DISSERTATION

DRIVING ANGER AND DRIVING BEHAVIOR IN ADULTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)

Submitted by

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In partial fulfillment of the requirements

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY TRACY RICHARDS ENTITLED DRIVING ANGER AND DRIVING BEHAVIOR IN ADULTS WITH ADHD BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

DRIVING ANGER AND DRIVING BEHAVIOR IN ADULTS

WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)

This study was designed to assess whether anger in the context of driving is associated with the negative driving outcomes experienced by individuals with Attention-Deficit/Hyperactivity Disorder (ADHD). ADHD adults (n = 56) completed measures on driving anger, driving anger expression, angry thoughts behind the wheel, and aggressive, risky and crash-related behavior. Results were compared to two non-ADHD control groups; one from the same community as the ADHD sample (n = 106), but who did not complete all instruments, and the other from college students (n = 432) who completed all instruments. ADHD participants reported more driving anger and aggressive expression through the use of their vehicle and less adaptive/constructive anger expression than their non-ADHD peers. Adult ADHD drivers rated themselves as more angry, risky and unsafe drivers and reported experiencing more losses of concentration and vehicular control than college students. Results are discussed in regard to understanding ADHD and implications for drivers with ADHD.

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CHAPTER I

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) affects approximately 3-5% of children, and while previously considered only a childhood disorder, has been shown to persist into adolescence and adulthood (Barkley, 1998; Weiss & Hechtman, 1993). ADHD is defined by the *Diagnostic and Statistical Manual for Mental Disorders – Fourth Edition – Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000), as a persistent pattern of inattention and/or hyperactivity-impulsivity that significantly impacts functioning. Symptoms of inattention include distractibility, poor sustained attention, failure to pay close attention to details, disorganization, forgetfulness, and poor listening skills (APA, 2000). Hyperactive symptoms include fidgeting, restlessness, excessive talking, and other behaviors which appear "driven by a motor," while impulsivity is characterized by interrupting others, difficulty awaiting one's turn, and blurting out answers before questions are completed (APA, 2000). The DSM-IV-TR categorizes ADHD diagnoses as ADHD Combined Type, ADHD Predominately Inattentive Type, and ADHD Predominately Hyperactive-Impulsive Type. ADHD Combined Type requires six of nine symptoms of both inattention and hyperactivity/impulsivity, while the other two subtypes require six of nine of only the predominate type (i.e., inattentive or hyperactive/impulsive, respectively).

Etiology and Developmental Course

A current model for explaining the etiology of ADHD has been developed by Dr. Russell Barkley (1997a, 1997b). Barkley proposes a neurological framework for understanding ADHD, and argues that prefrontal lobe deficits result in the visible symptoms of ADHD. The primary deficit is in response inhibition, and that poor response inhibition in turn results in secondary impairments in working memory, self-regulation, speech internalization, and reconstitution (e.g., combination of internal information with behavior). It is a combination of these impairments which result in the visible symptoms of inattention, hyperactivity, and impulsivity. Research supporting Barkley's theory has emerged from many studies [see Barkley (1997a, 1997b) for review]. Specifically, research examining the prefrontal brain activity of individuals with ADHD and individuals with prefrontal lobe damage indicates similarities in the level of underactivity, difficulties with response inhibition, and interruption of goal-directed behavior.

Symptoms of ADHD are typically first noticed when children attend school, due to the demands of the school environment. During the school years, difficulties in completion of schoolwork, household chores, and the development of social relationships become more apparent, and often result in future academic and interpersonal problems for children with ADHD (Barkley, 1998). Adults with ADHD often report having difficulties sustaining attention or avoiding distraction, and may be associated with disorganization at work and home as well as difficulties completing work in a timely fashion (Wender, 1995). Hyperactive behavior, while often more noticeable in children with this disorder, may lead adults to make a particular career choice (e.g., avoidance of

office jobs), and impulsivity may cause difficulties in interpersonal relationships (e.g., interrupting others) (Wender, 1995).

Current estimates suggest that 3-5% of children experience ADHD (APA, 2000), with adult estimates ranging from 1-6% (Wender, 1997). Research has shown that ADHD is continuous in nature throughout adolescence and adulthood, suggesting it is not a disorder which children merely "grow out of." For example, in two separate follow-up studies, Barkley, Fischer, Edelbrock, and Smallish (1990) and Biederman et al. (1996) found that 80% and 85%, respectively, of children diagnosed with ADHD continued to meet criteria for diagnosis as an adolescent. Other research has shown that those who do not continue to meet full diagnostic criteria for ADHD as an adult are still impacted by one or more symptoms of ADHD. Specifically, research (Alpert et al., 1996; Shekim et al., 1990; Weiss & Hechtman, 1993; Wender, 1997) has indicated that 50-75% of individuals diagnosed with ADHD in childhood continue to display at least some symptoms of the disorder in adulthood.

