year olds than for all other ages combined (Williams, 1996). In addition, survey data reveal that as many as 40% of American adolescents have driven after drinking (Mayhew et al., 1986) and that 37% of 15-20 year olds involved in fatal driving accidents during 1994 had been drinking (National Highway Traffic Safety Administration, 1995). Although rates of alcohol-related accidents in the US had been declining for the past two decades (Stewart & Voas, 1994), crash rates are currently on the rise, increasing by 4% in the year 2000 (Voas, 2002). Perhaps due to age-related alcohol effects, driving skill and experience, or other risky driving behaviors (e.g. speeding, following too closely, turning without signaling, etc), young drivers are at higher risk of accident involvement at all blood alcohol concentrations (Simpson & Beirness, 1993).

Although not all teenagers are risky drivers, these alarming statistics have stimulated an interest in identifying subgroups of individuals that exhibit risky driving practices and may be at an increased risk for risky driving, alcohol-impaired driving, and automobile-related injuries and fatalities. Review studies have found risk for hazardous driving to be associated with lack of driving skill and experience, infrequent use of seat belts, alcohol and/or drug intoxication, family-related stress (Brown et al., 1986; Boyd, 1984), and the presence of behavioral and emotional difficulties like depression, low frustration tolerance, aggression, sensation seeking, impulsivity and high levels of energy (Donovan et al., 1983). Many of these factors are likely to be found in individuals with Attention Deficit Hyperactivity Disorder (ADHD) (Barkley, 1998;

Gittelman et al., 1985; Weiss & Hechtman, 1986); consequently, adolescents and young adults diagnosed with ADHD may be at higher risk for a host of risky driving behaviors, including alcohol-impaired driving. The related costs of automobile accidents (in terms of lives, injuries, and money) justify an evaluation of the nature and magnitude of the association between ADHD and risky driving behaviors.

1.1. The Nature of ADHD in Childhood

As one of the most prevalent psychiatric disorders of childhood and one of the most common reasons children are referred to mental health practitioners, ADHD affects 3 to 5 percent of the population and 5 to 9 percent of boys (Barkley, 1998). Developmentally inappropriate levels of inattention, hyperactivity, and impulsivity— the three core features of ADHD-- result in difficulties sustaining concentration, restraining movement, inhibiting impulses, and regulating behavior across a variety of settings and situations. Research has revealed a multitude of impairments associated with ADHD, including delayed motor coordination, impaired emotion regulation, difficulties with peers and parents, and comorbid disruptive behavior disorders (Barkley, 1998). The academic and organizational difficulties associated with ADHD may adversely affect the ability to pass a written driving exam and to proceed through the steps required to obtain a license; as a result, individuals of driving age with ADHD should experience more difficulty attaining licenses in a timely manner. Driving competencies, furthermore, may be affected by the fact that individuals with ADHD are easily distracted, likely to shift "off task", and often respond quickly to situations without accurately appreciating what is required in a given setting (Murphy & Barkley, 1996).

Of considerable importance for theory and research, children with ADHD display a greater degree of oppositional and defiant behavior, aggressiveness, conduct problems, and

antisocial behavior than children without ADHD (Barkley, 1998); hyperactive/impulsive/ attentive problems are highly correlated with conduct problems (see Waschbusch for review, 2002). Research indicates that 54-67% of children and adolescents with ADHD meet full diagnostic criteria for Oppositional Defiant Disorder (Barkley, DuPaul, & McMurray, 1990; Biederman et al., 1992; Barkley, Fischer, et al., 1990) with an average across studies of at least 35% (Biederman et al 1991). These same studies suggest that 20-56% of children with ADHD and 44-50% of adolescents with ADHD meet diagnostic criteria for the more serious problem of Conduct Disorder, and around 20% meet criteria for antisocial personality disorder in adulthood (Weiss & Hechtman, 1986; Gittelman et al, 1985). Children with both ADHD and a comorbid externalizing disorder tend to have worse long-term adjustment—including more traffic offenses and automobile accidents-- than children with ADHD but not CD (Gittelman et al., 1985; Barkley et al., 1990; Jensen et al., 1997; Moffitt, 1990).

The construct of emotional undercontrol is a well-known associated feature of ADHD. For example, a study examining children's emotion regulation strategies in a family task that elicited frustration revealed a less constructive pattern of emotional coping among boys with ADHD than those without (Melnick & Hinshaw, 2000). In non-clinic samples, children lowest in temperamental, cognitive, and affective regulation have been at highest risk for later problem behaviors (Eisenberg, 1997). In addition, emotional instability, irritability, hostility, and low frustration tolerance all have been found to covary with increased driving risk (Donovan, 1983, 1985). These dispositional deficits in self-regulation of emotion—above and beyond the core ADHD deficits of attentional and inhibitory control-- may contribute uniquely to risk for later problem behaviors including risky driving, drinking, and alcohol impaired driving in individuals with ADHD. Because problem driving includes a wide range of behaviors that may (alcohol-

impaired driving) and may not (risky driving such as speeding) be explained by antisocial tendencies, underlying emotional control (i.e., irritability) may also explain driving risks in individuals with ADHD.

Specific ADHD symptoms at follow-up may contribute uniquely to the association between ADHD and risky driving, that is, they may act as separate mechanisms to outcome. Hyperactivity-impulsivity, for example, may contribute to poor choices while driving, quick decisions like turning without signaling, pulling into traffic prematurely, or passing cars when it is unsafe to do so. Inattention may cause an individual to be less focused on their surroundings, the actions of other cars on the road, and the posted traffic signs, which may then contribute to speeding violations, or running through stop signs and traffic lights. Finally, irritability with other drivers may explain why an individual may follow another vehicle too closely or cut off a fellow motorist. These specific relationships between personality characteristics and certain driving behaviors are purely speculative, as individual symptoms have not been investigated in terms of their unique effects, and as it is difficult to distinguish between accidental and purposeful driving behaviors.

1.2. ADHD and Risky Driving

Four studies have examined risky driving behavior in individuals with ADHD (Barkley, et al., 1993, 1996, 2002; Nada-Raja, 1997). Initial research by Barkley and colleagues has revealed high numbers of traffic citations and motor vehicle accidents within the ADHD population. The association between ADHD and risky driving, however, warrants further investigation.

In a three to five year follow-up study of clinic-referred adolescents and young adults with ADHD (Barkley et al., 1993), parent report for 71 participants ages 16-22 revealed that

those adolescents and young adults previously diagnosed with ADHD (n=35) were more likely than controls (n=36) to have driven a car without a license, to have had their licenses revoked or suspended, to have had more auto crashes, and to have been at fault for more of these crashes. Significantly more ADHD subjects had received traffic citations, particularly for speeding, and more had received multiple citations (upwards of three). Those teenagers with childhood ADHD and more comorbid oppositional defiant and conduct disorder symptoms at follow-up were at increased risk for parent-reported unsafe driving behaviors and negative driving-related outcomes such as tickets, accidents, and injuries (Barkley et al., 1993). Thus, antisocial characteristics may have mediated the association between ADHD symptoms and negative driving outcomes. The small sample size (35 ADHD/ 35 nonADHD) in this study may have prevented the detection of statistically significant group differences between 'pure' (non-antisocial) ADHD and driving outcomes. In addition, because parents are not often passengers in cars driven by their children, they may not be fully aware of their sons' or daughters' driving habits; as Barkley suggests (1993), the sole reliance on parent report in this study may have resulted in an under-representation of the targeted behaviors.

In 1996, Barkley and colleagues evaluated motor vehicle competencies in a slightly older (ages 17-30) but smaller (N = 48), sample of young adults and extended the previous study by including parent and self-report of tickets, accidents, and safe routine driving habits, corroboration by official driving records, a test of driving knowledge, and performance on a computer simulated driving test. Outcomes corroborated the driving risks reported in the 1993 study, reporting trends for the ADHD adults (n = 25) to have been cited more often for speeding, to have had their licenses suspended, and to have been involved in crashes. Official driving records from the Department of Motor Vehicles corroborated these self-report outcomes and

indicated that drivers with ADHD had more than five times the number of traffic citations on their records than control subjects. Both self and parent report indicated that the young adults with ADHD were rated as using safe driving habits significantly less often than controls. Although no group differences were found in 'driving knowledge' of motor vehicle operations and traffic procedures, young adults with ADHD had more crashes, scrapes, and erratic steering in the simulator than the community controls. Barkley offered the tentative conclusion that 'knowing what to do'- that is, how to operate the motor vehicle and what action to take in high risk situations-- is not the problem faced by drivers with ADHD; rather, the main difficulty seems to lie in 'doing what they know', that is, in the application of the driving knowledge (behavioral/motor performance, self-regulation, etc.). The motor control problems found in performance on the simulator are consistent with the literature citing deficits in the execution of complex, coordinated sequences of motor movements in children with ADHD (Barkley, 1996).

A later study (Barkley et al., 2002) of driving ability in teens and young adults, ages 17-27, with and without ADHD (n = 105 and n = 64, respectively) challenged this earlier evidence and found deficits within the ADHD group in multiple areas of driving knowledge as well as rapid decision-making. On the Driver Performance Analysis System (DPAS), participants with ADHD received significantly poorer scores in the areas of general knowledge (traffic laws and rules of the road), traffic risks, and driving procedures. In addition to impaired knowledge, young adults with ADHD were significantly less adept on at least half or more of the 12 measures of basic cognitive abilities that were believed to be critical for adequate operation of a motor vehicle. These deficits in knowledge and cognition, consequently, predicted significantly higher estimates of future crash probability for those individuals with ADHD. Although this study addressed the important question of how ADHD interferes with driving ability to

predispose certain drivers to more citations, crashes, and license suspensions/revocations than their same-age nonADHD peers, it utilized probands diagnosed with ADHD retrospectively (that is, not until their late teens) and did not include any consideration of comorbid conduct problems. Conversely, because diagnoses were based on current impairment due to ADHD symptoms, the study also suggests that current ADHD symptomatology may be associated with impaired driving performance. The question of which aspects of ADHD, and comorbidities associated with the disorder, are important for driving risk was left unanswered.

