

2018

Evaluating The Effectiveness Of An Anti-Texting-While-Driving Training Program For Young Drivers: The Role Of Adhd Symptomatology

J.Quyen Vu Alexander Nichols
University of Vermont

Follow this and additional works at: <https://scholarworks.uvm.edu/graddis>



Part of the [Clinical Psychology Commons](#)

Recommended Citation

Nichols, J.Quyen Vu Alexander, "Evaluating The Effectiveness Of An Anti-Texting-While-Driving Training Program For Young Drivers: The Role Of Adhd Symptomatology" (2018). *Graduate College Dissertations and Theses*. 768.
<https://scholarworks.uvm.edu/graddis/768>

This Dissertation is brought to you for free and open access by the Dissertations and Theses at ScholarWorks @ UVM. It has been accepted for inclusion in Graduate College Dissertations and Theses by an authorized administrator of ScholarWorks @ UVM. For more information, please contact donna.omalley@uvm.edu.

EVALUATING THE EFFECTIVENESS OF AN ANTI-TEXTING-WHILE-DRIVING
TRAINING PROGRAM FOR YOUNG DRIVERS: THE ROLE OF ADHD
SYMPTOMATOLOGY

A Dissertation Presented

by

J Quyen Vu Alexander Nichols

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
Specializing in Psychology

October, 2018

Defense Date: May 05, 2017
Dissertation Examination Committee:

Betsy Hoza, Ph.D., Advisor
Michael Rosen, Ph.D., Chairperson
Dianna Murray-Close, Ph.D.
Timothy Stickle, Ph.D.
Matthew Price, Ph.D.
Cynthia J. Forehand, Ph.D., Dean of the Graduate College

Abstract

A long-standing challenge for public health and safety is that motor vehicle crashes (MVCs) are the leading cause of death for U.S. teenagers, a population with disproportionately high crash involvement relative to other road users. Quantitative and qualitative research has identified distracted driving as a significant contributor to young drivers' overrepresentation in MVCs. This study was designed in the context of this notable public health concern, and the primary goal was to examine psychological factors that are hypothesized, via the Theory of Planned Behavior, to underlie teenage drivers' decisions to text-while-driving (TWD) with a focus on the influence of ADHD symptoms. The psychological factors of interest were attitudes toward TWD, perceptions of crash risk while TWD, self-perceptions of competence as a driver, and perceptions of task performance. The aims of this project were addressed through a program evaluation of an experiential driver training program designed to educate young novice drivers on the dangers associated with TWD. This program, Turn Off Texting (TOT), was designed and run by the Youth Safety Council of Vermont and the Vermont Department of Motor Vehicles, Safety and Education Unit. Participants included 1203 high school teenagers who participated in 42 TOT program demonstrations across Vermont. The first aim of this study was to examine the influence of ADHD symptoms on psychological factors and behavioral intentions while controlling for and examining the effects of age, gender, and driving experience. ADHD symptoms were associated with more favorable attitudes toward TWD, greater intentions to TWD in the future, and lesser intentions to intervene on a distracted driver in the future. Male gender and increased driving experience also tended to be associated with riskier attitudes, perceptions, and intentions. The second aim of this work was to examine if the psychological factors mediate the associations between ADHD symptoms and the two behavioral intention variables. Results from multiple mediation models showed that only attitudes toward TWD mediated the relations for both intentions to TWD and to intervene in the future. ADHD symptoms continued to have a direct effect on behavioral intentions even when accounting for the indirect effects of the psychological factors; these findings suggest a direct relation of ADHD symptoms and an indirect relation via attitudes. The third and final aim of this study was to investigate the influence of ADHD symptoms, as well as age, gender, and driving experience, on the rate of change in the psychological factors and behavioral intention variables over the course of the TOT program. Findings from two-level regression models showed that the TOT program generally was effective in its goal to produce safer views in regards to the psychological factors and intended behaviors. As hypothesized, ADHD symptoms were associated with less change toward safer attitudes, perceptions of crash risk, and both intentions to TWD and intentions to intervene in the future; the influences of male gender and increased driving experience were similar in their associations with less change toward safer attitudes, perceptions, and intentions. The findings from this study's three aims have important implications for the development and continued evaluation of specialized driver training programs. Namely, attitudes toward TWD are a viable target for intervention given this factor's direct and indirect (in the association of ADHD symptoms) effect on intended behavior. Increasing ADHD symptoms and male gender were associated with less change over the course of the program, which represent two areas for more specialized intervention and study.

Acknowledgments

I would like to express my deepest gratitude to my advisor, Betsy Hoza, for her support and encouragement in this process and throughout my development as a researcher, clinician, and professional. I also would like to extend my deepest appreciation to my dissertation committee members, Mike Rosen, Annie Murray-Close, Tim Stickle, and Matthew Price; their classes, feedback, and consultation have contributed invaluable to this dissertation.

I am grateful to the Youth Safety Council of Vermont (YSCVT) and, in particular, Jim Lockridge for initiating and maintaining a partnership with the Hoza Lab. This dissertation would not exist without his openness for an evaluation of the Turn Off Texting (TOT) program and his willingness to redevelop the program and survey instruments. YSCVT and Governor's Highway Safety Program were advised of these findings as part of this ongoing relationship and through a joint mission to help teens "fully understand their responsibilities while operating a motor vehicle on our highways and to understand the consequences of poor choices and irresponsible actions" (yscvt.org).

Lastly, to my family, friends, and partner-in-crime, thank you for everything (and sorry for some things – it has been a wild ride).

Table of Contents

Acknowledgements.....	ii
List of Tables	v
List of Figures.....	vi
Overview.....	1
Background and Significance	2
Public Health Statement of Problem	2
The Young Novice Driver.....	5
The Driver with ADHD.....	8
The Young Novice Driver with ADHD	13
Distracted Driving	16
Talking on cell phone	17
Text messaging	18
Theoretical Model of Distracted Driving	20
Factors Influencing Distracted and Unsafe Driving.....	20
Demographic variables	21
Attitudes toward unsafe driving.....	21
Driver perceptions of risk	22
Self-perceptions of competence	23
Current Study	25
Aims and Hypotheses.....	27
Aim 1: Association of ADHD symptoms	27
Aim 2: Mediation via psychological factors	27
Aim 3: Pre- to post-program change.....	29
Method.....	29
Participants	29
Recruitment.....	29
Sample demographics	30
Procedure.....	30
Data collection	32
Measures.....	32
Demographics	32
Driving experience.....	33
Actual task performance	33
Psychological factors	33
Behavioral intentions	34
Symptoms of ADHD	35
Data Analytic Strategies.....	35
Preliminary Analyses.....	35
Primary Analyses.....	35
Aim 1	36
Aim 2	37
Aim 3	38

Results.....	40
Preliminary analyses	40
Aim 1: Multiple Regression Models	44
Aim 2: Multiple Mediation Models	46
Intention to TWD in the future	46
Intention to intervene in the future.....	48
Aim 3: Two-Level Analysis of Program Effects	49
Model modifications	49
Attitudes toward TWD.....	49
Perceptions of crash risk with TWD	51
Self-perceptions of competence as a driver	52
Perceptions of distracted driving task performance	53
Intention to TWD in the future	53
Intention to intervene on a distracted driver in the future.....	55
Discussion	56
Aim 1	56
Aim 2.....	60
Aim 3.....	63
Conclusions	72
Limitations	75
Implications.....	76
References.....	98
Appendices.....	113
Appendix A: Pre-Program Survey	113
Appendix B: Post-Program Survey	114

List of Tables

Table 1. Descriptive statistics for all study variables	81
Table 2. Intercorrelations among independent and dependent variables for all analyses	82
Table 3. Results from path <i>a</i> of the multiple mediation models for psychological factors in Aim 1	83
Table 4. Results from path <i>a</i> of the multiple mediation models for behavioral intentions in Aim 1	84
Table 5. Indirect effects of ADHD symptoms on intention to TWD for Aim 2	85
Table 6. Indirect effects of ADHD symptoms on intention to intervene for Aim 2	86
Table 7. Results from the two-level regression models for psychological factors in Aim 3	87
Table 8. Results from the two-level regression models for behavioral intentions in Aim 3	88

List of Figures

Figure 1. Distribution of ADHD symptoms	89
Figure 2. Hypothesized multiple mediation model	90
Figure 3. Hypothesized two-level regression model without a random intercept	91
Figure 4. Multiple mediation model of intention to TWD in the future	92
Figure 5. Multiple mediation model of intention to intervene in the future	93
Figure 6. Simple slopes of cross-level interactions for attitudes toward TWD	94
Figure 7. Simple slopes of cross-level interactions for perceptions of crash risk	95
Figure 8. Simple slopes of cross-level interactions for intention to TWD	96
Figure 9. Simple slopes of cross-level interactions for intention to intervene	97

Overview

A long-standing challenge for public health and safety is that motor vehicle crashes (MVCs) are the leading cause of death for U.S. teenagers (Center for Disease Control and Prevention [CDC], 2015). In 2013, these young novice drivers had high crash involvement relative to other road users, accounting for 9% of all fatal crashes and 13% of all non-fatal police-reported crashes (National Highway Transportation Safety Alliance [NHTSA], 2015). Specifically, in 2013, 2,524 youth ages 13-19 died in MVCs (and almost 292,000 were injured), which is greater in this age group than suicide, homicide, and malignant neoplasms (CDC, 2015; Insurance Institute of Highway Safety [IIHS], 2015). The economic impact is also evident. Young people ages 15-24 represent only 14% of the U.S. driving population, yet they account for 30% (\$19 billion) of the total costs of motor vehicle injuries among males and 28% (\$7 billion) of the total costs of motor vehicle injuries among females (Corso, Finkelstein, Miller, Fiebelkorn, & Zaloshnja, 2006).