Associated Difficulties

Impairments associated with ADHD have been documented for children, adolescents, and adults. Recent research (Kitchens, Rosén, & Braaten, 1999) showed that school-age children with ADHD were significantly more angry and more depressed than children without the disorder. Mothers of these children confirmed reports of depression and reported that the children with ADHD were also more aggressive. Related research (Braaten & Rosén, 2000) indicated that boys with ADHD displayed less empathy and exhibited more behavioral manifestations of sadness, anger and guilt than young boys without the disorder.

Other research has shown that adults with ADHD experience more general psychological functioning difficulties (Barkley, Murphy & Kwasnik, 1996b; Biederman et al., 1996; Dooling-Litfin & Rosén, 1997; Murphy & Barkley, 1996; Ramirez et al., 1997; Weiss & Hechtman, 1993), conduct problems and oppositional defiant disorder (Barkley et al., 1996b; Biederman et al., 1993; Biederman et al., 1994; Millstein et al., 1997; Murphy & Barkley, 1996; Wilens, Biederman, & Mick, 1998), as well as substance use related disorders (Biederman et al., 1993; Biederman et al., 1994; Biederman et al., 1995; Downey et al., 1997; Mannuzza et al., 1993; Millstein et al., 1997; Murphy & Barkley, 1996; Wilens et al., 1998) than individuals without ADHD. Adults with ADHD experience more mood and anxiety disorders (Biederman et al., 1994; Downey et al., 1997; Wilens et al., 1998), and academic difficulties leading to less formal education (Mannuzza et al., 1993; Mannuzza, Klein, Bessler, Malloy, & Hynes, 1997; Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1998).

Interpersonal difficulties have been associated with ADHD in adults, as the inattention, hyperactivity, and impulsivity interfere with one's ability to interact effectively with others. A specific difficulty identified for ADHD individuals is related to anger and anger expression. Adults with ADHD experience more trait and state anger (Ramirez et al., 1997), and tend to display this anger in more socially inappropriate ways, while other research (Wender, 1997) has shown similar temper outbursts and emotional reactivity which leads to impaired social relations.

In examining other difficulties associated with ADHD, research has shown that ADHD individuals experience more negative outcomes while driving an automobile. Individuals with ADHD have been shown to experience more automobile crashes

(Barkley, Guevremont, Anastopolous, DuPaul, & Shelton, 1993; Barkley, Murphy & Kwasnik, 1996a; Weiss & Hectman, 1993), more bodily injury and at-fault determinations (Barkley et al., 1993; Barkley et al., 1996a), more traffic citations (Barkley et al., 1993; Barkley et al., 1996a; Nada Raja, McGee, Williams, Begg, & Reeder, 1997), and increased likelihood of having a suspended license (Barkley et al., 1996a; Murphy & Barkley, 1996). In addition, young adults and adolescents who report both ADHD and Oppositional Defiant Disorder (ODD) or Conduct Disorder (CD) are at highest risk for negative driving outcomes (Barkley et al., 1993; Nada-raja et al., 1997). Differences in driving outcomes for adults with ADHD, however, have not been shown to be related to differences in knowledge about driving procedures (Barkley et al., 1996a).

Driving Anger

Motor vehicle crashes are the leading cause of death for individuals between the ages of 15 and 24 (Anderson, Kochanek, & Murphy, 1997). While alcohol-intake and risky behaviors such as speeding contribute to many crashes (National Center for Statistics and Analysis, 1997), recent research has drawn attention to the contribution of angry and aggressive driving behaviors, such as anger experienced while driving and aggressive behavior motivated by that anger (Deffenbacher, Oetting, & Lynch, 1994; Deffenbacher, Lynch, Oetting, & Swaim, 2002).

Compared to low anger drivers, high anger drivers are angered by more things on the road (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000). High anger drivers are angered from 2.5 to 3.0 times more often and express more intense anger when provoked (Deffenbacher, Deffenbacher, Lynch, & Richards, in press; Deffenbacher et al.,

2000; Deffenbacher, Lynch, Oetting, & Yingling, 2001). High anger drivers engage in 3.5 to 4.0 times more aggression and 1.5 to 2.0 times more risky behavior on the road (Deffenbacher et al., in press; Deffenbacher et al., 2000). High anger drivers are also more likely to express their anger through verbal aggression, personal physical aggression, and using the vehicle to express anger and less likely to cope with anger in adaptive/constructive ways (Deffenbacher et al., 2002; Deffenbacher, Lynch, Deffenbacher, & Oetting, 2001). High anger drivers also report elevated anger and verbal and physical aggression in frustration driving simulations and angering visualized provocations, as well as more traffic citations (in some studies), close calls, minor loss of vehicular control, and minor accidents (Deffenbacher et al., in press; Deffenbacher et al., 2000).

In summary, high anger drivers are more frequently and intensely angry on the road, express driving anger in more hostile/aggressive ways, engage in more risky and aggressive behavior while driving, and experience more crash-related outcomes than low anger drivers.