1.3. ADHD and Alcohol-Impaired Driving

The limited research investigating rates of drinking-and-driving within the ADHD population has resulted in conflicting findings. Barkley's aforementioned 1993 study found a trend toward more citations in the ADHD group for driving while intoxicated, but his 1996 study failed to find group differences. Thus, as one measure of impaired driving, alcohol-impaired driving remains to be established as an outcome of childhood ADHD.

Previous studies have found childhood ADHD to be associated with higher levels of alcohol use and related impairment, which suggests that alcohol- impaired driving may be a related outcome of ADHD. For example, Weiss & Hechtman (1993) reported more alcohol abuse and addiction in young adults with childhood hyperactivity compared to controls. In a recent longitudinal follow-up study, adolescents with childhood ADHD were more likely than adolescents without ADHD to report frequent heavy drinking. In the 15-17 year old age range, for example, 9.9% of probands endorsed drinking five or more drinks once a week or more, versus 1.6% of controls (Molina, Pelham, & Gnagy, 2001). In addition, of those adolescents who have ever had a drink of alcohol in their lifetime, 24.1% of probands met criteria for a lifetime alcohol use disorder (abuse or dependence) vs. 0% of controls (Molina, Pelham,

Thompson, & Gnagy, 2002). Furthermore, in a study of behavioral and psychosocial correlates of drinking and driving, Donovan (1993) found drinking-driving in young adults to be most highly correlated with problem drinking ($r = .64$). In other words, drinking increases risk for DUI (Grube & Voas, 1996) as young adults most likely to drive after drinking were also the most heavily involved in problem drinking. Given these associations between alcohol use and alcohol-impaired driving, and between ADHD and increased alcohol use, it is reasonable to expect higher rates of alcohol-impaired driving in adolescents and young adults with ADHD. Previous failures to detect this finding may have been a function of small sample sizes.

Characteristics of ADHD may also cause the association between drinking and alcohol-impaired driving to be stronger in the ADHD group. Because alcohol's disinhibiting effects may be especially salient for individuals with hostile, nonconforming, or sensation-seeking predispositions (Stacy et al., 1991), individuals with ADHD may experience greater behavioral and cognitive impairment after drinking. The disinhibition process, thought to increase in frequency and strength as alcohol consumption increases, leads to a stronger association between normally inhibited personality tendencies, participation in socially sanctioned behavior, and the occurrence of its problem consequences (Stacy et al., 1991). Disinhibited individuals, then, are not only likely to drink more but also to experience more problems as a result of their drinking (Sher et al., 1991). For example, in laboratory tests of aggressive behavior, alcohol increased aggression for individuals with high levels of aggressivity, irritability, and low levels of empathy (Giancola, 2002a, 2002b, 2002c). These vulnerability characteristics are all expected to be present in individuals with ADHD.

In sum, the consumption of alcohol by adolescents and young adults with ADHD might compound their pre-existing impairments in self-regulation, impulse control, decision-making,

and evaluation of negative consequences, thereby increasing the likelihood that they would attempt to drive a motor vehicle when it would be dangerous to do so. Consequently, the association between alcohol impaired driving and problematic drinking in young adults should be explored further to determine whether it is the same—or stronger-- within the ADHD population.

1.4. Developmental Considerations

In general, observational studies (Evans & Waisielewski, 1983), official driving records (Peck, 1985), and survey research (Jonah, 1990) all confirm that young drivers are more likely than older drivers to speed, follow other cars too closely, turn without signaling, allow too little time to merge, and commit passing violations. Combined with a lack of driving experience, these factors may help explain the elevated crash rate, especially among the youngest drivers (Williams, 1996). Jessor et al (1997) discovered a developmental pattern—a linear decline-- in mean levels of risky driving as driver's age increases from 18 to 25 and found attainment of conventional young adult social roles and greater psychosocial and behavioral conventionality to be associated with lower levels of risky driving for both men and women. Crash data also confirm that the high rates of automobile accidents for 16 year olds decline sharply across the subsequent nine years (Williams, 1996). As drivers advance into adulthood, then, many seem to mature out of risky driving; age, therefore, is an important consideration in evaluating risk and may be best conceptualized as an index of cognitive and psychosocial maturity.

Research also supports an association between age, drinking, and heavy drinking. To some degree, alcohol use is a normal part of adolescent experimentation and exploration of adult behaviors (Baer et al., 1998); in the nationwide school sample of the Monitoring the Future Study, 73% of high school seniors reported consuming alcohol in the past year, with 52%

reporting getting drunk (Johnston, O'Malley, & Bachman, 1995). Entrance into college, however, marks a developmental transition in which drinking, often considered a "rite of passage", occurs in greater quantity and frequency (Miller et al., 2001). Survey data reveals that 44% of college students engaged in "binge" drinking (five or more drinks in a row on at least one occasion in the past two weeks) (Weschler et al., 1994) and 19% reported three or more episodes in the preceding two weeks. Levels of alcohol use peak in adolescence and young adulthood and tend to decline and moderate, on average, in the 20s (Monitoring the Future, Johnston et al., 1995; Baer et al., 1998) as a result of the transition to adulthood and increasing role demands from employment, marriage, and parenthood (Jessor et al., 1991).

These age-related trends may affect the magnitude of ADHD group differences found in problem driving. For example, group differences in alcohol-impaired driving may be the most salient in the twenties when alcohol use begins to decline in most adults (but not in probands). Previous research on ADHD and driving behavior has not addressed whether ADHD group differences vary with age. If differences exist within certain age groups, the small sample sizes (n=48, 71, 169) and large age ranges (17-30, 16-22, and 17-27) in previous studies may have obscured age-related or age-specific effects.

1.5. Persistence of Symptoms into Adolescence and Young Adulthood

The symptom expression and associated features of ADHD may change over the lifespan, with some symptoms becoming less conspicuous with age (i.e. hyperactivity), and others persisting or being replaced by new forms of symptomatic behavior. Early conceptualizations of ADHD maintained that children 'matured out' of the disorder, but it is now clear that most continue to experience impairment beyond the childhood years. Although variability in the method of diagnosing ADHD at follow-up has yielded conflicting results (Barkley, 1998;

Mannuzza, 1993; Weiss & Hechtman, 1986), most recent research shows that at least two-thirds of children with ADHD continue to experience significant symptomatology in adulthood.

Self-report of ADHD symptoms suggests that the vast majority of hyperactive children outgrow their disorder by adulthood; parental report, however, confirms the persistence of ADHD into adulthood. Barkley (2002) recently reported that when parent report is used to diagnose ADHD, 46% of young adults with childhood ADHD continue to meet criteria for the disorder; parent report in conjunction with a developmentally referenced cutoff of +2 SD above the mean resulted in 66% of young adults meeting diagnostic criteria. The finding of substantially lower rates of ADHD based on self-report only (12%) emphasize the importance of including/considering parental report even beyond adolescence. The issue of symptom persistence is of particular relevance for the proposed study, in which the presence of parent reported ADHD symptoms in adolescence and in young adulthood may explain ADHD/ nonADHD group differences in risky driving behaviors.

1.6. Summary

In summary, the existing literature, largely a result of work conducted by Barkley and colleagues, has produced a consistent set of findings that individuals with ADHD are more prone than their nonADHD peers to receive traffic citations, have their licenses suspended, and be involved in automobile accidents. Less attention has been paid to the risky driving behaviors (e.g. lane violations, passing violations, speeding, alcohol-impaired driving) that may underlie these negative driving outcomes. While researchers have reported group differences in select driving outcomes, they have given limited consideration to potential mediators of the association between ADHD and risky driving (i.e. ADHD symptoms and conduct problems). Finally, the developmental patterns of age-specific effects on driving performance have largely been ignored.

This study was a comprehensive examination of risky driving behaviors- beyond tickets and accidents and including alcohol-impaired driving- in a large sample of adolescents and young adults diagnosed in childhood with ADHD (probands) and demographically similar individuals without ADHD from the community (controls). Self-report of citations and accidents, alcohol-impaired driving, and risky driving behaviors were examined in relation to the presence or absence of a childhood diagnosis of ADHD. Current conduct problems, ADHD symptomatology, and irritability were tested as mediators of the ADHD-risky driving association. ADHD symptoms, specifically hyperactivity-impulsivity and inattention, the associated feature of irritability, and conduct problems were measured dimensionally to allow for more powerful tests of mediational hypotheses than those that have been conducted in previous research. In contrast to previous research, the independent effects of the mediators were tested above and beyond the effects of the remaining mediators. Finally, interactions with age (range 13 to 28) were considered in all analyses to examine whether risky driving was associated with age and, if so, whether that pattern differed among participant groups. The following hypotheses were tested:

Hypothesis 1. Probands of driving age will be less likely than controls of driving age to have driver's licenses, but probands will be more likely than controls to have driven without a license and to have had their license suspended or revoked. In addition, probands with driver's licenses will report more traffic tickets, accidents, risky driving behaviors, drunk-driving, and tickets/accidents due to alcohol impaired driving than controls with driver's licenses; that is, a childhood diagnosis of ADHD will predict future risky driving practices and negative driving outcomes.