Research shows that distracted driving is a significant contributor to young drivers' overrepresentation in MVCs, with recent findings implicating distraction as a primary factor in 58% of all MVCs, including 89% of road-departure crashes and 76% of rear-end crashes (AAA Foundation for Traffic Safety, 2016). Young drivers are the most susceptible to distraction-related crashes relative to all other road users; approximately 1 out of every 7 distraction-related fatal crashes in the United States is attributed to drivers less than 20 years of age (Governor's Highway Safety Alliance [GHSA], 2010).

Distracted driving is defined as the practice of driving a motor vehicle while engaged in another activity that takes the driver's attention away from the road (NHTSA,

2015). Distracted driving is particularly problematic for young drivers who are still in the process of developing the procedural and hazard perception skills essential to the driving task. Deaths resulting from motor vehicle crashes, specifically those related to driver distraction, are classified as “accidental deaths,” which implies a level of preventability and highlights driver distraction as a ripe target behavior for effective intervention in young drivers (CDC, 2013).

The purpose of the current work is to examine antecedent psychological factors that have been theorized to underlie teenage drivers’ decisions to text while driving, with focus on the influence of ADHD symptomatology. These findings may be critical to developing specialized driver education and training programs, as well as informing policy, for those in need of such intervention.

Background and Significance

Public Health Statement of Problem

The NHTSA investigated the prevalence of distracted driving as a part of the National Motor Vehicle Crash Causation Survey (NMVCCS). These data suggest that younger drivers, relative to the driving population as a whole, are more likely to be distracted by factors inside the vehicle, such as eating or drinking, adjusting the radio, retrieving a fallen object, and mobile phone-related activities (e.g., making calls, talking on the phone, sending or reading text messages, checking social media; NHTSA, 2008). Within the past several years, the use of cell phones while driving, particularly reading or composing text messages, has emerged as a particularly dangerous form of distracted driving. Of primary concern is the striking number of drivers who admit to texting while driving: latest available research indicates that 47% of adults and more than 50% of

young drivers *admit* to engaging in this unsafe driving behavior; actual prevalence of this behavior is suspected to be higher (Pew Research Center, 2011). There is now a growing evidence base showing that the risk of crash or near-crash among novice drivers increases substantially with the performance of many secondary tasks such as texting (odds of crashing increase by factor of 3.87) and dialing on a phone (odds of crashing increase by factor of 8.32; Klauer et al., 2014).

Young driver inexperience is associated with lower comprehension of driving risks and consequences, and less fully developed information processing capabilities (Lee, Simons-Morton, Klauer, Ouimet, & Dingus, 2011). As drivers primarily learn safe driving behaviors and roadway navigation through trial-and-error and direct feedback from the behavior of the vehicle, it becomes clear why inexperience may play such an important role in increased risk. For instance, a driver learns to slow down before taking a sharp turn by first experiencing the drastic decrease of vehicle control that results from taking a turn too quickly. Similarly, novice drivers who lack experience have difficulty appreciating the amount of information missed when their eyes are focused on reading or sending a text message.

Furthermore, as young drivers become confident in their driving abilities, they tend to over-estimate their ability to multitask while driving (Sarkar & Andreas, 2004). Such effects may be compounded if the driver is impaired, perhaps by fatigue, alcohol use, or drug use. Overestimation of driving skills positively correlates with involvement in risky driving, road crashes and traffic violations, which highlights a key intervention target behavior (Sumer, Ozkan, & Lajunen, 2006). As in-vehicle systems and devices become more popular and their use more ubiquitous, the development of both new and

supplementary education and training programs for young drivers becomes increasingly important (Olsen, Lerner, Perel, & Simons-Morton, 2005; Sarkar & Andreas, 2004).

Efforts to improve the safety of young drivers have focused on delivering information through pre-license driver education programs, which teach basic road laws and vehicle handling skills; however, studies have found that these types of programs are ineffective in decreasing rates of MVCs (Lonero & Mayhew, 2010). One reason may be that typical driver education programs do not adequately address the determinants of unsafe driving behaviors, such as the driver's attitudes and perceptions of risk, which reliably predict driving behaviors and crash involvement (Hatfield & Fernandes, 2009). Further, these programs take place in contrived settings (i.e., classrooms, parking lots, closed courses) that shield the young driver from learning, in an experiential manner and via direct feedback, the potentially harmful consequences to themselves and others of their unsafe driving behaviors. Hence, there is a critical need for the development and evaluation of effective experiential training programs that identify and directly address these behavioral determinants. Indeed, many policy makers and researchers have lamented that the field of young driver education is "stuck" in that no programs seem effective in reducing the disproportionately high rates of MVCs for this group (Glendon, McNally, Jarvis, Chalmers, & Salisbury, 2014; Peck, 2011).

Currently, neither legislative measures nor driver education programs that address distracted driving and specifically mobile phone use while driving have proven to be effective over the long term; rates of MVCs that cite driver distraction as a primary factor remain high (NHTSA, 2015; Klauer et al., 2014). With more and more automobiles equipped with wireless communication and entertainment devices, legislation alone is

unlikely to be sufficient in addressing the problem of driver distraction. In addition, the most widely used driver education programs are perhaps not satisfactory in *engaging* young drivers and encouraging safe behaviors when using an automobile.

In summary, distracted driving is a common behavior in all populations of drivers, but it is particularly prevalent among young and inexperienced road users, which increases their risk for crashes and collisions while driving. An increasingly common secondary distracting task is mobile phone use for the purposes of receiving or sending text messages, and a large body of evidence shows that driving while distracted by text messaging increases the risk of crashing or getting into a near-crash (i.e., “close-call”) event. Given the dangers and economic costs associated with TWD, it is critical to develop and evaluate new and supplementary driver education and training programs to address this notable public health concern. Considering the long-term *ineffectiveness* of legislation and most widely-used driver education programs, countermeasures such as driver training and education that focus on helping drivers realize and adjust for the risks associated with distracted driving, as well as their own limitations behind the wheel, could help mitigate the dangers of young inexperienced road users.

The Young Novice Driver

Current research emphasizes significant performance differences between teenage and adult drivers that result partly from differing levels of driving experience. Using a large dataset from the Fatality Analysis Reporting System (FARS) and the National Automotive Sampling System (NASS)/General Estimates System (GES) databases to investigate fatal and non-fatal crashes for teenage drivers between 1996 and 2005, Ferguson, Teoh, and McCartt (2007) found that 16-year-old drivers had the highest fatal

crash rate among teenage drivers, as well as among the driving population as a whole. Specifically, 16-year-olds were involved in approximately 11 fatal crashes for every 100 million miles traveled, which is contrasted with two per 100 million miles traveled for middle-aged drivers. Further examination of these results suggested that the crash risk for teenage drivers depends highly upon the context of the driving environment (Williams, 2003). For instance, a male driver with a female passenger emerged as low risk, and driving at night emerged as high risk. These results suggest that more nuanced analyses may be beneficial in future studies intending to dismantle reasons for increased crash involvement and risky driving behaviors among young drivers.

Naturalistic observation studies of driving have contributed substantially to the knowledge base on risky driving behaviors among young drivers. The 100 Car Naturalistic Driving Study collected data over a period of 12-13 months using cameras and sensors installed in 109 vehicles in the Northern Virginia and Washington, DC, metro areas. The data included information on the driving behaviors of 109 primary drivers and 132 secondary drivers, and there were 82 crashes/collisions, of which 15 were reported to the police (Dingus et al., 2006). The findings from the sensor and camera data provided evidence for an inverse relationship between experience and probability of crash and near-crash (defined as a conflict event requiring “rapid, evasive maneuver” to avoid a crash; Dingus et al., 2006, pg. xxxix) involvement, such that more experience was associated with a lower probability of these outcomes. These researchers also chose to analyze driving performance characteristics of “unsafe” drivers (i.e., those who drove in a significantly riskier manner relative to other participants). These unsafe drivers, who tended to be younger and have less driving experience than safer drivers, displayed a

higher frequency of hard braking, driving inattention, and driving too close to a forward vehicle. Like this previous study, Stutts et al. (2005) monitored 70 drivers over a period of one week each and were interested in identifying and quantifying distracted driving behaviors. The results showed that participants were engaged in distracting activities for 14.5% of the total time their vehicles were moving, which resulted in higher levels of driving with no hands on the steering wheel and significant increases in lane deviations (i.e., swerving within the driving lane).

Differences between adult and teenage drivers are also evident in regards to their engagement in secondary tasks while driving. In a controlled-access Smart Road test track, teenagers reported higher willingness to engage in secondary tasks relative to adults (Olsen, Simons-Morton, & Lee, 2006). The teenage participants also were less likely to suspend the secondary task when approaching and entering an intersection, and they reported a higher level of confidence in their abilities to manage the increased workload associated with a secondary task while driving relative to adults. These findings suggest that teenagers display a greater self-perceived ability to drive in the presence of secondary tasks compared to adults, which is counterintuitive given the increased crash risk for this driving population.

In a study examining the impact of different secondary tasks using a high-fidelity, moving-base simulator, teenage participants (16-18 years) drove in a riskier manner in terms of physical headway (i.e., distance behind a leading vehicle) relative to adult participants, and their lane-keeping was impacted significantly more than adult drivers while performing a cell-phone task (i.e., greater deviations in lane position; Greenberg et al., 2003). The 100 Car Study supports this concept with the finding that teenagers were

approximately four times more likely to be involved in a crash while performing complex secondary tasks, such as text messaging, as compared to adults (Dingus et al., 2006).

These studies support the notion that teenage drivers are less capable of dividing their attention between a secondary task and the primary task of driving.