Driving Anger and ADHD

In a recent study completed by Richards, Deffenbacher, and Rosén (2002), college students with low and high symptoms of ADHD showed that high ADHD symptom college students experience more driving anger, display such anger in more hostile/aggressive ways, are more aggressive and risky on the road, experience more crash-related outcomes, are more generally angry, and tend to display anger in socially unacceptable ways. Richards et al. (2002) noted that although only correlational, the

results suggest that this anger may contribute to a portion of their experiences and difficulties on the road (e.g., more traffic citations and more crash-related outcomes).

Richards et al. (2002) identified some important limitations in their study. First, the participants were not diagnosed ADHD, but instead were placed in low and high ADHD symptom groups based on self-report of current and childhood symptoms. Second, gender analyses were not conducted due to a low number of high ADHD symptom females. Third, all participants in the study were college students and may not generalize to other age groups or non-college students.

Present Study

The present study was designed to further assess whether anger in the context of driving is associated with negative driving outcomes experienced by individuals with ADHD. The present study was designed to account for some of the limitations outlined in Richards et al. (2002). Specifically, participants were obtained from a community sample of adults with diagnosed ADHD. Participants completed measures on driving anger, driving anger expression, and aggressive, risky and crash-related driving behavior. A measure of angry thoughts behind the wheel was added to examine a heretofore unexplored cognitive dimension of angry experience of ADHD drivers. The results from the ADHD sample were compared to two non-ADHD control groups, one obtained from the same community as the ADHD sample, but who did not complete all instruments, and the other from college students who had completed all instruments. Although the latter group was significantly younger and therefore likely to report greater anger, aggressive expression, and risky behavior, it provided an exploratory look at adults with ADHD on these other variables. It was expected that the ADHD adults would report experiencing

more driving anger, more hostile/aggressive expression and less adaptive/constructive expression of driving anger than their non-ADHD peers. If they surpassed college students on measures of anger, aggressive thinking, aggressive anger expression, aggressive and risky behavior while driving, and crash-related conditions, then it would suggest greater levels of these because they would have overcome age cohort differences.

CHAPTER II

Method

Participants

Participants included three groups: (a) a diagnosed ADHD group, and (b and c) two non-ADHD comparison groups. Participants in the ADHD group included 56 (41 males, 15 females) diagnosed ADHD adults (*M* age = 31.61, *SD* age = 11.59). Ethnic representation included 49 Caucasians, 2 African-Americans, 2 Latinos/Hispanics, 2 Native Americans, and 1 who self-identified as "other." ADHD participants completed instruments in this study as part of a larger study at the University of Massachusetts Medical School.

Participants in the non-ADHD community sample included 106 (59 males, 47 females) non-ADHD adults (*M* age = 37.46, *SD* age = 10.01). Ethnic representation included 96 Caucasians, 2 African-Americans, 2 Asian Americans, 4 Latinos/Hispanics, and 2 who identified themselves as "other." These participants completed two instruments from this study (i.e., DAS and DAX) as part of a larger study being conducted at the University of Massachusetts Medical School. This comparison group was included to provide a sample matched on geographic locale.

Participants in the college student normative group included 432 (217 males, 215 females) introductory psychology students (*M* age = 18.90, *SD* age = 2.08) who completed all instruments included in this study in the fall of 2000 at Colorado State University. Ethnic representation in this group included 372 Caucasians, 6 African Americans, 8 Asian Americans, 21 Latinos/Hispanics, 5 Native Americans, and 20 who

identified themselves as "other." Although this comparison group was not matched on age, educational status, or geographic locale to either the ADHD or non-ADHD group, the group was included to see whether data paralleled that of the college student sample, as that would provide the power to suggest similarities would be present on other measures not completed by the non-ADHD group.

Instruments

Demographic Form. This form was created for use in this study, and included the following information about participants: age, gender, SES, diagnosis, medication, number of ADHD symptoms endorsed (if non-ADHD). No identifying information (e.g., name) was included on this form.

Driving Anger Scale (DAS). The short-form of the DAS (Deffenbacher et al., 1994) consists of 14 items designed to measure the propensity for anger while driving on a 5-point scale ranging from (1 = not at all to 5 = very much). Prior research has shown alpha reliabilities from .80 to .92 with a 10-week test-retest reliability of .84 (Deffenbacher, 2000). Alpha reliability for the present study was .87. The DAS correlates positively with the frequency and intensity of anger and aggressive and risky behavior while driving, state anger and aggression in high impedance simulations, aggressive driving anger expression, aggressive driving cognitions, and trait anger (Deffenbacher, 2000; Deffenbacher et al., 2002; Deffenbacher, Lynch, Deffenbacher, et al., 2001; Deffenbacher, Lynch, Oetting, et al., 2001, in press).