Hypothesis 2. The relationship between heavy drinking and alcohol-impaired driving will be stronger among probands than controls; that is, ADHD status will moderate the relationship between heavy drinking and alcohol-impaired driving.

Hypothesis 3. ADHD symptomatology (inattention and hyperactivity-impulsivity) in adolescence and young adulthood will mediate the relationship between ADHD group status in childhood and later negative driving outcomes (alcohol impaired driving and risky driving).

Hypothesis 4. Irritability in adolescence and young adulthood will mediate the relationship between ADHD and negative driving outcomes.

Hypothesis 5. ADHD symptoms (inattention and hyperactivity-impulsivity) and irritability in adolescence and young adulthood will each have unique effects on negative driving outcomes as mediators of the association between childhood ADHD and negative driving outcomes.

Hypothesis 6. Conduct problems in adolescence and in young adulthood will mediate the association between ADHD group status in childhood and later alcohol-impaired driving, above and beyond persistence of ADHD symptoms and irritability. Conduct problems will be explained as an additional mediator of the remaining driving outcomes.

Although not originally hypothesized, analyses testing hypotheses 3-6 were extended to include traffic accidents and citations as dependent measures. These findings are presented separately as exploratory analyses.

2. Method

2.1. Follow-up Participants

Probands were recruited as adolescents from a large pool of children diagnosed with DSM-III-R or DSM-IV ADHD at the ADD Clinic at the Western Psychiatric Institute and Clinic in Pittsburgh, PA during the years from 1987-1996; age at initial evaluation ranged from 5 to 15 years, with most in their elementary school-aged years. All probands participated in the Summer Treatment Program for children with ADHD, an eight-week psychosocial intervention that included behavioral modification, parent training, and psychoactive medication trials (Pelham & Hoza, 1996). 493 of 519 eligible STP participants were re-contacted in adolescence or in young adulthood to participate in a longitudinal study of alcohol and other drug use and abuse at different developmental stages within this high-risk population. Of those contacted, 355 (72.0%) were interviewed (68.4% participation rate overall). Adolescent and young adult probands were between the ages of 11 and 27 at the time of their first follow-up interview in the longitudinal study, with the majority (92%) falling between 11 and 22 years of age and an average of 8.25 years having elapsed since the probands' initial assessment in the ADD program. The study is ongoing with interviews being conducted annually since the first follow-up interview. Collection of data from the first follow-up interview is complete; subsequent annual interviews are in progress.

The sample is 89% male, 85% Caucasian (a percentage roughly reflecting the racial composition of Allegheny county, indicated by 1989 census data to be 11% African Amercan), with approximately two-thirds coming from two-parent families. Parental education levels ranged from high school to graduate school, with the majority having attained partial college. Annual family income is diverse, ranging from <20k to >100k in a roughly rectangular distribution. Participating probands (n = 355) were compared to non-participating probands (n =

164) (those who refused or who could not be located) on nine childhood variables including parent and teacher ratings of ADHD, ODD and CD symptoms, IQ and achievement, and parental education level. None of the comparisons were statistically significant and, therefore, the probands are considered to be representative of the pool of eligible children from which they were drawn.

All probands met diagnostic criteria in childhood for DSM-IIIR or DSM-IV ADHD. At intake in childhood, parents and teachers completed norm-referenced, standardized measures of DSM-IIIR and DSM-IV ADHD symptom criteria and additional externalizing behaviors including the Disruptive Behavior Disorders Scale (DBD; Pelham et al 1992), the Child Behavior Checklist (CBCL; Achenbach, 1991; Achenbach & Edelbrock, 1986), the IOWA/Abbreviated Conners rating scale (Goyette et al, 1978; Loney & Milich, 1982), and the Swanson, Nolan, and Pelham rating scale of ADHD symptoms and associated features (SNAP; Atkins et al, 1985). In addition, a semi-structured diagnostic interview was administered to parents by Ph.D. level clinicians to confirm the presence of ADHD symptoms, assess comorbid problems and rule out alternative diagnoses. Exclusionary criteria for participation in the follow-up study included a full scale IQ less than 80, a history of seizures or other neurological problems, and/or a history of pervasive developmental disorder, schizophrenia, or other psychotic or organic mental disorders.

Two hundred and forty nonADHD demographically similar adolescents and young adults (controls) were recruited from the Pittsburgh area after their parents participated in a telephone screening questionnaire that gathered basic demographic characteristics, history of diagnoses and treatment for ADHD and other behavior problems, presence of exclusionary criteria as listed above, and a checklist of ADHD symptoms from the DBD (Pelham et al 1992). Most

adolescents and four young adults were recruited through several large pediatric practices in Allegheny County (40.8% of sample) that served a population of patients from diverse socioeconomic backgrounds. The remaining controls were recruited via advertisements in local newspapers and the university hospital staff newsletter (27.5%), local universities and colleges (20.8%), and through other mechanisms (Pittsburgh Public Schools, word of mouth, etc). Parents were interviewed in all instances and young adults (18+) provided self-report as well; symptoms were counted as present if reported by either the participant or his/her parent. Individuals who met DSM-III-R criteria for ADHD (presence of eight or more symptoms), either currently or historically were excluded; those with seven or fewer symptoms were included. Potential control participants were not excluded on the basis of non-ADHD externalizing disorders (i.e. ODD, CD) or internalizing disorders (i.e. anxiety or major depression).

To ensure similarity between groups, the nonADHD participants as a group were matched to the proband sample on age within one year (for ADHD, M = 17.62, SD = 3.35; for nonADHD, M = 17.17, SD = 3.16), gender, ethnicity, and level of parent education (See Table 1). Therefore, by design, the proband and control groups did not differ on these variables.

2.2. Study Sample

From this sample (n =355 probands; n = 240 controls), 580 participants (345 probands, 235 controls) completed (at least) the initial screener portion of the driving questionnaire. Probands and controls of driving age (16 years old and above) numbered 409 (n = 248 ADHD, n =161 nonADHD). Regardless of age and regardless of having a valid permit or license, those individuals who reported any driving in the past six months (N = 347, n = 196 probands; n = 151 controls) were included in the principal analyses because most driving behavior questions were administered only to those individuals.

2.3. Procedure

Interviews in adolescence and young adulthood were conducted in the ADD Program offices by post-baccalaureate research staff. In cases where distance prevented participant travel to WPIC, information was collected through a combination of mailed and telephone correspondence. Informed consent was obtained and all participants were assured confidentiality of all disclosed material except in cases of impending danger or harm to self or others. Self-report questionnaires were completed either with pencil and paper or web-based versions on a closed circuit Internet page.

2.4. Measures

2.4.1. Assessment of ADHD and associated features in adolescence and young adulthood

Because research indicates that adults under-report their ADHD symptoms (Barkley et al., 2002), the following variables indexing variability in current symptomatology were assessed using both parent and self report; the maximum item response between parent and self report was used in the analyses (Bird et al., 1992; Cohen et al., 1993). There were approximately 20 young adults for whom parent report was unavailable. In order to assess the impact of their inclusion on the results, analyses were conducted twice- once excluding these 20 participants and once using their self-report; results were not appreciably different, so results are presented from analyses that included these individuals.

Hyperactivity-impulsivity was measured with the Eysenck Impulsivity Scale (Eysenck et al., 1984) and the hyperactivity-impulsivity subscale of the Disruptive Behavior Disorders rating scale (DBD; Pelham et al., 1992). The Eysenck Impulsivity Scale is a well-known questionnaire adapted by White and colleagues (1994) for American dialect and simplicity of vocabulary. This measure includes 23 items, 12 of which assess impulsive behavior with face valid items (e.g. Has your son or daughter ever bought things he/she doesn't need?, Does your son or daughter ever

act without thinking first?, etc). Item responses are dichotomous (yes/no) and positively coded items were summed to create an index of the subject's current level of impulsivity. In this sample, internal consistency was .87 (12 items). The Disruptive Behavior Disorders Scale (DBD; Pelham et al., 1992) assesses the occurrence of DSM-IV symptoms for ADHD, ODD, and CD on a four-point scale (0=not at all, 3= very much). Alpha for the nine hyperactivity-impulsivity items (3 impulsivity, 6 hyperactivity) was .91 and the scores for the items were summed.

The index of hyperactivity-impulsivity was created by taking the maximum item response across reporters; for each individual item, if the self-report value exceeded that of mother report, than the self-report value was used, and vice versa. Additionally, if mother report was unavailable, father report was used. The large majority of cases (87%) considered both mother and child report; father report was used in 8% of cases, and 5% of cases had only self-report available. Correlations between the EIS and DBD scales were .60 for participant self-report ($p < .01$) and .76 ($p < .01$) for mother report so they were combined by averaging z-scores. Mean for the final scale is .00 (SD = .91), with a range of 3.99 (-1.71 to 2.29); alpha for the final scale is .93; skew = .21.

The maximum responses between parent and self-report to nine items of the inattention subscale of the DBD (e.g. difficulty sustaining attention in tasks or play, does not seem to listen to what is being said, etc.) were summed and divided by nine to create a mean index of current inattention. Mean for this scale was 1.12 (SD = .81), with a range of 3.00 (0 to 3). Internal consistency was .90 and skew was .51.

The Caprara Irritability Scale (Caprara et al., 1985), a 30 item 5-point scale with responses ranging from 'strongly agree' to strongly disagree', was administered to parents. Drs.