Taken together, research has shown that younger drivers, particularly the population of *newest* road users around the age of 16 years, are the most dangerous and at risk for crashes and collisions. Young drivers also have been found to display, based on naturalistic observation and simulator studies, risky driving behaviors and less awareness of the dangers and consequences associated with these behaviors. In particular, younger drivers look away from the forward roadway, follow a lead-vehicle too closely, drive over the speed limit, and engage in secondary tasks at a greater frequency than older and more experienced drivers. Particularly in regards to distracted driving, young drivers report increased willingness to TWD in different complicated driving scenarios and are less likely to stop text messaging when attentional demands of driving increases (e.g., approaching and entering an intersection). Given the increased danger and risk for crashing posed by young and inexperienced road users, it is critical that programs be designed to more effectively teach and train this population of road users on the consequences of their risky and distracted driving behaviors.

The Driver with ADHD

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that includes developmentally inappropriate symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association [APA], 2013). In the United States, the disorder affects approximately 5% of children and adolescents (APA,

2013). Of these individuals, up to 65% continue to report symptoms of ADHD as they age (Faraone, Biederman, & Mick, 2006), resulting in a prevalence of 2.5-4% in adults (APA, 2013; Kessler et al., 2006). Symptoms of hyperactivity may manifest differently in childhood and early adolescence than in adulthood, with motoric hyperactivity giving way to fidgetiness and feelings of restlessness, while inattention and impulsivity often continue to be problematic (APA, 2013). Adults with ADHD have been found to have significant occupational and social problems, including lower levels of educational attainment and employment, disruption of intimate partnerships, and difficulties in social functioning (Biederman et al., 1993; Gjervan, Torgersen, Nordahl, & Rasmussen, 2012; Knouse et al., 2008; Safren et al., 2010). One commonly reported area of difficulty is a pattern of negative driving outcomes, such as an increased risk of accidents, citations, and license revocations (Barkley, Murphy, & Kwasnik, 1996; Barkley et al., 2002; Fried et al., 2006; Murphy & Barkley, 1996).

Longitudinal studies following children diagnosed with ADHD into young adulthood, as well as studies of community-derived samples with ADHD using self-report, have found an increased frequency of crashes, traffic citations (as indicated by DMV records), and driving without a license in adults with ADHD as compared to non-ADHD groups (Barkley, Guevremont, Anastopoulos, DuPaul, & Shelton, 1993; Fischer, Barkley, Smallish, & Fleisher, 2007; Thompson, Molina, Pelham, & Gnagy, 2007; Weiss, Hechtman, Perlman, Hopkins, & Werner, 1979). Studies using clinic-referred samples with ADHD, which often differ from non-clinic community samples (i.e., samples recruited from the wider community often via advertisement) in severity, number

of symptoms, and comorbid conditions, have yielded similar results (Barkley et al., 1996; Barkley et al., 2002; Fried et al., 2006; Murphy & Barkley, 1996).

Data from official DMV reports have consistently shown increased frequency of motor vehicle crashes, license suspensions/revocations, and citations in clinic-referred drivers with ADHD as compared to control group drivers (Barkley et al., 1996). An additional study supports similar findings of more scrapes and collisions, increased steering variability, and poorer steering control in individuals with ADHD as compared to controls (Fischer et al., 2007). However, work from Barkley et al. (2002) that included a larger sample failed to find differences on driving simulator measures, which the authors hypothesized might be attributed to the simplicity of the simulator used (i.e., possible saturation effect). Interestingly, in a high-fidelity simulator-based study comparing sober adults with ADHD to community control participants in sober and legally intoxicated (blood alcohol content of 80mg/100ml) conditions, the drivers with ADHD differed from sober control drivers on variability in lane position and rate of turning the steering wheel (i.e., greater frequency of sudden movements in steering), yet they did not differ from the control drivers while intoxicated (Weafer, Camarillo, Fillmore, Milich, & Marczinski, 2008).

Two components of ADHD that have been examined in research as separate constructs are inattention and impulsivity. Attention and distractibility have been the subject of much driving research recently, and deficits in attention, a hallmark symptom of ADHD, are consistently found to be related to dangerous driving (e.g., Dula, Martin, Fox, & Leonard, 2011; Randell, Charlton, & Starkey, 2016; Thornton, Faires, Robbins, & Rollins, 2014). Sustained attention in the presence of distraction, either from inside the

vehicle (e.g., changing radio or other vehicle controls) or outside of the vehicle (e.g., pedestrians, animals, other road users), is critical for safe navigation using a motor vehicle, and this demand presents a challenge for those with ADHD, particularly during periods of low arousal (Forster, Robertson, & Jennings, 2014; Lavie, 2005).

More specifically regarding the ability to resist distraction in individuals with ADHD, Reimer et al. (2010) conducted a study in which participants completed measurable secondary distractor tasks introduced during periods of low and high stimulus driving to determine the influence of demand on distractibility. The performance of ADHD drivers suffered considerably when presented with a secondary cognitive task during low stimulus driving, resulting in greater distances travelled in excess of the speed limit, and increased speed variability compared to a control group. However, under high stimulus driving conditions, driving performance was similar between driver groups, indicating that ADHD drivers could effectively regulate the attentional demands of the secondary task. This finding points to the significance and utility of driving environment measures in both understanding and predicting ADHD driver distraction and performance. Under less demanding driving conditions, poor task regulation may predispose ADHD drivers to invest more attention toward a distraction in the driving environment, thus compromising their driving performance.

Along with deficits in attention, impulsivity is a key feature of ADHD. Impulsivity commonly is defined as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to potential negative consequences (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Empirical research has linked dangerous driving to impulsivity through self-report measures (Owsley, McGwin, & McNeal, 2003;

Teese & Bradley, 2008) and behavioral data (Dula, Martin, Fox, & Leonard, 2012; Fischer et al., 2007; Fox, Dula, Martin, & Leonard, 2012). Research consistently has supported the notion that drivers with ADHD, as a group, engaged in more self-reported risky driving behaviors than drivers without the disorder (Thompson et al., 2007; Richards, Deffendbacher, Rosen, Barkley, & Rodricks, 2006).

Another feature of ADHD that impacts driving performance and safety is the tendency of individuals with ADHD to hold elevated self-perceptions of competence, termed a “positive bias”, compared to individuals without ADHD (Hoza, Pelham, Dobbs, Owens, & Pillow, 2002; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007). The positive bias is defined as the reliable difference between self-assessed competence and a criterion assessment of competence in which the self-assessment is more positive than the criterion (Hoza et al., 2002; Owens et al., 2007). Interestingly, researchers recently have surmised that there may be important differences in the level of this bias depending on the types of questions and domains assessed; more specifically, individuals with ADHD have been found to have comparable estimations to those without ADHD when asked specific questions (e.g., objective items, like, “how many cones do you think you hit during this drive?”) as compared to more global or subjective questions (e.g., “how competent of a driver do you think you are?”; see, e.g., Alicke & Govorun, 2005; Fabiano et al., 2015; Watabe, Owens, Serrano, & Evans, 2017).

In sum, ADHD is a child-onset neurodevelopmental disorder that persists into adulthood for many and is characterized by an array of deficits that have the potential to increase risk for crashes or collisions while driving. It is a consistent finding that drivers with ADHD record a higher frequency of adverse driving outcomes, including a higher

rate of crashes, citations, and license revocations. Inattention, impulsivity, and inflated self-perceptions of competence have received consideration in empirical studies, and these components of ADHD have been shown to relate to unsafe driving behaviors and poor outcomes.

The Young Novice Driver with ADHD

Given the adverse outcomes associated with either being a young novice driver, or with being an individual with ADHD, it is not surprising that outcomes are even worse when considering the driving records and outcomes of young drivers diagnosed with ADHD (Barkley & Cox, 2007; Fischer et al., 2007; Jerome, Segal, & Habinski, 2006; Thompson, Molina, Pelham, & Gnagy, 2007). During adolescence, ADHD is associated with high rates of illegal driving and license suspension, as well as *repeated* driving infringements (Barkley et al., 1993; Fischer et al., 2007; Nada-Raja et al., 1997; Narad et al., 2013; Woodward, Fergusson, & Horwood, 2000). Adolescent drivers with ADHD are more likely to be cited for a traffic citation for speeding, reckless driving, and hit-and-run incidences (see Barkley & Cox, 2007 and Jerome et al., 2006, for a review).

Narad et al. (2013) examined driving performance of adolescents, aged 16 to 17 years, with and without ADHD and found that despite having fewer months of driving experience by an average of four months, a greater proportion of adolescents with ADHD reported a history of at least one written traffic violation (17%) relative to the control group (6%). In a follow-up study, Narad et al. (2015) found that not only do young drivers with ADHD experience a higher frequency of negative consequences due to their driving behavior (e.g., fines, negative points, and hours in driving class) than those

without ADHD, but these consequences also appear to be more severe (e.g., greater fines and more hours in remedial driving class).

Several studies have examined self-perceptions in young drivers with ADHD, and these investigations suggest that the positive bias (i.e., inflated self-perceptions of competence) contributes to adverse driving outcomes experienced by those with ADHD. Hoza and colleagues (2013) found that inflated self-ratings of behavioral competence, relative to those of an external rater, fully explained the relationships between ADHD symptoms and risky driving outcomes (frequency of driving illegally, frequency of traffic violations, and having a license/permit revoked or suspended). Knouse, Bagwell, Barkley, and Murphy (2005) compared self-appraisals of simulated driving performance in naturalistic-seeming settings between individuals with and without ADHD. Despite employing fewer safe driving behaviors and having greater rates of collisions and traffic citations, ADHD participants rated their own performance similarly to controls who did not evidence impairment in driving (Knouse et al., 2005). Fischer et al. (2007) also found that adolescents with ADHD appraise their own driving skills as being better than parent or objective record reports. More recently, Fabiano et al. (2015) replicated findings of previous work and found that teen drivers with ADHD exhibited a positive bias and overestimated their performance on a driving simulation task. Notably, the researchers found that the teens with ADHD exhibited a much stronger bias for global ratings of performance than for ratings of specific driving behaviors. Overestimation of ability amongst individuals with ADHD also has been associated with reduced admission of consequence, more positive expectations of risk taking behaviors, and little inclination to pursue measures of injury prevention (Farmer & Peterson, 1995; Knouse et al., 2005).