Driving Anger Expression Inventory (DAX). The DAX consists of 49 questions asking how the person expresses anger when driving (Deffenbacher et al., in press). Items are rated on a 4-point scale (1 = almost never, 4 = almost always) according to how

often the person employs the behavior described in the item. The DAX breaks down into two general dimensions, a 34-item (present study $\alpha = .93$) Aggressive Expression (e.g., I try to get out of the car and tell the other driver off, I try to cut in front of the other driver, and I call the other driver names aloud) and a 15-item (present study $\alpha = .89$) Adaptive/Constructive Expression (e.g., I turn on the radio or music to calm down, I tell myself it's not worth getting all mad about, and I try to think of positive things to do). The Aggressive Expression dimension consists of the following subscales: Verbal Aggressive Expression (present study $\alpha = .89$) assessing verbally aggressive expression of anger (e.g., yelling or cursing at another driver); Personal Physical Aggressive Expression (present study $\alpha = .81$), the ways the person uses him/herself to express anger (e.g., trying to get out and tell off or have a physical fight with another driver); and Use of the Vehicle to Express Anger (present study $\alpha = .90$), the ways the person uses his/her vehicle to express anger (e.g., flashing lights at or cutting another driver off in anger). Verbal, personal physical, and vehicular aggressive expression correlate positively with each other (rs = .39 to .48) and negatively with Adaptive/Constructive expression (rs = -.10 to -.22). Aggressive forms of expression are more strongly associated with increased anger, aggression, and risky behavior while driving than Adaptive/Constructive Expression (Deffenbacher et al., 2002; Deffenbacher, Lynch, Deffenbacher, et al., 2001).

Driving Survey. The Driving Survey (Deffenbacher et al., 2000) is designed to gather frequency data as well as global ratings of crash-related variables and driving-related risky and aggressive behaviors. Global ratings are completed on 7-point scales with descriptive anchors (i.e., very calm to very angry, very unaggressive to very aggressive, very cautious to very risk-taking, and very safe to very unsafe). Males rate

themselves as more aggressive and risky than females, and high anger individuals generally rate themselves higher on all four ratings (i.e., more angry, aggressive, risk-taking, and unsafe) (Deffenbacher et al., in press; Deffenbacher et al., 2000). This survey includes three items which ask the participant to indicate how many times in the past three months (0 to 5+ times) she/he has (a) lost concentration while driving, (b) had a minor loss of control of a vehicle he/she was driving, and (c) had a close call but was not actually in an accident. It also includes a 13-item (0 to 5+ times) three-month measure of aggressive behavior (present study $\alpha = .86$), and a 15-item three-month report of risky behavior (present study $\alpha = .87$). Additionally, three items (0 to 5+ times) address moving (non-parking) tickets, minor and major accidents in the participant's lifetime of driving (present study $\alpha = .39$). Because the crash-related indices do not form highly reliable scales, these crash-related items are analyzed separately. High anger drivers report greater risky and aggressive behavior and some crash-related outcomes (Deffenbacher et al., 2000; Deffenbacher, Richards, et al., 2002). Aggressive and risky behavior while driving correlate positively with trait driving anger and aggressive forms of driving anger expression (Deffenbacher, Lynch, Oetting, et al., 2001; Deffenbacher, Lynch, Deffenbacher, et al., 2001).

Driver's Angry Thoughts Questionnaire (DATQ). The DATQ (Deffenbacher, Petrilli, Lynch, Oetting, & Swaim, 2001) assesses angry thoughts people may have while driving. The 65-item DATQ has participants rate on a 1-5 scale (1 = not at all, 5 = all the time) how often the specific thought in the item (or one like it) occurs when angry while driving. The DATQ yields five scales of driving-related cognitions: (1) 21-item Judgmental and Disbelieving Thinking (present study $\alpha = .96$) (e.g., Who in their right

mind would drive like that?); (2) 13-item Pejorative Labeling and Verbally Aggressive Thinking (present study $\alpha = .94$) (e.g., I am going to get even with them.); (3) 14-item Revenge and Retaliatory Thinking (present study $\alpha = .95$) (e.g., What an ass!); (4) 8-item Physically Aggressive Thinking (present study $\alpha = .94$) (e.g., I would like to beat the hell out of them.); and (5) 9-item Coping Self-instruction (present study $\alpha = .88$) (e.g., Just back off and relax). The three aggressive scales (Revenge/Retaliation, Pejorative Labeling/Verbally Aggressive, and Physically Aggressive Thoughts) correlate positively with each other and minimally or negatively with Coping Self-instruction. Judgment and Disbelief tends to correlate positively with all other scales. The three most aggressive cognitive patterns correlate positively with aggressive and risky behavior on the road and with aggressive driving anger expression, whereas Coping Self-instruction tends to correlate negatively with these variables (Deffenbacher, Petrilli, et al., 2001).

Procedure

Data for the ADHD group and the non-ADHD group was collected by Dr. Russell Barkley and his research team at the University of Massachusetts Medical School as part of larger ADHD research study. Dr. Barkley obtained human research approval from the Institutional Review Board at the University of Massachusetts Medical School. Diagnosis of ADHD was established by DSM-IV-TR criteria (APA, 2000) and the judgment of an expert clinician at the medical school. Diagnosis was determined through a clinical diagnostic interview with the participant and parent (when possible), self-report (and parent-report, when possible) questionnaires of current and childhood functioning, and review of past school records (where available). Participants who were taking medication prior to beginning this study were asked to cease medication 24 hours prior to

their initial appointment. The driving anger instruments were part of the research protocol administered by a research technician, and completed by participants in 20-30 minutes during their first appointment (off medication).