Brooke Molina and Oscar Bukstein modified the original measure by Caprara in order to simplify wording. Sample items include "My child easily flies off the handle with people who don't want to listen or understand", and "Sometimes when my child is angry, he/she loses control over his/her actions". In preliminary research with adolescents from the same population, irritability was higher in the ADHD versus nonADHD adolescents by maternal report, and parent report alpha was .91 (Molina, personal communication, 2002). Answers were recoded so that high scores indicate higher levels of irritability at follow-up. With a range of 2.93 (1.83 to 4.77), the scale's mean was 3.40 (SD = .51). Internal consistency in this sample was .91 and skew was -.13.

2.4.2. Assessment of conduct problems at follow-up

Parent and self-report of conduct problems were measured (e.g. Have you ever stolen from a store? Have you ever been physically cruel to others?, Have you ever been arrested?, etc.) using the CD module of the Diagnostic Interview Schedule for Children, version 3.0 (Shaffer et al., 1996) for adolescents and the Pittsburgh Youth Study's Self-Report Delinquency measure (SRD; Loeber et al., 1998) for young adults. For adolescents, the DISC was supplemented with SRD items to create a comparable response set across the ages. The DISC has well-established psychometric properties (Schwab-Stone, 1996). The Self-Report Delinquency measure was originally based on a delinquency measure developed by Elliot, Huizinga, & Ageton (1985) and has been used widely to study the onset and development of delinquent and antisocial behavior and is comprehensive in design.

Rather than relying on the categorical diagnoses of ODD, CD, or ASP, a continuous measure of current symptoms was created by forming a proportion score from the number of conduct problem behaviors endorsed within the past twelve months over the total possible number of behaviors (23 total behaviors for adolescents and 35 for young adults). Again, the

maximum item response across reporters was used in the analyses (that is, if a young adult endorsed an item that his/her parent did not, and if a parent endorsed an item that his/her child did not, both items were counted in the total) (Bird et al., 1992; Cohen et al., 1993). The mean proportion score was .09 (SD = .09) with a range from 0 to .61; skew was 1.72.

2.4.3. Assessment of Driving Behavior

Driving habits were evaluated with an adaptation of The Young Adult Driving Questionnaire, a self-report measure originally developed to test Problem Behavior Theory in high school and college students (Jessor & Jessor, 1977) and later modified for assessment of young adults in their mid to late twenties (Jessor et al., 1991). The YADQ includes report of license suspension (yes/no) and revocation (yes/no), driving without a license (yes/no), number of lifetime citations and accidents, and number of accidents and citations received while intoxicated. Alcohol-impaired driving is assessed by a four-item scale (in this sample, $\alpha = .89$) that consists of the frequency within the past six months of driving after one or two drinks, after three or more drinks, when coordination was knowingly affected, and while drinking. The response scale consisted of 15 choices ranging from 'not at all' to 'more than ten times per day' in the past six months. The scale's mean in this sample is .53 (*SD* = 1.26), with a range of 7.50 (from 0 to 7.50). Skew is 3.08. The scale of risky driving behaviors consists of 24 items ($\alpha = .92$) covering speeding and violations of passing, following, lane-usage, right-of-way, turning, and use of signal (Donovan, 1993). The response scale was the same as that of the alcohol-impaired scale described above. Additional study specific items were added (e.g. Does taking your medication help you with your driving?) but will not be included in the current study due to insufficient numbers of medicated probands. With a range of 7.17 (0 to 7.17), mean for this scale is 1.19 (*SD* = 1.31); skew is 1.62.

Adolescents and young adults were administered the Young Adult Driving Questionnaire (N = 580, 345 probands, 235 nonADHD), but those who had not driven in the past six months only completed the preliminary screener portion [which includes whether or not they have a license, the reason why they do not (suspended, revoked, parent's choice, etc) and whether they have ever driven without a license]. Those participants who completed the entire questionnaire (N = 347; 196 probands, 151 controls) are included in the principal analyses. Of the 16 young adults who endorsed license suspension or revocation, only two had not driven in the past six months (that is, only two skipped out of the rest of the measure); the possibility of selecting out those drivers who may exhibit highest levels of the target behaviors, therefore, is unlikely.

2.4.4. Assessment of Drinking Habits

Alcohol use was evaluated with a structured pencil-and paper substance use questionnaire that is an adaptation and extension of existing measures (e.g., Health Behavior Questionnaire, Jessor et al., 1989; National Household Survey of Drug Abuse, NHSDA 1992). This self-report measure evaluates a full range of substance use variables including frequency of drinking, quantity of drinking, frequency of heavy drinking, age of first drink, age first drunk, etc. Two-week test-retest reliability is acceptable; for alcohol use, r 's range from .79 to .94 and kappas from .50 to .93.

Drinking behavior was operationalized as four variables: 1) frequency of drinking within the past twelve months (12 choices ranging from 'not at all' to 'several times a day') 2) usual quantity of drinking/per occasion in the last twelve months (14 choices ranging from 'I didn't drink in the past twelve months' to 'more than 25 drinks'), 3) frequency of drinking five or more drinks in the past twelve months (same scale as 1), and 4) frequency of drunkenness (same as scales 1 and 3).

3. Results

3.1. Overview of Analytic Plan

First, descriptive statistics for the driving variables for the entire sample are provided in Table 2. ADHD group differences in individual driving variables (accidents, tickets, etc.) and the risky and alcohol-impaired driving scales were tested. Chi-square analyses were used to test for ADHD group differences in current license status and driving without a license or permit among all individuals of driving age. Among the individuals who had driven in the past six months, logistic and least squares regressions were used to test for ADHD group differences for the remaining driving variables. Age and frequency of driving were included as covariates. Multiple regression was used to test moderation of drinking and alcohol-impaired driving by childhood ADHD, as well as the association between adolescent symptoms at follow-up and driving outcomes. Finally, additional exploratory regression models were tested to explore mediation of the relationship between childhood ADHD and number of tickets and accidents by symptoms at follow-up.

3.1.1. Outlier analyses/ Regression Diagnostics

To reduce nonessential multicollinearity, continuous predictor variables in all regression analyses were centered by subtracting the group mean from individual scores. Because high correlations among predictors can bias regression coefficients (Fox, 1991), variance inflation factors—direct indices of the impact of multicollinearity on estimation--were examined. None of the regression models had variance inflation factors greater than 10 (highest VIF = 3.70); however, zero-order correlations among the predictors are presented to facilitate interpretation of the results.

To evaluate the reliability and generalizability of the results, residual diagnostics (specifically DFFITS and DFBETAS) were examined to determine whether particular cases were

influencing the overall regression equation and, if so, on what variable(s) they were manifesting themselves (Fox, 1991). DFFITS, a measure similar to Cook's d, indicates how an individual case influences the regression line, and DFBETAS measure influence on specific regression coefficients. All values were within range; none approached cutoff values suggested by Cohen, Cohen, West, & Aiken (2003).

3.1.2. Power

In a sample size of 347 (196 licensed probands and 151 licensed controls), power to detect small group differences of d = .30 or higher is at least .80 (Cohen, 1988). In addition, the sample size was sufficient to detect small mediated effects at a level of power between .70 and .97 (MacKinnon & Lockwood, 2001).

3.2. Descriptive Statistics

Table 2 lists means and standard deviations or percentage endorsement for individual driving variables. At the time of interview, 61.4% of driving age participants (16 years and older, n = 404) reported having a license. Among the entire sample, N = 580, 12.4% of participants reported having driven a motor vehicle without a valid license or permit. Of those who had driven (regardless of whether they have a valid license or permit), 42.6% reported having had at least once accident in the past six months; similarly 41.6% of the sample reported having received at least one ticket. 11.9 % of drivers have had their licenses suspended, and 3.6% have had to go to traffic school.

3.3. Group Differences in Driving Variables

Table 3 shows percentages of endorsement and mean values for individual driving variables as well as the risky driving and alcohol-impaired driving scales for the ADHD and nonADHD groups. Effect sizes for group differences are included—Cohen's ds for continuous

variables and odds ratios for dichotomous variables. Chi-square tests on individuals of driving age (16 or above, $n = 404$) reveal that controls were significantly more likely than probands to be licensed drivers at the time of interview ($\chi^2 = 34.6$, $df = 1$, $p = .00$, OR = .27), but that probands were four times more likely than controls to have ever driven without a license or a permit ($\chi^2 = 19.4$, $df = 1$, $p = .00$, OR = 3.91). Kaplan- Meier survival analysis confirmed that individuals with childhood ADHD, as a group, received their licenses at significantly older ages than did controls. Mean survival time (i.e. age by which license was received) for controls was 17.52 years, while for probands it was 20.60 years (Breslow statistic = 46.71, $df = 1$, $p = .00$).

Only those individuals who reported driving in the last six months (regardless of their age or license status) were included in analyses for the remainder of the driving variables. Group differences were found for age ($t = -3.44$, $df = 341$, $p = .00$) and frequency of driving ($t = 3.65$, $df = 341$, $p = .00$) such that probands were older and less frequent drivers than controls. Thus, these variables were used as covariates in logistic regressions (for dichotomous variables) and ordinary least squares regression (for continuous variables). Small to medium sized associations were found between ADHD and the number of accidents in the last six months ($\beta = .11$, $p = .05$, $d = .30$) and number of tickets received in lifetime ($\beta = .11$, $p = .03$, $d = .43$). The small sized effect found for number of tickets received in the last six months ($\beta = .10$, $p = .06$, $d = .30$) was marginally significant. Probands were over four times more likely than controls to have gone to traffic school, though this difference did not meet conventional cutoffs for statistical significance (Wald $\chi^2 = 2.75$, $p = .09$, OR = 4.15). In addition, the risky driving mean was also marginally significant between groups ($\beta = -.08$, $p = .11$, $d = .25$); the effect was small and in the opposite direction than was hypothesized such that controls reported more risky driving than probands. No group differences were found for means of the alcohol-impaired driving scale. Lack of

significant differences were confirmed using logistic regression after dichotomizing the continuous variables--less than once per month/ more than once per month or more for the risky driving scale and never/ ever for the alcohol-impaired driving scales.