Prevatt et al. (2011) supported these findings with a sample of college students with and without an ADHD diagnosis on self-reported driving behaviors. The researchers found that 46% of participants with ADHD, compared to 31% of the non-ADHD group, gave a global rating of their ability that indicated an over-estimation based on what would be predicted from their performance. Importantly, these findings in ADHD samples represent a general perceptual style that cannot be explained by deficits in driving knowledge (Barkley, Murphy, & Kwasnik, 1996) or maturation to adulthood (Knouse et al., 2005).

Overall, these findings complement results from the adult literature and suggest that negative driving outcomes for those with ADHD manifest early in their driving careers. This highlights a critical stage for intervention and suggests the need for additional training specifically designed for adolescents with ADHD. There is some empirical work showing that young drivers with ADHD *can* learn to operate a motor vehicle and navigate complex road situations in a safer manner (Fabiano et al., 2011; Paaver et al., 2013). It is well documented that young drivers with ADHD, as a population, tend to drive in a riskier manner (e.g., speeding, reckless driving) and report a higher frequency of negative outcomes (e.g., fines, negative points, and hours in driving class) relative to drivers without ADHD. In addition, the tendency of individuals with ADHD to overestimate their competence and performance as drivers has shown to relate to more positive expectations of risk taking behaviors and little inclination to pursue measures for injury prevention. These implications are concerning: the novice driver with ADHD who overestimates ability may take more risks and learn less from mistakes if blame is not appropriately attributed to his/her own ability or competence.

Distracted Driving

Driver error has long been recognized as the primary cause of MVCs, and the landmark Tri-Level study by Indiana University researchers (Treat et al., 1979) further solidified this understanding. Human factors such as speeding, inattention, distraction, and performance errors were found to contribute to 92.6 percent of all crashes. In addition, this study identified internal distraction (i.e., driver distracted by stimuli internal to the vehicle) as a “definite” cause in 5.7 percent of crashes and a “probable” cause in 9.0 percent; notably, this was *before* cell phones emerged as a potent source of internal distraction. As an update to these landmark findings, the National Motor Vehicle Crash Causation Survey (NMVCCS; NHTSA, 2008, July) sponsored by NHTSA, found that driver-related factors were the primary cause in 95.4 percent of crashes. These driver-related factors include both performance errors and errors related to non-driving activities, which typically involve distraction, inattention, and inadequate roadway scanning.

The NHTSA’s analysis of the economic costs of MCVs estimated that 18% of injury-only crashes in 2010 were reported as distraction-affected crashes, and crashes in which at least one driver was identified as being distracted caused \$123 billion in comprehensive costs during that year (NHTSA, 2015). Of those people killed in distraction-related crashes, 419 occurred in crashes in which at least one of the involved drivers was using a cell phone; further, for those injured in distraction-affected crashes, an estimated 27,000 were injured in crashes that involved the use of cell phones at the time of the incident (NHTSA, 2015). Specifically regarding distracted driving among young road users, 11% of all drivers under age 20 involved in fatal crashes were reported

as distracted at the time of the incident, and 19% of those involved in fatal crashes were distracted using cell phones (NHTSA, 2012).

Talking on a cell phone. Driving and talking on a cell phone has long been recognized as a dangerous activity and an area of interest to researchers. Talking on cell phones while driving has been linked to significant performance degradation within the general driving population (Dingus et al., 2006; Klauer et al., 2014; Strayer, Drews, & Crouch, 2006). Interestingly, research has found that the distracted driver is aware of the increase in mental workload that results from the addition of a cell phone task, as supported by self-reported levels of increasing subjective workload while driving in the presence of a cell phone task (Rakauskas, Gugerty, & Ward, 2004). Despite this self-reported increase of mental workload, drivers do not appear to be aware of the performance degradation seen in the presence of cell phone use while driving (Lesch & Hancock, 2004). Furthermore, younger teenage drivers (aged 16-17 years) tend to be more willing to use cell phones while driving (Olsen et al., 2005), particularly when bored, and they also tend to rate engagement in this secondary task as less risky relative to older drivers (Lerner & Boyd, 2005). These findings illustrate the higher prevalence of cell phone use among novice teenage drivers compared to older drivers, a rate which has only increased with the advent of smartphones. Alarming, researchers have also found that the driving styles of cell-phone-distracted drivers are marked by a significant delay in response to stimuli in the driving environment and a higher frequency of “jerky” driving maneuvers (i.e., sudden lane or speed corrections), a similar type of driving style and level of impairment as that of legally intoxicated drivers (i.e., 0.08% wt/vol intoxication level; Strayer et al., 2006). Further, the cell-phone-distracted drivers in this

study reported that driving while talking on a cell phone was no more difficult than driving while not on a cell phone, suggesting a cognitive disconnect between the performance degradation that results from cell phone use while driving and individuals' perceptions of this degradation.

Text messaging. The distraction posed by cell phones has become increasingly prominent as these devices have become more advanced, now including a wide array of social media applications and ubiquitous internet connectivity. One of the most popular and potentially distracting of these features is the capacity to text message. For the purposes of this literature review, text messaging includes any form of person-to-person communication using a cell phone's keyboard feature. More than ever, young people are using texting as a primary means of communication, as in one study over 78% of the youngest age group surveyed (13-19 years) reported that they text more than they make calls with their phone; their rate of text messaging was over 500 texts per month (Vlingo Corporation, 2009). Grinter and Eldridge (2003) classified common reasons for choosing text messaging over other forms of communication and found that text messaging is quicker, cheaper, easier, and more convenient. This new form of communication is both pervasive and important as a means of maintaining self-esteem and social networks, possibly making the use of these devices the norm among younger drivers.

Text messaging is a dangerous secondary task that decreases driving performance and increases crash risk significantly for the general driving population (Dingus et al., 2006; Klauer et al., 2014). This act of driving distracted leads to problems such as incorrect lane changes (Hosking, Young, & Regan, 2009), increased braking delay (Drews, Pasupathi, & Strayer, 2008), and increased speed variability, lateral speed, and

lane position variability (Crisler et al., 2008). These errors suggest a decrease in the ability to control the vehicle. Drivers face a dual task that often requires them to take their eyes off the road for a sustained amount of time, as composing a text message while driving requires visual, manual, and cognitive attention from the operator.

The dangers of texting while driving are especially evident for younger drivers who are unlikely to suspend a text messaging task when faced with a difficult driving situation (Klauer et al., 2008), yet there have been few studies providing clues about why a behavior that outwardly seems so dangerous might be so prevalent among younger drivers. Hosking, Young, and Regan (2006) examined the effects of text messaging on the performance of 20 young drivers between 18 and 21 years of age on a high-fidelity simulated roadway. This study had drivers negotiate several events, including a pedestrian suddenly entering the roadway, traffic lights, lane change scenarios, and cars turning right in front of the driver. Participants then completed questionnaires regarding subjective workload increases while performing this simulator session, and the results from these measures showed a significant subjective workload increase when both retrieving and sending text messages. These behaviors also resulted in increased lane deviations (i.e., swerving) and slower responses to traffic signs, which was similar to findings from Greenberg and colleagues (2003).

Dingus et al. (2006) discovered a comparable increase in time drivers spent looking away from the roadway while performing complex secondary tasks. These researchers also found that drivers tended to increase following distance from a forward vehicle when performing complex secondary tasks. Although this finding may indicate that individuals engaged in these tasks while driving realize the behavior is risky and are

compensating for that risk, it is equally plausible that they were not attending to their position relative to other vehicles. Hosking et al. (2006) also noted that drivers likely recognized the threat of increased crash risk that complex secondary tasks imposed upon their driving ability. While performing these tasks, participants noticeably slowed down and increased following distance from a forward vehicle.

Theoretical Model of Distracted Driving

The question remains as to why so many people would engage in a practice that is known to be dangerous and increasingly illegal, even if it is the norm. Walsh, White, Hyde, and Watson (2008) explored this question using the Theory of Planned Behavior (TPB; Ajzen, 1991). TPB posits that intentions, influenced by attitudes, subjective norms, and perceived behavioral control, are the main determinants of behavior. In their work, intentions to call or text were assessed across a variety of different scenarios that ranged in the level of “riskiness.” They found that TPB constructs could account for 11–14% of intentions to text message while driving. Also interesting to note is their finding that the perceived risk of apprehension by police or perceived risk of crashing did not influence the driver’s decisions to text message while driving. The current study seeks to continue the application of the TPB in the context of distracted driving by adding an examination of a particularly risky population of young drivers – those with symptoms of ADHD.

Factors Influencing Distracted and Unsafe Driving

The ability to understand and predict the occurrence of distracted driving, and all forms of dangerous driving, is essential to the improvement of traffic safety. Parents of teenagers who are seeking to get their licenses, as well as DMVs, can use such information to guide the readiness and safety of the teenager to begin driving. In addition,

insurance companies can better determine risk, and law enforcement can prevent damage and injury through a greater understanding of the factors related to distracted driving.