For the non-ADHD group, participants were recruited from the University of Massachusetts Medical School and surrounding community. These participants completed ADHD diagnostic measures, and two of the driving anger measures (i.e., DAS and DAX) as part of a larger study.

Participants in the college student normative sample were involved in a previous study conducted at Colorado State University examining driving anger in college students. Participants were registered for this study on the department's website which described research options. The study was described as a study involving driving, emotions especially anger, and substance use. Interested students signed up on the website and were assessed in groups of 30-100 in large university classrooms. Students completed the DAS, DAX, DATQ, and Driving Survey as part of a large study.

CHAPTER III

Results

To determine if adults with ADHD differ from adults without ADHD in driving anger and driving anger expression, driver's angry thoughts, and risky, aggressive, and accident-related driving behaviors, 3 x 2 (Group x Gender) and 2 x 2 (Group x Gender) MANOVAs were performed on clusters of measures assessed by a common methodology and employed the Wilks' λ statistic. Significant univariate group effects and interactions were analyzed by Tukey's *post hoc* comparisons ($p < .05$). Effect sizes are reported in terms of η^2, and are interpreted within Cohen's (1988) criteria (i.e., η^2 of .01-.04 = small effect size, .05-.14 = moderate effect size, and > .14 = large effect size).

Driving Anger and Driving Anger Expression

Because the DAS and DAX were completed by all three groups, a 3 x 2 (Group x Gender) MANOVA was performed on the DAS total score, and the four forms of driving anger expression. Results (Table 1) revealed a significant moderate multivariate effect for group, $F(10, 1168) = 12.62$, $p < .001$, $\eta^2 = 0.10$, but not for gender, $F(5, 584) = 2.27$, or the interaction, $F(10, 1168) = 0.96$. A large group effect was found for the DAS score (Table 1), as the ADHD group reported significantly more driving anger than the non-ADHD comparison group, but significantly less than the college normative comparison group. Small to moderate univariate group effects were found on all four forms of driving anger expression (Table 1). College student drivers reported engaging in more Verbal Aggressive Expression than the ADHD and non-ADHD groups, who did not

Table 1

Driving Anger and Driving Anger Expression

Measure	Group						Univariate	Effect
	Non-ADHD		ADHD		College		Group	Size
	M	SD	M	SD	M	SD	$F(2, 588)$	η^2
DAS	36.52	8.31	40.39	8.78	46.38	9.34	54.76**	.16
DAX								
Verbal Aggressive	23.67	6.01	23.63	5.78	26.74	7.99	9.21**	.03
Personal Physical	11.85	1.45	12.46	2.57	13.19	3.45	9.46**	.03
Use of Vehicle	14.80	3.51	16.71	5.45	19.27	6.16	29.44**	.09
Adaptive/ Constructive	35.77	7.49	32.61	8.25	33.66	8.59	3.98*	.01

*$p < .05$, **$p < .001$

Note. DAS = Driving Anger Scale, and DAX = Driving Anger Expression Inventory

differ significantly from each other. On the Physical Aggressive Expression dimension, the non-ADHD group reported significantly less of such behavior than the college students. The ADHD group did not differ significantly from either comparison group. College students reported using the vehicle more often to express anger than the ADHD group, who reported using the vehicle significantly more often than the non-ADHD control. The ADHD group reported engaging in adaptive/constructive anger expression significantly less than the non-ADHD group, whereas college students did not differ significantly from either group.

Driver's Angry Thoughts

A 2 x 2 (Group x Gender) MANOVA performed on the five dimensions of the DATQ (Table 2) revealed significant small multivariate effects for group and gender, $F(5, 480) = 3.10$ and 3.21, $ps < .01$, η^2s $= 0.03$, but not for the interaction, $F(5, 480) = 1.32$. Small univariate gender effects were found for Revenge and Retaliatory Thinking and Physically Aggressive Thinking, Fs$(1, 484) = 4.15$ and 13.50, $ps < .05$, η^2s $= 0.01$ and 0.03, due to males (Ms $= 28.28$ and 14.53) reporting more of each than females (Ms $= 22.40$ and 9.49). Small group effects (Table 2) were found for Judgmental and Disbelieving Thinking, Pejorative Labeling and Verbally Aggressive Thinking, and Revenge and Retaliatory Thinking, with the ADHD drivers reporting less of these types of thinking than the college norm group.