3.4. Moderation of drinking and alcohol impaired driving by childhood ADHD

Multiple regression was used to test whether or not childhood ADHD status moderated the association between drinking and alcohol impaired driving. Drinking variables examined were frequency of drinking, quantity of drinking, frequency of binge drinking, and frequency of drunkenness. Intercorrelations among predictors and outcome are shown in Table 4. The alcohol impaired driving scale was regressed on age and frequency of driving in step one, followed by ADHD status in step two, one of the three alcohol variables listed above in step three, and finally the corresponding interaction term (ADHD x drinking variable) in step four. In addition, to test for age specific effects, the three way interaction of age X ADHD x drinking variable was included in step five (which then required the inclusion of all corresponding two way interactions in the previous step). Results are shown in Table 5.

The three-way interaction was trimmed from the models since it was not significant for any of the drinking variables. In each model, frequency of driving and all drinking variables were significantly and positively associated with alcohol-impaired driving; as would be expected, more frequent alcohol-impaired driving was reported by individuals who drive more often and drink more often or more heavily. The ADHD X drinking variable interactions were not significant in the models, indicating that ADHD group status did not act as a moderator of the association between drinking and alcohol impaired driving. Small regression coefficients for the interaction terms suggest that power was not a problem in detecting interaction effects.

3.5. Mediation by adolescent symptoms at follow-up

The mediational analyses that were originally proposed to evaluate ADHD symptoms, irritability, and conduct problems at follow-up as mediators of the association between childhood ADHD and risky or alcohol-impaired driving could not be conducted. An assumption of mediation is that three paths exist: 1) between the independent variable and the dependent variable prior to controlling for the variance accounted for by the mediator (path c); 2) between the independent variable and the mediator (path a); 3) between the mediator and the dependent variable (path b) (Baron & Kenny, 1986) (see Figure 1). A second assumption is that the magnitude of the path c effect is substantially diminished after accounting for the effects of the mediator (Baron & Kenny, 1986). These assumptions were not met since path c was not supported. However, the plans to test paths a and b were retained.

Table 7 provides the matrix of zero-order correlations among predictor and outcome variables in the sample of drivers. As expected, ADHD symptoms of hyperactivity-impulsivity and inattention were highly correlated at .83. Irritability was also positively correlated with hyperactivity-impulsivity (r = .67) and inattention (r = .61). Of the follow-up symptoms, only conduct problems were significantly correlated with risky driving (r = .15), but both conduct problems and hyperactivity-impulsivity were significantly correlated with alcohol-impaired driving (r = .26 and r = .14, respectively).

3.5.1. Path a: Association between childhood ADHD and adolescent symptoms at follow-up.

Independent sample t tests revealed that the current symptoms of hyperactivity-impulsivity, inattention, irritability, and conduct problems were significantly different between groups, with the ADHD adolescents and young adults more severe on each of the dimensions (see table 6). Effect sizes for hyperactivity-impulsivity, inattention, and irritability were large (d

= 1.68, 1.77, and .95, respectively) while the effect size for conduct problems was relatively small (d = .35).

3.5.2. Path b: Association between adolescent symptoms at follow-up and driving outcomes.

To test the association between ADHD symptoms at follow-up and driving outcomes, risky driving and alcohol-impaired driving were separately regressed on age and driving frequency in step one and current hyperactivity-impulsivity and inattention in step two. Table 8 shows that current hyperactivity-impulsivity and inattention were each significantly related to risky driving; while similar in magnitude, these associations were opposite in direction. The more hyperactive-impulsive an individual, the worse driver he/she reported to be, but the more inattentive an individual, the better driver he/she reported to be. Hyperactivity-impulsivity was marginally related to drunk driving while inattention was not.

In the second set of regression models, the two driving outcomes were similarly regressed on age and driving frequency in step one and the associated feature of irritability at follow-up in step two. Current levels of irritability were significantly related to alcohol impaired driving but not associated with risky driving.

To test the independent effects of ADHD symptoms and irritability, a third model was tested. Risky driving and alcohol-impaired driving were each regressed on age and driving frequency in step one; followed by hyperactivity-impulsivity and inattention in step two, and irritability in step three. Effects were interpreted using results after all terms were entered. The ADHD symptoms were again both related to risky driving (and again of equal magnitude in opposite directions) but irritability, as in the previous model, was not. For alcohol-impaired driving, neither impulsivity, inattention, nor irritability was significantly related.

The final set of regression models examined the role of conduct problems in negative driving outcomes (see Table 9). Risky driving and alcohol-impaired driving were regressed on age and frequency of driving in step one; hyperactivity-impulsivity and inattention in step two, irritability in step three, and conduct problems in step four. Effects were again interpreted after all terms were entered, and once again, none of the interactions with age proved significant. Hyperactivity-impulsivity and inattention still remained significantly associated with risky driving even after the addition of conduct problems. In the model of alcohol-impaired driving, however, only conduct problems at follow-up were statistically significant ($\beta = .29$, $p < .01$).

3.6. Exploratory Analyses

3.6.1. Mediation of number of tickets and accidents

As discussed previously, group differences were not found for the risky driving and alcohol-impaired driving scales. Because group differences were found for number of tickets and accidents and because the inattention effect was a surprising finding, the proposed mediation models were conducted with these driving related outcomes. A single dependent variable was created by summing each participant's reported number of lifetime tickets and accidents in the past six months. Zero –order correlations between this variable ($M = 1.94$, $SD = 3.21$, range = 0 to 32) and the predictors were: age, $r = .34$, $p = .00$; ADHD, $r = .11$, $p = .04$; frequency of driving, $r = .24$, $p = .00$; hyperactivity-impulsivity, $r = .17$, $p = .00$; inattention, $r = .07$, $p = .23$; irritability, $r = .09$, $p = .10$; and conduct problems, $r = .07$, $p = .20$.

In the first mediation model, number of tickets and accidents were regressed on age at follow-up and driving frequency in step one, followed by childhood ADHD status in step two, and then the adolescent symptoms of hyperactivity-impulsivity and inattention in step three. A statistically significant effect emerged for hyperactivity-impulsivity but not inattention. In addition, the ADHD group effect was substantially diminished with the addition of

hyperactivity-impulsivity to the regression, which is suggestive of mediation. In Model 2, irritability at follow-up, added in step 3, was significantly associated with number of tickets and accidents. When hyperactivity-impulsivity, inattention, and irritability were tested simultaneously in model 3 and when conduct problems were added to the regressions in model 4, only hyperactivity-impulsivity remained significant. Regression results can be seen in Table 10.

Mediation effects were tested statistically by multiplying the unstandardized betas from path a and path b (a*b, the indirect effect). Approximate Z scores for each mediated effect were estimated by dividing the product by its standard error (*SE* (ab)) where $SE\ (ab)^2 = SE\ (a)^2 * (b)^2 + SE\ (b)^2 * (a)^2$; z scores greater than or equal to 1.96 are interpreted as statistically significant mediation (MacKinnon & Dwyer, 1993; MacKinnon, Krull, & Lockwood, 2000). In models 1 and 2, both hyperactivity-impulsivity and irritability at follow-up were statistically significant mediators (when tested separately) of the association between ADHD status and number of tickets and accidents ($z = 2.99$, $z = 2.09$, respectively). In model 3, these variables were tested simultaneously, but none were statistically significant mediators. In model 4, conduct problems were included as an additional mediator, and again none of these variables were statistically significant mediators.

4. Discussion

4.1. Summary of Results

This longitudinal study of children with ADHD found that by adolescence and early adulthood, individuals with a childhood diagnosis of ADHD were over four times more likely to have ever driven without a valid license or permit. Among drivers, ADHD group differences were not present for self-reported risky driving and alcohol-impaired driving scales, but were found for driving outcomes less vulnerable to reporting bias; specifically, small to medium effects were found for number of lifetime tickets (d = .43) and accidents in the last 6 months (d = .30). ADHD symptoms of hyperactivity-impulsivity and inattention and co-occurring conduct problems at follow-up were each significantly and uniquely associated with risky driving. Together, these variables accounted for 23 % of the variance, a modest-to-large effect size as per Cohen (2003). Small to medium effects were found for the association between alcohol-impaired driving and both irritability and conduct problems (R^2 = .07 and .15, respectively). Exploratory analyses further revealed that both hyperactivity-impulsivity and irritability were significant mediators of the association between childhood ADHD and number of tickets and accidents.

4.2. Lack of group differences

Consistent with Barkley's work (1993, 1996, 2002), this study found a significantly greater number of tickets and accidents and a trend toward more license suspensions in adolescents and young adults with childhood ADHD compared to their nonADHD peers. Whereas Barkley reported group differences in self-report of safe driving practices, this study did not find an association between childhood ADHD and self reported driving behavior. This discrepancy may be due, at least in part, to differences in the nature of the studies' samples.