Demographic variables. Through multiple avenues of assessment, several demographic trends have emerged in driving safety research. Sex-related behavioral differences are consistently shown in driving research. Males have exhibited riskier driving behaviors than females on driving simulator tasks (Kass, Beede, & Vodanovich, 2010; Lenné et al., 2010) and report risky driving behavior more often (Dula & Ballard, 2003; Ellison-Potter, Bell, & Deffenbacher, 2001). Age is a more complicated factor. Younger drivers typically exhibit riskier behaviors (Dula & Ballard, 2003; Owsley et al., 2003), yet as drivers reach advanced ages, a decline in certain key cognitive abilities can lead to unsafe driving performance (Shanmugaratnam, Kass, & Arruda, 2010). Though research on demographic factors provides excellent insight into dangerous driving behaviors, many other variables influence dangerous driving.

Attitudes toward unsafe driving. Attitudes toward traffic safety are negatively correlated with unsafe driving behaviors (i.e., riskier attitudes associated with increased engagement in unsafe driving behavior), including aggressive driving, speeding, and self-reported crash involvement (Ulleberg & Rundmo, 2003). Attitudes also predict future unsafe driving (Iversen, 2004), while explaining additional variance in unsafe driving behavior when controlling for age, experience, risk perception, personality, and motivation (Jovanovic, Stanojevic, & Stanojevic, 2011; Ulleberg & Rundmo, 2003). Demographically, young males report riskier attitudes toward driving than females do (Harré, Brandt, & Dawe, 2000; Ulleberg, 2004).

To evaluate road safety programs, Ulleberg and Rundmo (2002) recommended that attitude scales be administered before and after programs designed for adolescents to determine whether their attitudes had changed. These researchers argued that campaigns aimed at influencing safety attitudes in general had been unsuccessful as they did not focus on the specific attitudes likely to influence risk-taking behavior. Research has demonstrated that *general* attitudes are poor predictors of specific behaviors (Ajzen & Fishbein, 1991), such as unsafe driving (Iversen, 2004; Iversen, Rundmo, & Klempe, 2005). In contrast, more *specific* attitudes toward risk-taking behavior in driving can predict unsafe driving behavior, such as attitudes toward rule violations, joyriding, and speeding (Iversen, 2004; Ulleberg & Rundmo, 2002). Research suggests that associations between attitudes toward traffic safety and self-reported behavior, and success modifying behaviors by addressing attitudes, are only seen when the attitudes are specific (Iversen et al., 2005).

Driver perceptions of risk. Deery and Fildes (1999) suggested that driver training programs lacked success due to the limited attention given to psychological factors, primarily citing the driver's perceived risk, that are important in crash etiology. Indeed, researchers have argued that psychological processes associated with risk judgments require further investigation, especially in relation to whether young drivers perceive less risk than older drivers do, and/or are more confident in their abilities to deal with hazards (Beyth-Marom, Austin, Fischhoff, Palmgren, & Jacobs-Quadrel, 1993; Hatfield & Fernandes, 2009; Price, 2001; Williamson, 2003).

Research has demonstrated that perceived risk, including the subjective probability of MVC involvement and the anticipated severity of consequences associated

with unsafe driving behaviors (Lund & Rundmo, 2009; Sjoberg, Moen, & Rundmo, 2004) are related to self-reported engagement in unsafe driving (Hatfield & Fernandes, 2009). Further, the finding that low perception of risks correlates with a high level of unsafe driving behavior (Ivers et al., 2009; Ulleberg & Rundmo, 2003) has led researchers to argue that influencing risk perception may result in behavior change (Rundmo, 1999; Sjoberg et al., 2004).

There also are consistent findings for gender differences on perceptions of crash risk. Compared with young females, young males reported less perceived risk associated with driving unsafely and perceived objectively risky situations as having a lesser effect on safety (Ginsburg et al., 2008; Ivers et al., 2009). Young males also reported a lower perception of risk in hazardous traffic situations, more driving skill, and a greater ability to deal with traffic hazards relative to young females (Farrow & Brissing, 1990; Farrand & McKenna, 2001).

Self-perceptions of competence. The study of self-perceptions and driving behavior is critical to understanding dangerous and distracted driving, given that overestimations of competence have been linked in previous research in the general population to lower utilization of safety precautions such as wearing a seatbelt (DeJoy, 1989; Harré, Foster, & O'Neill, 2005; Svenson, Fischhoff, & MacGregor, 1985). As younger drivers become confident in their driving abilities, they tend to overestimate their ability to multitask while driving (Sarkar & Andreas, 2004). Indeed, overestimation of driving skills positively correlates with involvement in risky driving, road crashes and traffic violations, which highlights a key intervention target behavior (Sumer, Ozkan, & Lajunen, 2006).

Some research has questioned the assumption that young drivers are overconfident. By comparing each driver's self-rating to their instructor's ratings, up to 50% of novice drivers were found to accurately assess their skills, while 30–40% overestimate and 10–20% underestimate their abilities (Mynttinen et al., 2009a, 2009b; Sundström, 2011). In addition, drivers who receive more professional instruction, and those trained in self-assessment, tended to have more accurate self-perceptions of driving performance (Mynttinen et al., 2009a, 2009b). There also is some research suggesting that only very inexperienced learner drivers significantly overestimate their driving skills; beyond this initial stage, self-ratings increase proportionately to actual skill level (Boccaro, Delhomme, Vidal-Gomel, & Rogalski, 2011). One interpretation of these findings is that drivers can be trained to self-assess accurately their skills via experience, which could lead to safer driving. However, no existing studies have directly linked accurate self-assessment of driving skills with crash involvement or safe driving behavior.

To summarize, the Theory of Planned Behavior provides a beneficial base from which to investigate psychological determinants of TWD among young drivers toward an end goal of better conceptualizing the influence of ADHD symptoms on the occurrence of distracted driving. In fact, although there have been investigations of the TPB as it pertains to risky driving and distracted driving, there have been no studies to date examining how ADHD symptoms relate to key psychological factors in the framework of the TPB. The psychological factors of interest to this project include attitudes toward TWD, perception of crash risk when TWD, self-perceptions of competence as a driver, and perceived task performance on a distracted driving task.

Current Study

Approaches to reducing MVC rates have included stricter traffic regulation, increased and improved education, and improving vehicle and road safety (Lund & Rundmo, 2009). Despite evidence of some success (Elder et al., 2004), death, injury and crash rates remain higher for younger drivers than for all other age groups (Mayhew, Simpson, & Pak, 2003; Shope, 2006). Intervention programs designed to modify driver behavior often fail to acknowledge the *antecedents* of specific unsafe driving behaviors (Schwebel, Severson, Ball, & Rizzo, 2006; Sheehan, Siskind, & Schonfeld, 2004). Lund and Rundmo (2009), however, hypothesized that appropriately executed psychological road safety interventions could reduce MVCs. However, developing interventions to reduce young drivers' over-representation in MVCs has proven exceedingly complex (Sheehan et al., 2004), with driver education and training motivating much continuing research and evaluation (Mayhew & Simpson, 1995).

Evaluations are vital in enhancing the benefits of interventions by investigating their impacts on traffic safety, identifying areas requiring focus, and encouraging resources to convert research into practice (Iversen et al., 2005). However, the gap between road safety research and practical interventions persists and impedes progress in preventing traffic-related injuries (Sleet & Baldwin, 2010). Reviewing nearly 1,500 traffic psychology publications for the years 1998–2008, Glendon (2011) found that fewer than 2% could be classified as either intervention or evaluation studies. The current study aims to increase knowledge in this aspect of the field by examining the effectiveness of a community-run experiential driver training program that focuses on text messaging while driving.

Limited evaluation research has determined that, while offering the promise of reduced deaths and serious injuries from young drivers' MVCs, the efficacy of road safety campaigns has generally been low (Phillips, Ulleberg, & Vaa, 2011; Senserrick, 2007; Strecher et al., 2006; Vaa et al., 2004), including traditional and school-based driver education programs (Mayhew, 2007; Senserrick et al., 2009). Rather than measuring rates of death or serious injury, the field may benefit from evaluating these campaigns by targeting and measuring important predictors of safe and unsafe driving behaviors, in the expectation that these potentially translate into corresponding driving behaviors (Ulleberg & Rundmo, 2003). Two such predictors are attitudes and perceived risk, which have been shown to predict reliably unsafe driving behavior and crash involvement (Hatfield & Fernandes, 2009; Kraus, 1995; Iversen et al., 2005). Rowe and colleagues found that pre-driver attitudes became riskier as driver training and experience increased, opening the possibility, and need for further investigation, that interventions seeking to influence pre-driver attitudes may be producing an adverse effect (Rowe, Maughan, Gregory, & Eley, 2013).

To address this gap, the current study adds to the literature by exploring the extent to which novice driver attitudes and perceptions might be influenced by a training intervention, and how these psychological predictors may influence behavioral intentions. In addition, this study explores the influence of ADHD symptoms given a strong evidence base indicating a higher level of risk for injury and death while driving for individuals diagnosed with this neurodevelopmental disorder.

Aims and Hypotheses

The current project was designed in the context of this critical need to evaluate and review community-based approaches to challenging youths' engagement in distracted driving. Towards this goal, the antecedent psychological and cognitive factors that underlie teenage drivers' decisions to text while driving were examined, with a focus on the impact of ADHD symptoms. This study occurred in the context of the Turn Off Texting (TOT) program, which is an experiential anti-texting-while-driving training program designed and run by the Youth Safety Council of Vermont (YSCVT) and the Vermont Department of Motor Vehicles, Safety and Education Unit (see Procedure section for a description of this program). This project had three Aims, each associated with specific hypotheses that were tested.