Global Ratings of Self as a Driver

A 2 x 2 (Group x Gender) MANOVA on the global ratings of self as a driver (Table 3) indicated significant small multivariate effects for group, $F(4, 478) = 4.72$, $p < .01$, $\eta^2 = 0.04$, gender, $F(4, 478) = 2.74$, $p < .05$, $\eta^2 = 0.02$, and the interaction, $F(4, 478)$

Table 2

Driver's Angry Thoughts

Measure	Group				Univariate	Effect
	ADHD		College		Group	Size
	M	SD	M	SD	$F(1, 484)$	η^2
JDT	46.93	16.39	54.55	19.23	6.70**	.01
PLVAT	33.09	11.32	40.00	12.70	13.35***	.03
RRT	21.45	8.64	26.03	12.27	6.56*	.01
PAT	11.14	5.61	12.29	7.07	2.36	.01
CSI	19.80	6.68	20.86	7.27	1.63	.00

*$p < .05$, **$p < .01$, ***$p < .001$

Note. JDT = Judgmental/Disbelieving Thinking, PLVAT = Pejorative Labeling/Verbally Aggressive Thinking, RRT = Revenge/Retaliatory Thinking, PAT = Physically Aggressive Thinking, and CSI = Coping Self-Instruction

Table 3

Ratings of Self as a Driver

Measure	Group				Univariate	Effect
	ADHD		College		Group	Size
	M	SD	M	SD	$F(1, 481)$	η^2
Angry Driver	3.12	1.34	2.80	1.23	4.32*	.01
Aggressive Driver	4.04	1.46	3.59	1.56	3.17	.01
Risky Driver	3.57	1.44	3.17	1.42	7.90**	.02
Unsafe Driver	3.21	1.25	2.64	1.10	18.74***	.04

*$p < .05$, **$p < .01$, ***$p < .001$

= 3.14, $p < .05$, $\eta^2 = 0.03$. Post hoc testing of the interaction revealed ADHD females (Ms = 4.27 and 3.80) described themselves as more risky and unsafe, Fs(1, 481) = 9.80 and 6.23, ps < .05, η^2s = 0.02 and 0.01, than ADHD males (Ms = 3.32 and 3.00), whereas men and women in the college group did not differ from one another. A small gender effect was found for the safety rating, F (1, 481) = 5.20, $p < .05$, $\eta^2 = 0.01$, as males described themselves as more unsafe than females (Ms = 2.73 and 2.68). However, as shown above this was due to differences within the ADHD group. Small group effects were found for ratings of self as an angry, risky and unsafe driver, as ADHD participants described themselves as more angry, risky and unsafe than the college student drivers.

Aggression, Risky Behavior, and Crash-Related Outcomes

A 2 x 2 (Group x Gender) MANOVA on the three-month total reports of aggressive and risky driving behavior (Table 4) revealed no significant multivariate effect for group, gender, or the interaction, Fs(2, 478) = 1.15, .045, and 2.09.

A 2 x 2 (Group x Gender) MANOVA on the six crash-related items (Table 4) revealed a significant multivariate effect for group, $F(6, 478) = 5.57$, $p < .001$, $\eta^2 = 0.07$, but not for gender, or the interaction, Fs(6, 478) = 0.89 and 1.70. Group effects (Table 4) were identified for lost concentration while driving and minor loss of control in the last three months, and for moving tickets and minor accidents in the last year. ADHD drivers reported having more losses of concentration and vehicular control than college students. However, college students received more tickets and experienced more minor accidents than the ADHD group. Effect sizes were small for significant differences.

Table 4

Aggression, Risky Behavior, and Crash-Related Outcomes

Measure	Group				Univariate	Effect
	ADHD		College		Group	Size
	M	SD	M	SD	F	η^2
Aggression	11.37	10.50	11.05	10.39	0.02[a]	.00
Risky Behavior	24.26	12.71	22.28	14.76	1.64[a]	.00
Lost Concentration	3.11	1.95	2.62	1.72	5.52*[b]	.01
Loss of Control	1.65	1.89	1.13	1.28	11.13**[b]	.02
Close Call	1.35	1.29	1.13	1.24	0.73[b]	.00
Moving Violations	0.71	0.98	1.26	1.39	5.32*[b]	.01
Minor Accidents	0.42	0.71	0.89	0.99	9.03**[b]	.02
Major Accidents	0.13	0.34	0.28	0.59	2.59[b]	.01

*$p < .05$, **$p < .01$

Note. [a]df = 1, 479, [b]df = 1, 483. All rates are over the last three months, except for moving violations and accidents which are over the last year.

Analyses with Age as a Covariate

Because of the mean age difference between the ADHD group and the college student group, some analyses were run to covary for the effect of age. Such analyses were conducted on the Global Ratings, the Driver's Angry Thoughts Questionnaire, and the Driving Survey (Table 5). In addition to the group differences identified without age as a covariate, other significant differences were also identified. Moreover, some significant differences obtained prior to the use of age as a covariate were found to be insignificant with the covariate. Analyses with age as a covariate indicated that ADHD drivers rated themselves as more aggressive drivers as compared to the college student group, and reported engaging in more risky and aggressive driving behavior. ADHD drivers did not rate themselves as more angry, nor were any significant differences obtained between the ADHD and college student drivers on the Judgmental and Disbelieving Thinking subscale of the DATQ.