Barkley's samples consisted of individuals self-identified as ADHD and self-referred to ADHD clinics in adulthood. They represent a subgroup of the ADHD population who by definition have insight into the nature and extent of their problems, and therefore are more likely to report impairment. The sample from the present study, in contrast, resembled that of Barkley and colleagues' 2002 study of the persistence of ADHD (discussed previously) in that probands were identified by their parents, teachers, or professionals, diagnosed in childhood, and subsequently followed into adolescence and adulthood. This recent study (Barkley et al., 2002) found that parental reports of ADHD symptoms were more useful in predicting impairment in major life activities than were self report. Previous research, then, questions the validity of self-report in the larger population of individuals with ADHD.

Group differences found for the number of tickets and accidents suggest that in reality, differences in risky driving behaviors between probands and controls probably exist, as poor driving habits ultimately lead to more traffic citations and crashes. It is reasonable to believe, then, that probands underreported their risky driving and alcohol-impaired driving behaviors. Because previous research reveals that individuals with a history of ADHD are poor reporters of their symptoms (Barkley et al., 2002), the current study suggests that adults with childhood ADHD may be less-than-optimal reporters for other variables as well. Several explanations for this reporting bias exist.

First, research has shown that children with ADHD provide inflated estimates of their competence in a variety of domains (Hoza et al., 2000; Hoza et al., 2002; Diener & Milich, 1997). Hoza and colleagues (2002), for example, demonstrated that boys with ADHD overestimated their self-perceptions more than controls in the scholastic, social, and behavioral domains, relative to teacher ratings. In addition, ADHD boys tended to overestimate their

competence the most in areas of greatest deficit/ impairment. To the extent that this "positive illusory bias" (Hoza et al., 2002) persists into adulthood, inflated estimates of performance in another behavioral domain- driving- may account for the low rates of self-reported risky driving by probands in the sample. Controls, in contrast, produce more realistic estimates of their abilities (Hoza et al., 2002), and therefore may be more accurate reporters of their driving behavior. Finally, individuals with ADHD may be unaware of their driving practices and therefore, due to attentional deficits, may be unable to report accurately the frequency with which they perform certain actions. Inaccurate self-perceptions reflect a low level of insight, if a young adult is unaware that the speed limit is 25mph or that he is traveling at 40 mph, he will be unable to report that transgression.

Previous research with the ADHD population has used the Driving Performance Rating Scale, a 20 item measure asking participants to rate **safe routine** driving habits on a Likert scale from 1-3 (not at all, sometimes, and often); items include 'drives within the posted speed limits', 'observes traffic signals', 'adjusts speed to bad weather'. In contrast, the Young Adult Driving Questionnaire (Donovan, 1985) used in this study required the participant to report driving behaviors that by definition are risky or unlawful and may be socially unacceptable or undesirable. Since Barkley's items are all framed in the positive, the reporting bias may be different, such that individuals with ADHD will underreport "bad" behaviors (that is, are more likely to underreport risky or alcohol-impaired driving). The admission of frequent risky driving practices may be more threatening than the admission of infrequent safe driving habits. In accordance with Hoza's (2002) finding that ADHD boys overestimate their abilities in domains of greatest deficit, this underreporting may be most likely for an individual experiencing the most impairment (i.e. the worst drivers).

Among both controls and probands, the items of both the risky driving and alcohol-impaired driving scales were endorsed infrequently. While the risky driving scale had greater variability of response within the sample than the alcohol-impaired driving scale, endorsement was still low relative to previous research with large community samples (Donovan, 1993). For example, in Donovan's sample of over one thousand 18 to 25 year olds, the most frequently endorsed item was speeding 10-19 mph over the speed limit; his sample reported an average of 27.8 times in the past year. The controls of the study sample, in contrast, endorsed this behavior at an average of 6 times in the past 6 months (and therefore 12 times in the past year—a substantially lower rate). Running a yellow light as it changed to red was endorsed, on average, 20.2 times in the past year by Donovan's sample, while the study sample reported an average of 10 times. These low rates of endorsement may contribute to the lack of overall group differences in risky driving. Similarly, only 32.4% of the sample endorsed any of the four behaviors assessed on the alcohol-impaired driving scale, and a mere 4.8% endorsed a frequency of once a month or more. The lack of variability in responses for the current study may reflect participants' reluctance to endorse socially unacceptable behaviors like driving under the influence and may account for the lack of group differences.

4.2.1. Implications

Researchers have encouraged expanding the focus of road safety from singular outcomes (i.e. crashes and citations) to a wider range of risky driving behaviors (Jessor, 1989). Results from the present study suggest that self-report of these behaviors may not be the best way to capture the true variability in risky driving behaviors, especially if highly vulnerable populations (i.e. impulsive) are of interest. Regarding research on individuals with ADHD, parents serve as useful reporters of their child's ADHD symptomatology, but unfortunately they may not be optimal reporters of their offspring's risky driving behavior, especially as parental monitoring

tends to diminish over time (Jacobson & Crockett, 2000). Future research would benefit from a collateral reporter, specifically one who is a frequent passenger and around whom the driver might be less likely to censor his driving (such as a close friend or spouse/significant other). Beyond self- and other report of risky driving, driving simulator data may be useful. This strategy removes the need for self-report and may eliminate the biases observed in the present study. At the same time, concerns about the ecological validity of lab-based measures require that data from such tests be integrated with other sources (Gordon & Barkley, 1998). Because the discrepancy between this study and the extant literature regarding ADHD group differences in driving behavior may, at least in part, be due to different driving behavior measures, it also seems necessary to create a measure that minimizes reporting bias, that accurately captures risky driving tendencies without causing a defensive reporting style.

4.3. Effects of separate ADHD dimensions

4.3.1. Hyperactivity-Impulsivity, Irritability, and Conduct Problems

While conduct problems were associated with both risky-driving and alcohol-impaired driving, it is noteworthy that hyperactivity-impulsivity was associated with risky driving and tickets/accidents, even when associations with conduct problems were statistically controlled. Thus, beyond an expected co-occurrence of conduct problems and careless driving, a core symptom of ADHD may contribute to adverse driving-related outcomes. In fact, mediational analyses indicate that children with ADHD are more likely to receive driving-related citations and be in automobile accidents when their hyperactivity-impulsivity persists beyond childhood. By itself, irritability was associated with alcohol-impaired driving and proved to be a significant mediator of the relationship between childhood ADHD and number of tickets and accidents. After controlling for ADHD symptoms at follow-up, however, its effect was no longer significant, suggesting overlap between this variable and persisting ADHD symptomatology.

Hyperactivity-impulsivity may have a proximal impact on risky driving as poor regulation of impulse control interferes with an individual's ability to modulate his or her behavior and to anticipate negative consequences of his or her actions (speeding, running a red light, etc.). Similar thinking has been used to explain the association between hyperactivity-impulsivity and substance use in the ADHD population (Molina, Smith, & Pelham, 1999).

The pattern of associations between hyperactivity-impulsivity, conduct problems, and the three driving-related outcomes (risky driving, alcohol-impaired driving, and tickets/ accidents) may reflect two diverging outcome pathways reflected in longitudinal studies of children with ADHD (e.g. Barkley et al., 1990; Mannuzza et al., 1993; Biederman et al., 1997; Molina & Pelham, 2003). One pathway is characterized by development of conduct problems and outcomes typically associated with antisociality, which include substance use disorder and antisocial personality (e.g. Gittleman et al., 1985; Bierderman et al., 1997). The other pathway is characterized by the persistence of ADHD symptoms and related impairment but not necessarily antisocial outcomes, such as peer rejection (Bagwell et al., 2001), daily cigarette smoking (Burke et al., 2001; Molina & Pelham, 2003), and occupational difficulties (Mannuzza et al., 1997).

Findings from the current study suggest that alcohol-impaired driving, like substance use outcomes, may be most common among those who end up in the antisocial pathway, while tickets and accidents are associated with the persistence of ADHD independent of antisocial behavior. Thus, the results of this study suggest an unfortunate long-term consequence for children diagnosed with ADHD, which is a modest but statistically significant increased liability for impaired driving that results in accidents. This finding makes conceptual sense given the cognitive demands of effective and safe driving behavior and the cognitive deficits underlying ADHD. The implications of this finding are unclear at the present time, as it is not known

whether specialized driver training or medication could decrease this liability. Alternatively, it is important to note that the association is modest in magnitude, and not all children with ADHD will drive in a way that increases their risk for accidents. Further study should focus on identifying additional risk and protective factors within the ADHD population (e.g. medication, parental monitoring) that distinguish the risky drivers from the non-risky drivers.

The third driving variable (risky driving), which was correlated with both the antisocial (alcohol-impaired driving) and non-antisocial (tickets/ accidents) outcomes and was associated with both impulsivity-hyperactivity and conduct problems, may reflect a broader behavioral construct that taps into both pathways. Due to the heterogeneity of driving behaviors assessed, the risky driving scale of the Young Adult Driving Questionnaire may tap into both the purely impulsive, nondelinquent pathway (with behaviors like running through a red light or rolling through a stop sign) as well as the more antisocial pathway (with behaviors like tailgating another car to get it to go faster or racing on city streets). Unfortunately, because many behaviors in the driving scale were difficult to separate into antisocial versus non-antisocial risky behaviors, it was not possible to analyze risky driving separately for aggressive versus nonaggressive driving behaviors.

The distinction between the purely impulsive pathway and the antisocial pathway (and their associated sequelae) is supported by existing research that individuals with conduct problems alone may be at higher risk for more serious crimes than those with hyperactivity-impulsivity alone, who may be at higher risk for less serious crimes that may be specifically related to their impulsivity and inability to delay gratification (Babinski et al., 1999). Findings from this study seem consistent with Hinshaw's (1987) factor analytic studies that suggest that

although hyperactivity and conduct problems are moderately to highly correlated (in this sample, r = .39), they are separate dimensions of behavior.