Aim 1 was to provide data on the association of ADHD symptoms with psychological factors proposed to underlie the decision to engage in distracted driving, while also controlling for and examining the influence of driver age, gender, and behind-the-wheel experience. The key psychological factors that were examined are attitudes toward TWD, perceptions of crash risk when TWD, self-perceptions of competence as a driver, and perceptions of performance on a distracted driving task. Hypothesis 1: It was hypothesized that an increasing number of ADHD symptoms would be associated with less safe attitudes, lower perceptions of crash risk, greater self-perceptions of competence, and greater perceptions of task performance.

Aim 2 was to determine if the four psychological factors explain the association between ADHD symptoms and behavioral intentions accounting for the effects of age, gender, and driving experience. A large evidence base demonstrates that drivers

diagnosed with ADHD or with elevated symptoms of ADHD, particularly of younger age, are vulnerable to adverse outcomes while driving (i.e., road departures, crashes, injury, and death). However, not all young drivers with ADHD symptoms engage in risky or distracted driving. Hence, it is important to understand mechanisms that may link ADHD symptoms to risky driving intentions as this may help in efforts to target driver training programs or specialized interventions. Considering this need, Aim 2 is intended to assess whether ADHD symptoms have a direct effect on risky driving intentions or, rather, if the effects of ADHD symptoms are indirect and influence risky driving intentions through the proposed psychological factors informed by theory. Hypothesis 2: It was hypothesized that the total indirect effect of the psychological factors would mediate the relations between ADHD symptoms and 1) intentions to TWD in the future and 2) intentions to intervene on a distracted driver in the future. More specifically, it was predicted that the direct effect of ADHD symptoms on behavioral intentions would be significant, but this association would no longer be significant when accounting for the combined effects of the psychological factors. This hypothesis implies that ADHD symptoms relate to behavioral intentions indirectly via the effects of attitudes toward TWD, perceptions of crash risk when TWD, self-perceptions of competence as a driver, and perceptions of performance on a distracted driving task. This prediction is supported by theoretical and empirical evidence from social cognition models acknowledging that stable traits, ADHD in the context of this study (Hechtman et al., 2016; Swanson, et al., under review), affect behavior indirectly through their influence on determinants of behavior (Theory of Planned Behavior: Ajzen, 1988; Health Belief Model: Rosenstock, 1974). In addition, previous work documents that the effects of personality traits (i.e.,

aggression, altruism, anxiety, and normlessness) on risky driving behaviors were generally mediated through attitudes (Ulleberg & Rundmo, 2014).

Aim 3 was to examine the influence of ADHD symptoms on the impact of the community-run intervention program in changing young drivers' attitudes, risk perceptions, self-perceptions of competence, perceptions of task performance, and intentions to TWD and intervene on a distracted driver in the future. Towards this aim, the influence of ADHD symptoms, age, gender, and driving experience on the change-over-time from pre- to post-program on the psychological factors and behavioral intention variables were examined. Hypothesis 3: It was predicted that increasing ADHD symptoms would be associated with significantly less change or movement toward safe attitudes, perceptions, and intentions over the course of the training program.

Method

Participants

The study sample was drawn from data collected as part of the Turn Off Texting program from demonstrations run between April 2015 through November 2015.

Recruitment. There are 13 counties in Vermont and 89 high schools including both public and private institutions. The latest available public data from the Vermont Agency of Education indicate that in the 2011-2012 academic year, there were 6,954 9th grade students, 6,883 10th grade students, 6,983 11th grade students and 6,951 12th grade students (total of 27,221 9th – 12th grade students). Recruitment for this season of TOT and for the current study was completed by the head of the Youth Safety Council of Vermont, for which word-of-mouth and email LISTSERVs were the primary sources of outreach and recruitment at the school level. As this was not the first season of the TOT

program demonstrations, previous schools that had participated or showed interest in setting up a TOT program for their students were among those contacted. Participants were not excluded based on driving experience or licensing status.

Sample demographics. Participants were 1203 high school students from 42 different TOT demonstrations around the state of Vermont. Participant age ranged from 14 years to 20 years, with a mean age of 15.78 years. Of the total sample, 0.2% ($n = 2$) were 14-years-old, 41.4% ($n = 498$) were 15-years-old, 42.1% ($n = 507$) were 16-years-old, 13.4% ($n = 161$) were 17-years-old, 2.4% ($n = 29$) were 18-years-old, 0.2% ($n = 3$) were 19-years-old, and 0.2% ($n = 3$) were 20-years-old. Regarding participant gender, 43.7% ($n = 526$) identified as female, 55.9% ($n = 673$) identified as male, 0.2% ($n = 3$) identified as non-binary, and 0.2% ($n = 3$) declined to answer. There was a wide range of driving experience among this sample, operationalized in this study as the average number of miles driven per week, and the grand mean of average numbers of miles driven per week was 164.02 ($SD = 155.72$; $N = 1203$). Self-reported endorsement of the 18 symptoms of ADHD was obtained for each participant. The frequency of total ADHD symptom count is presented graphically in Figure 1. The mean and median number of inattentive symptoms was 1.89 and 1.00, hyperactive-impulsive symptoms was 2.44 and 2.00, and total ADHD symptoms was 4.33 and 3.00.

Procedure

The Turn Off Texting (TOT) program, designed and run by the Youth Safety Council of Vermont (YSCVT) and the Vermont Department of Motor Vehicles, Safety and Education Unit, is a course of instruction designed to educate young drivers on the dangers of using handheld communication devices while driving, particularly reading and

sending text messages. This training program was designed to engage the young driver in the component activities and demonstrations fully and actively. This program included a brief presentation on possible consequences of a driver's risky choices, including fatalities, crashes, fines, and penalties; however, at the core of the TOT program is an experiential demonstration activity. In this demonstration, the young driver navigates a pre-determined course using an electric golf cart two times, the first time without a distraction task and the second time while composing and sending a text message. The course is demarcated by cones to represent the driving lane, and each cone that is struck symbolizes a potential collision with a pedestrian, bicyclist or motor vehicle. Given that an average travel lane width on an actual highway is 12 feet and the maximum width of most motor vehicles is 8 feet, the lanes on the TOT course were 6 feet wide to account for the 4-foot width of an electric golf cart; this structure ensured that the course is to scale with actual highway driving conditions. Within the TOT program's experiential demonstration, the young driver may learn to resist reading, composing, or sending a text message while driving in the real world by first experiencing the marked decrease in performance and safety resulting from driving while distracted in a controlled and safe environment. Further, the group format of this program allows the young driver to learn both directly and vicariously the extent to which he/she, along with his/her peers, were at an increased risk of harming themselves and others while engaged in a secondary activity while driving. Texting while driving is an ideal target behavior for an experiential driver training program given its prevalence among all road users, particularly younger drivers, and its marked contribution to MVCs among youth.

The intervention program was not based on any theoretical literature but on the intuitions of organizational staff that designed and delivered the training. Our research team was completely independent of the training program, not being involved in its design or delivery, but was invited by the organization to modify and improve the survey measures, provide design and methodology recommendations, and undertake the data analyses described in this paper. Independently of the evaluation study, the training organization, YSCVT, gained permission from each school's principal to invite the students to participate in the training program. The use of unidentified data provided by YSCVT was approved by the University of Vermont's Institutional Review Board-Committee on Human Research in the Behavioral and Social Sciences and the required ethical guidelines were followed throughout.

Data collection. During the TOT program trainings, data primarily were collected at two measurement points. Pre-program data collection occurred once the participants entered the TOT program, and post-demonstration data collection occurred after the participants concluded the program's components and their second behind-the-wheel distracted driving activity. During each of the two drives, TOT staff counted the number of cones struck and recorded the participant's total drive time. TOT staff members were instructed to check the survey measures once the participants completed all questions to limit the amount of missing data.

Measures

Demographics. Demographic data were obtained from two items included in the pre-program survey instrument designed by the research team for collecting information regarding participants' age and gender (female; male; "non-binary"; "don't want to say").

Preliminary feasibility analyses revealed highly unequal cell sizes for two of the gender response options: “non-binary” ($n = 3$) and “don’t want to say” ($n = 3$). Therefore, data from these six participants were omitted from all primary analyses.

Driving experience. For the purposes of the current study, driving experience was operationalized as the self-reported average miles driven per week. Although data were also gathered regarding licensing status, preliminary feasibility analyses revealed highly unequal cell sizes with 91% of participants holding a Learner Permit (LP). The state of Vermont has a Graduated Driver License law (Vermont Department of Motor Vehicles, 2016), and a Learner Permit may be obtained from age 15 years and requires the driver be accompanied by a licensed adult.

Actual task performance. Participants’ actual task performance was assessed via two variables: *time* and *hits*. Time was operationalized as the time it takes a participant to navigate the entire driving course from the starting point to the finishing point. The TOT driving course was outlined by cones, and each cone struck represented a driving violation (e.g., lane deviation) or a collision with a foreign object (e.g., road barriers, other vehicles, bicycles, etc.). Hits were operationalized as the total number of cones struck by the participant driver.

Psychological factors. Each of the key antecedent factors was assessed via responses on the pre- and post-program survey measures.

Attitudes. Participants’ attitudes toward texting while driving were assessed with a single item. This item read, “Do you think that texting or emailing while driving is acceptable?” Response options for this item were presented on a five-point Likert scale and ranged from (1) *Unacceptable* to (5) *Acceptable*.

Perceived crash risk. Participants' perceptions of the risk of collision associated with texting while driving were assessed with one item. This item read, "How likely is someone to be in a crash if they are texting or emailing while driving?" Response options for this item were presented on a five-point Likert scale and ranged from (1) *Definitely unlikely* to (5) *Likely*.