Table 5

Analyses with Age as a Covariate

Measure	Group				Univariate	Effect
	ADHD		College		Group	Size
	M	SD	M	SD	F	η^2
Global Ratings						
Angry Driver	3.12	1.34	2.79	1.22	3.53[a]	.01
Aggressive Driver	4.04	1.46	3.59	1.57	4.21*[a]	.01
Driving Behavior in Last 3 Months						
Aggression	11.37	10.50	11.01	10.39	4.28*[b]	.01
Risky Behavior	24.26	12.71	22.30	14.79	5.08*[b]	.01
DATQ						
JDT	46.93	16.34	54.40	19.13	2.63[c]	.01

*$p < .05$, **$p < .01$

Note. [a]df = 1, 478, [b]df = 1, 476, [c]df = 1, 481. DATQ = Driver's Angry Thoughts Questionnaire; JDT = Judgmental and Disbelieving Thinking.

CHAPTER IV

Discussion

Limitations of the Present Study

Although the present study was designed to account for limitations of Richards et al. (2002), there are some alternative limitations of the present study. First, all three groups were not identically matched in regard to demographic variables (e.g., age, gender, geographic locale, etc.). The lack of matched samples in this study may have resulted in the identified differences between the comparison groups and the ADHD group. For example, driving anger research conducted by Schwartz and Deffenbacher (2002) has shown that younger drivers tend to report experiencing more driving anger, report engaging in more aggressive and less adaptive forms of anger expression, are more risky and aggressive on the road, and experience more of some crash-related outcomes than older drivers. As suggested by the analyses using age as a covariate, differences between the ADHD and college student group were obtained despite the difference in age between the samples.

A second limitation involves gender, as participants included only 15 females in the diagnosed ADHD group. Although few gender effects were present in this study, results should be interpreted with caution as many of the differences may reflect primarily differences in the college norm group. Future research should be designed to adequately target and include equal numbers of males and females with ADHD in order

to properly assess gender differences and should have a non-ADHD group matched for age and other demographics that is assessed on all variables.

A third limitation of the present study is that all data were obtained through self-report measures. As is true with any self-report instrument, it is possible that participants may not have accurately reported their level of anger experienced while driving, as well as the outcomes associated with such anger. Future research should be designed to include additional instruments to assess driving anger, risky and aggressive driving behavior, as well as crash-related outcomes. For example, state driving anger assessments (Spielberger, 1999), driving anger field measures (i.e., Driving Logs) (Deffenbacher et al., 2000; Deffenbacher, Lynch, Oetting, et al., 2001), idiographic assessment of most intense anger (i.e., Personal Driving Anger Situations) (Deffenbacher, Lynch, Filetti, et al., in press), and driving simulations (Deffenbacher et al., in press) may further examine driving anger variables, while checking motor vehicle records may increase accuracy in the examination of accident-related outcomes (Barkley, Murphy & Kwasnik, 1996a, 1996b).

Driving Anger and Driving Anger Expression

It was hypothesized that the ADHD group would report experiencing more driving anger and more aggressive/less adaptive ways of expressing such anger on the road than the non-ADHD group. The ADHD group reported more driving anger, reported using the vehicle to express anger more often, and reported engaging in less adaptive/constructive expression than the non-ADHD group. That is, ADHD adult drivers reported more driving-related anger and were more likely to respond to that anger less adaptively and by using their vehicle to intimidate and retaliate than the non-ADHD

group. While these findings were not evident across all other variables in the present study, results suggest that ADHD drivers may be similar to other high anger drivers, as previous driving anger research indicates that high angry drivers engage in more aggressive and less adaptive/constructive driving anger expression (Deffenbacher, Lynch, Filetti et al., in press). However, additional research is warranted to further assess such differences with a broader range of measures.

In addition to differences in driving anger and driving anger expression identified between the ADHD and non-ADHD groups, differences were also present between the ADHD and college student group. The ADHD group reported significantly less anger on the Driving Anger Scale, but described themselves on the global ratings as more angry than the drivers in the college group. They also rated themselves as more risky and unsafe drivers. Results showed that although the ADHD drivers reported using their vehicle to express anger more than the non-ADHD drivers, they reported significantly less of such behavior than college students. The college student group did not differ from either the non-ADHD and ADHD groups on adaptive/constructive expression. As previously mentioned, some of these discrepancies may be due to the age-cohort difference between the ADHD and college students. However, it is important to note that despite the age difference, ADHD drivers still described themselves as more angry, risky, and unsafe than college students. Thus, future research is warranted to further assess differences in driving anger and driving anger expression in ADHD and non-ADHD drivers.