Studies of drunk driving often identify both conduct problems and irritability (or low frustration tolerance/ impatience) as related to increased risk (Stacy et al., 1991; Donovan et al., 1983); in contrast to the general driving population, for example, the DWI population have been found to exhibit higher levels of both covert and overt hostility and irritability (Donovan et al., 1983). In the current study, then, the association between alcohol-impaired driving and both irritability and conduct problems at follow-up is consistent with extant literature. The same body of literature reveals that DWI individuals highest in hostility and irritability also had the highest rates of accident involvement, a finding consistent with irritability as a significant mediator of the relationship between childhood ADHD and number of tickets and accidents.

The relationship between personality and driving under the influence has been explained by an interactional framework (Stacey et al., 1991), where alcohol serves as a releasing agent of underlying personality traits (like irritability and antisocial tendencies). Although this particular model was not tested in the current study, previous research with laboratory-based provocation tasks has shown that alcohol exacerbates aggression for people with higher levels of trait anger, dispositional aggressivity, and irritability (Giancola, 2002a, 2002b, 2002c). This hypothesis seems of particular relevance for individuals with ADHD, since they score higher on rating scales of these pertinent personality traits (e.g. in this sample, the effect size for irritability was quite large, d =.95, and the effect size for conduct problems was moderate, d =.43). An interesting next step in research, then, might be to test this hypothesis in the ADHD population by examining alcohol-impaired driving behavior in a simulator with and without aggression challenges (Waschbusch et al., 2002).

4.3.2. Inattention

The negative association between risky driving and inattention was a surprising finding. Subsequent exploratory analyses also confirmed a negative correlation between inattention and number of tickets and accidents. Although this ADHD sample is largely comprised of children with both attentional and behavior inhibition problems, this finding invokes speculation about the experiences of driving among individuals with purely attentional deficits. This subgroup of children, who exhibit more passive-inattentive behavior than individuals with combined type ADHD (Barkley, 1998), has been suggested to have a "sluggish cognitive tempo", a dimension consisting of behaviors such as drowsiness, lethargy, and hypoactivity (Carlson & Mann, 2000; Milich et al., 2001; Lahey et al., 1987; Barkley et al., 1990) that are captured in rating scale items like "lost in a fog", "daydreaming or getting lost in thought", and "apathetic or unmotivated". To the extent that adults with purely attentional difficulties exist in this sample, a decreased awareness of risky driving may co-occur, which might have caused the inverse association between self-reported risky driving and inattention.

Research indicates that individuals with attentional deficits exhibit less behavioral disinhibition (Nigg et al., 2002) and have less adverse outcomes (Milich et al., 2000) than individuals with hyperactive-impulsive features. Inattentive individuals, then, may not be engaging in frequent risky behavior. The portion of inattention that is not common to hyperactivity-impulsivity may be conceptualized as a non-disruptive component of inattention, and therefore may be less severe. In addition, although this notion is purely speculative, the negative association between inattention and adverse driving outcomes might reflect overcompensation for deficits in this population. Future studies should explore the potentially protective effect of inattention within a purely inattentive-type sample and with driving outcomes less vulnerable to reporting bias. Finally, although multicollinearity may have contributed to this

finding, the zero-order correlation between inattention and risky driving was in the negative direction, suggesting that statistical error is not a complete explanation.

4.3.3. Implications

Researchers have argued that children with ADHD are a heterogeneous group and that their risk for later negative outcomes varies considerably based on their symptomatology (Hinshaw, 1987). Findings from the current study regarding the relationship between hyperactivity-impulsivity and risky driving and the relationship between irritability and alcohol-impaired driving confirm that different symptoms may in fact have different sequelae. Previous research supports the notion of differential associations between symptoms of ADHD and other outcome variables, as inattention has been strongly associated with academic performance and impairment (Hudziak et al., 1998; Lahey et al., 1994, Molina et al, 2001), while hyperactivity-impulsivity is more strongly associated with conduct problems (DuPaul et al., 1998). In addition, Babinski and colleagues (1999) reported that both hyperactivity-impulsivity and early conduct problems independently as well as jointly predicted a greater likelihood of arrest for males, while inattention did not contribute to the risk and seemed largely unrelated to criminal involvement in adulthood. Authors argue that their results highlight the importance of distinguishing between the two symptom clusters of ADHD, since the subtype with predominant symptoms of hyperactivity-impulsivity seem to be at higher risk for antisocial outcomes than those with only inattentive symptoms (Babinski et al, 1999; Power & DuPaul, 1996).

Finally, differential associations between driving behaviors and symptom dimensions suggest that there may be differing underlying processes or unique neuropsychological profiles that put individuals at risk for different problems (Molina et al., 2001). Just as research suggests that the processing deficits in the combined and inattentive groups may be qualitatively different (Marshall et al., 1997), the underlying processes involved in delinquent behavior (like stealing,

fighting, and driving after drinking alcohol) may be distinct from those involved in non-normative behaviors that are not necessarily delinquent and that are more broadly disconnected from social consequences (like clowning around, talking out of turn, and taking risks while driving).

4.4. Limitations of the current study and future directions

A limitation of the current study is the sole reliance on self-report of risky and alcohol-impaired driving which may have caused an underreporting of the target behaviors within the proband sample. Future research, as discussed previously, should consider additional information from a collateral reporter and/or data from performance in driving simulators.

Age-interactions may not have been found because many participants have not yet exceeded the period of highest risk for risky driving behaviors. Research suggests that a decline in risky driving and accident involvement typically occurs after age 25, when individuals have transitioned out of adolescent and assumed conventional adult roles (Jessor et al., 1997; Williams, 1996). The relatively young age of the follow-up sample, consequently, necessitates reexamining risky driving and alcohol-impaired driving as the majority of the sample proceeds through their late twenties and into their early thirties, when they have surpassed the period of highest risk within the general population.

Statistical tests of mediation typically require the significance of path c (between the independent variable and the dependent variable prior to controlling for the variance accounted for by the mediator). MacKinnon (2003, Different tests of mediation, ¶ 3), however, offers an alternative means of testing mediation, a less stringent variation of the conventional causal step method, that simply requires that the paths from the independent variable to the mediator (path a) and from the mediator to the dependent variable (path b) both be significant. Although path c

was not supported in the current study, paths a and b were both significant in several regression models, suggesting that children with ADHD, if they have persistent symptoms, are at risk for risky driving as well as tickets and accidents. The development of conduct problems, furthermore, increases the risk for both risky driving and alcohol-impaired driving. Future studies should explore the implications of using this less common method to examine mediation.

While this study attempted to clarify the role of ADHD symptoms, irritability, and conduct problems at the time of follow-up, it will be important to consider—from an intervention standpoint-- the prediction of risky driving from childhood symptoms. As CNS stimulant medication is known to reduce task-irrelevant restlessness and motor activity and increase task persistence, future studies should examine the role of medication on risky driving in the ADHD population. Finally, the small percentage of females in the sample precluded the examination of gender-specific associations with risky and alcohol-impaired driving. This is an important direction for future research since current knowledge of long-term outcomes of childhood ADHD in females is quite limited.

4.5. Conclusions

Individuals with ADHD are at increased risk for negative driving outcomes, specifically tickets and accidents, and this finding, of small-to-medium effect size, suggests that they engage in more frequent risky driving practices. Like lower educational and occupational attainment (Mannuzza et al., 1997), increased substance use disorder (Gittleman et al., 1985; Weiss & Hechtman, 1993; Molina & Pelham, 2003) and tobacco use (Molina et al., in press; Burke et al., 2001; Milberger et al., 1997), risky driving can be considered a long-term adverse outcome of childhood ADHD. Unlike heavy substance use, however, risky driving may not necessarily be delinquent in nature. As cigarette smoking appears to be associated with ADHD independent of

conduct problems (Molina & Pelham, in press; Burke et al., 2001; Milberger et al., 1997), so too do the adverse driving outcomes of tickets and accidents; alcohol-impaired driving, on the other hand, is quite clearly associated with an antisocial pathway. An important question that remains to be answered is whether individuals with ADHD will mature out of risky driving during their late twenties or continue their unsafe driving practices when their nonADHD peers have desisted.

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Table 1. Demographics of Participants

	Non ADHD N (%)
Gender	
Male	213 (88.8)
Female	27 (11.3)
Ethnicity	
White/Caucasian	203 (84.6)
Minority	37 (15.4)
Parent Education	
High school or less	8.1%
Some college (or post high school training)	30.2%
College	61.7%
N	240

Note. No statistically significant differences.

Table 2. Descriptive Statistics for Driving Variables

	Mean (SD)	Range	% endorsement
Currently have a license[a]			61.4%
Ever driven w/o a license or permit[b]			12.4%
Ever had an accident			42.6%
# accidents in lifetime	.97 (1.90)	0-24	
# accidents last 6 months	.23 (.61)	0-6	
# accidents after drinking	.05 (.39)	0-6	
Ever received a ticket			41.6%
# tickets in lifetime	.96 (2.20)	0-30	
# tickets last 6 months	.23 (.59)	0-5	
# tickets after drinking	.03 (.22)	0-1	
Ever had license suspended			11.9%
# suspensions	.14 (.42)	0-3	
Ever had to go to traffic school			3.6%
Risky Driving	1.19 (1.30)	0-7.17	
0-3x in the past 6 months			58.1%
4- 6x in the past 6 months			36.5%
2x/ month to once a week			4.8%
2-6x per week			.6%
Once/ day or more			0%

Note. [a] among those of driving age (16 or older), n=404. [b] in entire sample, N= 580. All other variables are among those who have driven in the past six months, n= 347.