Self-perceived competence as a driver. Participants' self-perceptions of their own competence as a driver were assessed with a single item that read, "Compared to others your age, how competent are you as a driver?" The response options were presented on a five-point Likert scale that ranged from (1) *Less competent than others* to (5) *more competent than others*.

Perceived task performance. Participants' perceptions of their performance on the driving task during which they were directed to send a text message was assessed with one item that read, "How well do you think you did on this drive compared to other participants your same age?" Response options were presented on a five-point Likert scale that ranged from (1) *Worse than others my age* to (5) *Better than others my age*.

Behavioral intentions. Participants' intentions to text while driving were assessed using two items based on those specified by Ajzen (1991). The first item read, "Will you text or email while driving in the future?" The second item read, "If you are a passenger in a vehicle driven by someone texting or emailing, do you (or would you) ask them to stop?" Response options for these two items were on a five-point Likert scale and ranged from (1) *Definitely would not* to (5) *Definitely would*. These items were treated as distinct as they assess different aspects of the young driver's intentions.

Symptoms of ADHD. ADHD symptomatology was assessed using the *Swanson, Nolan, and Pelham Rating Scale—IV (SNAP–IV)*. The MTA version of the SNAP-IV (Swanson et al., 2001) was used to obtain ratings from the young drivers on the 18 symptoms of ADHD, 9 for inattentive and 9 for hyperactive/impulsive. Items in the SNAP-IV were rated on a 4-point scale from (0) *not at all* to (3) *very much*, and any item rated a “2” or a “3” on this measure counted as a symptom endorsement. The two ADHD symptom dimensions were correlated at $r = 0.62$ ($p < .001$), providing justification to combine them into a total ADHD symptom count. Notably, this variable does not imply diagnostic status of these youth given that impairment and age of onset were not assessed.

Data Analytic Strategies

Preliminary analyses. Preliminary analyses were conducted to obtain descriptive statistics and frequencies on all the study variables. Intercorrelations among the study variables were examined to assess the associations between ADHD symptoms, demographic variables, psychological factors, behavioral intention variables, and performance variables from the program. Analyses also were conducted on the performance measures to assess for the influence of ADHD symptoms, age, gender, and driving experience on TOT course time and number of hits; pre- to post-program difference scores on these performance variables also were examined. All data were screened for patterns of missing data to inform estimation procedures, and the normative distribution of each variable was examined.

Primary analyses. All primary analyses were completed using *Mplus* version 7.1 (Muthén & Muthén, 2013). For all primary analyses, bootstrapping occurred with 10,000

replications to (1) deal with an expected non-normal distribution and (2) estimate bootstrapped confidence intervals with which to assess statistical significance (Howell, 2009; Preacher & Hayes, 2008). Null hypothesis testing was used as an indicator of statistical significance, but there was also an equal influence of the bootstrapped confidence intervals on interpretations of the results, given cited limitations of strict null hypothesis testing (e.g., Abelson, 1995; Howell, 2010; Levine, Weber, Hullett, Park, & Lindsey, 2008; Nickerson, 2000).

Aim 1: Differences in psychological factors and intentions as a function of ADHD. The first aim of this study was to examine the relation of ADHD symptomatology with the proposed psychological factors of attitudes toward TWD, perceptions of crash risk while TWD, self-perceptions of competence as a driver, and perceptions of task performance while accounting for and examining the influence of age, gender, and driving experience. Intentions to TWD in the future and intervene on a distracted driver in the future also were included as outcomes. Towards this aim, multiple regression models were conducted wherein the psychological factors and behavioral intention variables were regressed on ADHD symptoms, age, gender, and experience. Parameter estimates were taken from path *a* (see Figure 2) from the multiple mediation models that were run for Aim 2, described below. Path *a* in these models represents the psychological factors regressed on ADHD, as well as age, gender, and experience in the context of a Multiple Indicators Multiples Causes (MIMIC; Muthén, 1989) model. Two additional regression models were run to examine the associations of ADHD symptoms, age, gender, and experience with the two behavioral intention variables: intention to TWD in the future and intention to tell a distracted driver to stop TWD. Unstandardized

and fully standardized path coefficients for all variables were evaluated for valence, magnitude, and statistical significance, and the bias-corrected bootstrapped 95% confidence intervals (95% CI) for all model estimates were examined for significance (i.e., inclusion of zero).

Aim 2: Examining the association of ADHD and behavioral intentions via psychological factors. The second set of analyses assessed if the psychological factors explain the association between ADHD symptoms and behavioral intentions to engage in distracting secondary tasks when driving on the road; all measurements for these analyses were taken from pre-program responses. For this aim, two multiple mediation models were examined, one for each of the behavioral intention variables. The direction of these models is based on past theoretical and empirical work; however, it is important to point out a limitation of this cross-sectional mediation model in terms of inferring directionality. Given that the psychological mechanisms (attitudes, perceptions of crash risk, perceptions of driving competence, perceptions of task performance) were moderately correlated (see Table 2), they were simultaneously entered in these multiple mediation models to examine their unique associations with risky behavioral intentions (see Figure 2 for the hypothesized model). For these models, the psychological factors were regressed on ADHD symptoms (path *a*), risky behavioral intention was regressed on the psychological factors (path *b*), risky behavioral intention was regressed on ADHD symptoms (path *c*), and risky behavioral intention was regressed on ADHD symptoms while accounting for the influence of the psychological factors (path *c'*). Given a large evidence base supporting the influence of age, gender, and driving experience on risky driving behaviors and attitudes, the effects of these variables were controlled in these

multiple mediation models using MIMIC modeling (Muthén, 1989). A MIMIC model allows the influence of the covariates on all other study variables to be estimated; in other words, age, gender, and experience were treated as covariates.

Preacher and Hayes (2008) suggest that multiple mediation models involve two components. The first is an analysis of the total indirect effects (i.e., aggregate of all the mediators being examined). The second is an analysis of the specific indirect effects—the influence of a specific mediator. The significance of these indirect effects was tested using bootstrap analyses, which is recommended and commonly used in multiple mediator analyses given the greater statistical power allotted without assuming multivariate normality in the sampling distribution (Mallinckrodt, Abraham, Wei, & Russell, 2006; Preacher & Hayes, 2008; Williams & MacKinnon, 2008). Thus, parameter estimates and confidence intervals of the total and specific indirect effects were generated based on 10,000 random samples. For these models, mediation is demonstrated via a statistically significant indirect effect, which is demonstrated if the 95% bias-corrected confidence interval for the parameter estimate does not contain zero. To compare the magnitude of the indirect effects, all variables were standardized as suggested by MacKinnon (2000).

Aim 3: Evaluating the impact of the intervention program. The final set of analyses determined if the intervention program was successful in changing the young drivers' attitudes, risk perceptions, self-perceptions of driving competence, perceptions of task performance, and behavioral intentions. Towards this aim, two-level regression models were employed to analyze change in the psychological factors and behavioral intention variables from the pre-program to the post-program assessment points,

examining the influence of ADHD symptoms, age, gender, and driving experience on the rate of change on the outcomes (see Figure 3 for the hypothesized model). Each of the psychological factors and behavioral intention variables was assessed in a separate model and was included in the definition of the random slope variable. Bootstrapped confidence intervals were not computed for these models given the nature of how *Mplus* estimates random effects. To obtain interpretable parameter estimates for these models, ADHD symptom count, age, and driving experience were mean-centered for the unstandardized coefficients. Standardized coefficients also were computed and reported for each of the continuous predictors.

Conceptualized as a type of multilevel model, the random slope and random intercept were level 1 variables, with the random slope defined in the model syntax as the specific psychological factor or intention variable regressed on time (pre-program = 0, post-program = 1). ADHD symptoms, age, gender, and driving experience were level 2 variables, which remain constant between measurement points but vary from participant to participant; as such, they were conceptualized in these models as between-subject variables. Each of these models regressed the random slope and random intercept on ADHD symptoms, age, gender, and driving experience. In the context of this Aim, the primary analysis assessed whether ADHD symptoms, age, gender, and driving experience had a cross-level influence on the linear change from pre- to post-program on the psychological factors and behavioral intention variables (the random slope components of each model). In these models, a meaningful cross-level influence was reflected statistically as a significant *interaction* of time with the level 2 variable in relation to the outcome variable (i.e., psychological factor or behavioral intention).

Simple slope tests of the significant cross-level interactions were completed following instruction from Preacher, Curran, and Bauer (2006) to estimate simple slopes at different levels of the level 2 variables (e.g., low (-1SD), mean, and high (+1SD) levels of the continuous variables). All estimates for the simple slope analyses were taken from the fully standardized two-level regression models in *Mplus*, including variance and covariance estimates from the asymptotic covariance matrix. An online calculator developed and provided by Preacher and colleagues was used to compute significance tests of the simple slopes, as well as to graph the simple slope results. All significant interactions were probed in the models for which there was a significant cross-level influence of ADHD symptoms (i.e., significant interaction of *time* and *ADHD*).

Model estimation issues were addressed based on the underlying reason for misfit and/or by modifying the model syntax based on localized area(s) of misfit. Model comparisons, when necessary, were completed using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) model fit indices. Based on recommendations from Kass and Raftery (1995), smaller AIC and BIC values indicate a better fitting model with the following convention: difference between 0 – 6 indicates "positive" evidence, between 6 – 10 indicates "strong" evidence, and greater than 10 indicates "decisive" evidence (p. 789).