Driver's Angry Thoughts

A measure of angry thoughts behind the wheel was added to the present study to examine the cognitive dimension of angry experience of ADHD drivers. Results on this measure indicate that the ADHD drivers reported experiencing less judgmental/disbelieving thinking, pejorative labeling and verbally aggressive thinking, and revenge/retaliatory thinking than college students. No differences between groups were identified on physically aggressive expression or coping self-instruction. Previous driving anger research (Deffenbacher, Petrilli, et al., 2001; Richards, Lynch, Kogan, Deffenbacher & Swaim, 2001) has shown that the types of thoughts drivers reported were strongly related to the specific ways in which they express their anger on the road. It is possible that the findings that ADHD drivers reported having less aggressive thoughts than the comparison group drivers may again be due to an age effect. Because the present study was the first to include this cognitive measure to assess angry thoughts that occur while driving, it is recommended that future research continue to include this instrument to further assess differences between same-aged non-ADHD and ADHD drivers.

Aggression, Risky Behavior, and Crash-Related Outcomes

ADHD drivers and college students did not differ on aggression or risky behavior on the road over the last three months. Given the age-related drop in aggression and risky behavior, then ADHD participants who averaged almost 13 years older would have been expected to show less risky and aggressive behavior, and yet they did not. ADHD drivers did report more incidents of lost concentration, and minor losses of control, in the past three months than the college student group. However, ADHD drivers reported

fewer tickets and minor accidents in the past year than the college students. No differences were found for major accidents or close calls. Additional analyses using age as a covariate indicated that ADHD drivers did report engaging in more aggressive and risky behavior on the road than did the college student drivers.

Richards et al. (2002) found similar results, as high ADHD symptom drivers described themselves as being more risky and unsafe on the road, but not more aggressive. While results from the present study did not indicate any difference in three-month aggressive and risky behavior, Richards et al. (2002) found that high ADHD symptom drivers did report engaging in more of both types of behavior than low symptom drivers. Clearly more research is needed to further explore such differences.

Gender Differences

Some small gender differences were identified in the present study. Males reported engaging in more revengeful/retaliatory thinking as well as more physically aggressive thinking than females. Males also described themselves as more unsafe on the road than females. Previous research has shown that men and women do not typically differ on measures of anger, but men do tend to report greater aggressiveness and risk-taking than women (Arnett, Offer & Fine, 1997; Deffenbacher et al., 2000; Deffenbacher, Lynch, Filetti, et al., in press; Richards, Deffenbacher, Cato, & Befort, 2002). One interaction was obtained, which indicated that ADHD females described themselves on the global ratings as more risky and unsafe than the ADHD males. It is not clear why ADHD females would describe themselves as more risky and unsafe; however, this result should not be over-interpreted as no similar interactions were found, and the effect size was small.

Implications and Conclusions

In summary, the present results partially supported the hypotheses that ADHD drivers experience more driving anger, express such anger in more aggressive and less adaptive/constructive ways, and experience more of some crash-related outcomes. ADHD participants reported more anger and aggressive expression through the use of their vehicle and less adaptive/constructive anger expression than their non-ADHD peers. Adult ADHD drivers rated themselves as more angry, risky and unsafe drivers and reported experiencing more losses of concentration and vehicular control than college students. Comparisons between the ADHD and college student samples are compromised by age difference wherein college students would generally be expected to be more angry, aggressive and risky drivers than older, ADHD drivers. ADHD drivers overcame any age cohort differences and were significantly higher than college students on these variables. Moreover, no differences were found on aggressive and risky behavior, where difference due to age cohort differences might be expected. However, after covarying for the effects of age, ADHD drivers did report engaging in more aggressive and risky behavior than college student drivers. Although these arguments are speculative because they are not based on direct comparisons to non-ADHD drivers, they suggest that adult ADHD drivers may be more like the younger, more angry, aggressive, and risky college student drivers.

These results somewhat parallel those of Richards et al. (2002), which showed that high ADHD symptom drivers experience more driving anger, more hostile/aggressive expression (i.e., less adaptive/constructive), and more risky and aggressive behavior on the road. ADHD drivers in the present study also reported more

driving anger and more of one type of hostile/aggressive expression, with less adaptive/constructive expression, but did not report engaging in more risky and aggressive behavior than the non-ADHD drivers, as was found by Richards et al. (2002). However, the ADHD drivers did rate themselves as more risky and unsafe than the non-ADHD drivers in the present study. The study conducted by Richards et al. (2002) included same-aged comparison groups, with more significant differences identified between the low and high ADHD symptom groups. This suggests that with a non-ADHD control group matched for age, differences between groups may be more appropriately identified. Therefore, additional research addressing the limitations outlined is warranted to further examine differences between adult ADHD and non-ADHD drivers.

Although results were not consistent across all variables, differences identified between the ADHD and non-ADHD groups offer some support for Barkley's (1997a, 1997b) theory of ADHD. Barkley's theory proposes that the primary deficit in ADHD involves response inhibition, which consequently results in observable symptoms including poor emotional self-regulation. In the present study, ADHD drivers reported experiencing more driving anger than non-ADHD drivers, and also reported using the vehicle more often to express their anger, with reports of significantly less adaptive/constructive driving anger expression. Therefore, these results offer some additional support for Barkley's theory regarding emotional self-regulation and ADHD.

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