Table 3. ADHD Group Differences for Driving Variables

	Controls	Probands	Odd's Ratio	Cohen's d	p value
Currently have a license[a]	78.9%	49.8%	.27		.00
Ever driven w/o a license/ permit[a]	5.1%	17.4%	4.04		.00
Ever had an accident	44.3%	41.2%	.88		.51
# accidents in lifetime	.86 (1.25)	1.05 (2.27)		.15	.39
# accidents last 6 months	.15 (.43)	.28 (.72)		.30	.05
# accidents after drinking	.03 (.18)	.07 (.50)		.22	.52
Ever received a ticket	36.4%	45.6%	1.46		.18
# tickets in lifetime	.65 (1.26)	1.19 (2.67)		.43	.03
# tickets last 6 months	.16 (.40)	.28 (.70)		.30	.06
# tickets after drinking	.03 (.18)	.03 (.25)		0	.80
Ever had license suspended	9.3%	13.9%	1.57		.48
# suspensions	.10 (.32)	.18 (.48)		.25	.16
Ever had to go to traffic school	1.3%	5.3%	4.15		.09
Risky Driving	1.36 (1.23)	1.05 (1.30)		.25	.11
Alcohol-Impaired Driving	.46 (1.19)	.59 (1.30)		.11	.51

Note. [a] among those of driving age (16 or older), n=404. [b] in entire sample, N= 580. All other variables are among those who have driven in the past six months, n=347. Except for the first two comparisons, all analyses control for age and frequency of driving in the past six months. Cohen's ds are calculated using the SD of the control group.

Table 4. Zero order correlations of predictor and outcome variables for moderation analyses

	1	2	3	4	5	6	7	8
1. Age	_	.24**	.07	.35**	.18**	.21**	.17**	.18**
2.Frequency of Driving		_	-.03	.06	.01	-.02	-.04	.20**
3. ADHD			_	.02	.03	.06	.01	.04
4. Frequency of Drinking				_	.71**	.83**	.80**	.45**
5. Usual Quantity of Drinking					_	.77**	.74**	.35**
6. Frequency of Binge Drinking						_	.88**	.47**
7. Frequency of drunkenness							_	.46**
8. Alc-Impaired Driving								_

Note. ** $p < .01$; n=335 participants who have driven in the past six months with complete data.

Table 5. Regression Analysis for ADHD Status as Moderator of the Relationship between Drinking and Alcohol-Impaired Driving

	Alcohol Predictor Variables							
	Frequency of Drinking		Quantity of Drinking		Frequency of Binge Drinking		Frequency of Drunkenness	
Predictors	B	P	B	P	B	p	B	P
Age at follow-up	-.04	.70	.08	.37	.01	.91	.04	.68
Frequency of Driving	.17	.00	.18	.00	.19	.00	.19	.00
Childhood ADHD status	.05	.36	.04	.45	.02	.61	.05	.33
Alcohol Variable	.42	.00	.35	.00	.44	.00	.40	.00
ADHD x Age	.03	.73	.00	.98	.04	.67	.04	.69
ADHD x Alcohol Variable	.03	.73	-.03	.75	.04	.61	.08	.28
R squared	.23	.83	.17	.95	.27	.75	.27	.45

Note. n = 334 with complete data. B = standardized regression coefficient. Highest Variance Inflation Factor = 3.843.

Table 6. Current Levels of ADHD Symptoms and Associated Feature

	ADHD Mean (SD)	nonADHD mean (SD)	t	df	Cohen's d	p value
Hyperactivity-Impulsivity	.41 (.86)	-.60 (.60)	-15.60	578	1.68	.00
Inattention	1.46 (.80)	.61 (.48)	-14.70	587	1.77	.00
Irritability	3.56 (.52)	3.18 (.40)	-9.38	587	.95	.00
Conduct Problems	.09 (.10)	.06 (.07)	-4.91	593	.43	.00

Note. Cohen's ds are calculated using the SD of the control group.

Table 7. Zero order correlations of predictor and outcome variables for mediation analyses

	1	2	3	4	5	6	7	8	9
1. Age	-	.07	.24**	-.04	-.11*	-.11*	-.05	.19**	.18**
2. ADHD		-	-.03	.51**	.49**	.33**	.15**	-.11	.04
3. Frequency of Driving			-	-.02	-.06	-.08	-.09	.39**	.20**
4. Hyp-Impulsivity				-	.83**	.67**	.39**	.06	.14*
5. Inattention					-	.61**	.37**	-.05	.09
6. Irritability						-	.37**	-.03	.10
7. Conduct Problems							-	.15**	.26**
8. Risky Driving								-	.44**
9. Alc-Impaired Driving									-

Note. * $p < .05$ and ** $p < .01$; n = 347 participants who have driven in the past six months with complete data.

Table 8. Regression Analyses Predicting Risky Driving and Alcohol-Impaired Driving from Adolescent Symptoms

	Risky Driving		Alcohol-Impaired Driving	
Predictors	B	P	B	P
Model 1				
Age at follow-up	.10	.08	.14	.01
Frequency of Driving	.37	.00	.18	.00
Hyp-Imp at follow-up	.26	.00	.15	.11
Inattention at follow-up	-.21	.02	.00	.99
R squared	.19	.01	.08	.02
Model 2				
Age at follow-up	.11	.04	.15	.01
Frequency of Driving	.37	.00	.17	.00
Irritability at follow-up	.02	.75	.13	.02
R squared	.16	.75	.07	.02
Model 3				
Age at follow-up	.09	.08	.14	.01
Frequency of Driving	.37	.00	.18	.00
Imp-Hyp at follow-up	.28	.00	.12	.24
Inattention at follow-up	-.20	.03	-.01	.93
Irritability at follow-up	-.04	.61	.06	.38
R squared	.19	.61	.09	.38

Table 9. Regression Analyses Predicting Risky Driving and Alcohol-Impaired Driving from Adolescent Symptoms including Conduct Problems

	Risky Driving		Alcohol-Impaired Driving	
Predictors	B	P	B	P
Age at follow-up	.09	.08	.14	.01
Frequency of Driving	.38	.00	.19	.00
Hyp-Imp at follow-up	.25	.01	.07	.47
Inattention at follow-up	-.23	.01	-.05	.58
Irritability at follow-up	-.07	.28	.02	.83
Conduct Problems	.20	.00	.29	.00
R squared	.23	.00	.15	.00

Note. n = 347 participants with complete data.

Table 10. Mediation Analyses Predicting Number of Tickets and Accidents from Adolescent Symptoms

	# accidents and tickets	
Predictors	**B**	**p**
Step 1		
Age at follow-up	.30	.00
Frequency of Driving	.17	.00
Step 2		
Age at follow-up	.29	.00
Frequency of Driving	.18	.00
ADHD status	.11	.04
Model 1		
Step 3		
Age at follow-up	.29	.00
Frequency of Driving	.17	.00
ADHD status	.03	.63
Hyp-Imp at follow-up	.28	.00
Inattention at follow-up	-.13	.14
R squared	.19	
Model 2		
Step 3		
Age at follow-up	.31	.00
Frequency of Driving	.18	.00
ADHD Status	.06	.25
Irritability at follow-up	.12	.03
R squared	.17	
Model 3		
Step 4		
Age at follow-up	.30	.00
Frequency of Driving	.17	.00
ADHD Status	.03	.63
Hyp-Imp at follow-up	.26	.01
Inattention at follow-up	-.14	.12
Irritability at follow-up	.05	.48
R squared	.19	
Model 4		
Step 5		
Age at follow-up	.30	.00
Frequency of Driving	.18	.00
ADHD Status	.03	.57
Hyp-Imp at follow-up	.25	.01
Inattention at follow-up	-.15	.10
Irritability at follow-up	.04	.57
Conduct Problems	.05	.38
R squared	.19	

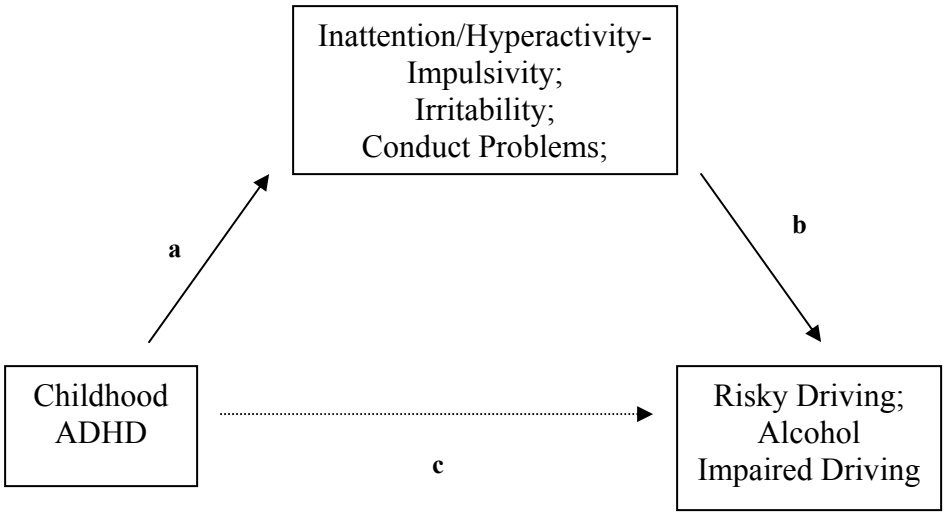

Figure 1. Mediation.