Results

Preliminary Analyses

Descriptive statistics for all study variables are presented in Table 1, and correlations among these variables are presented in Table 2. ADHD symptoms were significantly associated with gender ($r = .08, p = .02$), yet not significantly associated

with either age or driving experience, such that males typically reported a higher number of ADHD symptoms than females. In addition, the significant associations among ADHD symptoms and attitudes ($r = 0.11, p < .001$), risk perceptions ($r = -0.07, p = .03$), and both behavioral intention variables (text in future: $r = 0.16, p < .001$; tell driver to stop: $r = -0.13, p < .001$) satisfy the requirements to test for mediation in Aim 2; in other words, mediation may be examined given that there is a relationship between the independent variable (ADHD symptoms) and the behavioral intention outcomes. The associations between ADHD symptoms and self-perception of driving competence and perception of task performance were not significant.

The relations between ADHD symptoms, age, gender, and driving experience and the performance measures from the TOT program (i.e., time to completion and number of cone hits) were examined to provide a context in which to discuss the psychological factors and behavioral intention variables. Regarding Drive 1 (no distraction) time, a higher number of ADHD symptoms ($r = -.13$) and a higher number of miles driven per week ($r = -.16$) were significantly associated with less time navigating the course; also, male participants took significantly less time to drive the course without distraction than female participants (Cohen's $d = 0.47$). For Drive 1 hits, a higher number of miles driven per week ($r = -.13$) was associated with significantly fewer cones hit; male participants also hit significantly fewer cones on this drive than did female participants (Cohen's $d = 0.25$).

Drive 2 (with texting task) time, followed a similar pattern to Drive 1 time. A higher number of ADHD symptoms ($r = -.16$) and a higher number of miles driven per week ($r = -.20$) were significantly associated with less time navigating the course, and

male participants again took significantly less time to drive the course with distraction than female participants (Cohen's $d = 0.38$). Similarly, for Drive 2 hits, a higher number of ADHD symptoms ($r = -.07$) and a higher number of miles driven per week ($r = -.19$) were significantly associated with fewer cones hit; male participants again hit significantly fewer cones on the distracted drive than did female participants (Cohen's $d = 0.25$). As it was also of interest to examine the influence of ADHD symptoms, age, gender, and driving experience on performance change between drives, additional analyses were completed using change scores (Drive 2 – Drive 1) of both time to completion and number of hits. These analyses revealed that a higher number of ADHD symptoms ($r = -.08$), increasing age ($r = -.07$), and a higher number of miles driven per week ($r = -.09$) were associated with less change in Drive 1 to Drive 2 time. In regards to number of cone hits, only driving experience was significant such that a higher number of miles driven per week was associated with lesser change in hits from Drive 1 to Drive 2 ($r = -.14$).

The pattern of missing data was examined using two methods: Little's MCAR (Missing Completely at Random) Test and dummy coding analyses to assess differences based on predominant patterns of missing data. Little's MCAR Test examines the hypothesis that the data are missing completely at random, and this test was conducted using SPSS Version 23.0 (IBM Corp., 2014). Little's Test was significant at $p < .001$ ($\chi^2(121) = 225.00$), which suggested that these data were not missing completely at random. Follow-up analyses then were completed with the predominant pattern of missing data to analyze differences between those with and without this pattern of missing data. Data were missing most often on all post-program ratings ($n = 139$) or all post-program ratings

and ADHD symptom ratings ($n = 147$), with those missing ADHD symptoms subsuming those with missing post-program ratings. As such, the missing data pattern of interest included the 147 participants missing post-program ratings and ADHD symptoms. Dummy coded (missing = 0; non-missing = 1) independent samples t tests revealed that those with missing data were a higher portion male (67% male vs. 55% female; $t(1201) = 2.70, p = .007$) and rated their perceived risk of crashing while TWD as slightly lower (4.13 vs. 4.40; $t(1201) = -3.27, p = .007$). Of note, these questions were the last part of the post-program survey, and, based on feedback from the program's staff, were often omitted simply based on time limitations. Based on this information, these data were assumed to be missing at random, and so it was decided to estimate these missing data values in *Mplus* for all primary analyses, as opposed to listwise deletion.

The univariate normality of the ADHD symptom count variable, the psychological factors, and the behavioral intention variables were examined using SPSS Version 23.0. According to West, Finch, and Curran (1995), concern is indicated if skewness values exceed two and if kurtosis values exceed seven. Based on these recommendations, an asymmetrical distribution with positive skew emerged for both pre-program attitudes, skewness of 2.31 ($SE = .07$) and post-program attitudes, skewness of 3.68 ($SE = .08$). Kurtosis was not a concern for any of the study variables. As most of these data were normally distributed per skewness and kurtosis, with only pre- and post-program attitudes showing mildly positive skew, it was decided to use the maximum likelihood (ML) missing data estimation in *Mplus* given that this method assumes that the data is *at least* missing at random (MAR). Although maximum likelihood estimation with robust standard errors (MLR) might be preferred given these two violations of univariate

normality, ML in *Mplus* allows for bootstrapping, whereas MLR does not, which is the recommended approach by Preacher and Hayes (2008) when using multiple mediation models.

A power analysis conducted using G*Power version 3.1.3 for a multiple linear regression model with random effects and four predictors (i.e., ADHD symptom count, age, gender, and driving experience) indicated a total sample size of $N = 903$ for an actual power of .95 with the nominal alpha level of 0.05. Intercorrelations (see Table 2) were used to inform these power analyses, which determined an estimated squared multiple correlation value (ρ^2) of .02. Given the total number of participants included in these analyses, there was sufficient statistical power to conduct these analyses and uncover statistically significant associations.

Aim 1: Multiple Regression Models

Multiple regression analyses were used to test if ADHD symptom count, age, gender, and driving experience were significantly associated with the psychological factors and behavioral intention variables. The results from these models are presented in Table 3 for the psychological factors and Table 4 for the behavioral intention outcomes, and they are described below.

The regression model, taken from path *a* of the multiple mediation models run for Aim 2, with driver attitudes toward TWD regressed on ADHD symptoms, age, gender, and experience explained 2.7% of the variance ($R^2 = 0.03$, 95% CI [0.01, 0.05]). ADHD symptoms and gender had significant positive regression weights, indicating that higher number of ADHD symptoms and male gender were associated with higher levels of

reported acceptability of TWD, after controlling for the other variables in the model. Age and driving experience did not contribute to this multiple regression model.

The regression model with perceived risk of crashing while TWD regressed on the four independent variables explained 1.6% of the variance ($R^2 = 0.02$, 95% CI [0.00, 0.03]). However, ADHD symptom count, age, gender, and driving experience were not significantly associated with the participants' ratings of how likely they are to crash while TWD.

The regression model with perceived self-competence as a driver regressed on the independent variables explained 8.4% of the variance ($R^2 = 0.08$, 95% CI [0.06, 0.12]). Gender and driving experience had significant positive regression weights, whereas age had a significant negative regression weight; ADHD symptoms did not contribute to this model. Thus, lower age, male gender, and more experience were associated with higher levels of perceived competence as a driver, after controlling for all other variables in the model.

Finally, the regression model with perceived self-competence in the TWD task regressed on the independent variables explained 8.0% of the variance ($R^2 = 0.08$, 95% CI [0.05, 0.11]). Like the previous model, gender and driving experience had significant positive regression weights, and age had a significant negative regression weight; ADHD symptoms did not contribute to this model. Lower age, male gender, and more experience were associated with higher levels of perceived performance on the distracted driving task, after controlling for all other variables in the model.

The additional multiple regression model with intention to TWD in the future regressed on ADHD symptoms, age, gender, and experience explained 5.7% of the

variance ($R^2 = 0.06$, 95% CI [0.03, 0.08]). ADHD symptoms, gender, and driving experience each had significant positive regression weights, indicating that higher number of ADHD symptoms, male gender, and more driving experience were associated with higher levels of reported intention to engage in distracted driving in the future. Age did not contribute significantly to this model.

Lastly, the regression model with intention to intervene on a distracted driver regressed on the independent variables explained 2.7% of the variance ($R^2 = 0.03$, 95% CI [0.01, 0.05]). Only ADHD symptoms and gender had significant negative regression weights, indicating that a higher number of ADHD symptoms and male gender were associated with lower levels of reported intention to tell a distracted driver to stop TWD. Age and driving experience did not contribute significantly to this model.

Aim 2: Multiple Mediation Models

Intention to TWD in the future. The first multiple mediation model examined the direct and indirect—through the psychological factors—effects of ADHD symptoms on the reported intention to TWD in the future (see Figure 4 for standardized parameter estimates; $R^2 = 0.25$, $p < .001$). The *a* paths, reported previously and presented in Table 3, show that ADHD symptoms were significantly positively associated with driver attitudes only and none of the other psychological factors. In regards to the *b* paths, attitudes had a significant positive association, risk perception had a significant negative association, and perception of task performance had a significant positive association with intention to TWD in the future. These path coefficients suggest that higher ratings of acceptability were associated with an increased likelihood of TWD in the future, higher ratings of the likelihood of crashing while TWD were associated with a decreased likelihood of TWD

in the future, and higher ratings of perceived performance on the distracted driving task were associated with an increased likelihood of TWD in the future. Self-perceptions of competence as a driver did not influence this intention variable significantly. Driver age and gender were not significantly associated with intention to text (95% CI's include zero), but driving experience was significantly associated with this behavioral intention outcome ($\beta = 0.12, p = .001$).

The total effect of ADHD symptoms, without the psychological factors included in the model, on intention to text was significant, $c = 0.15, p < .001$. Even after accounting for the indirect effects of the psychological factors, the direct effect of ADHD symptoms on intention to text continued to be significant, $c' = 0.10, p < .001$. Both the total and direct effects of ADHD symptoms suggest that a higher number of symptoms were associated with an increased intention to TWD in the future. Though widely accepted statistical methodology (i.e., Baron & Kenny, 1986) may interpret these results as indicating no mediation for this model, more contemporary statistical research (e.g., MacKinnon, 2000; Preacher & Hayes, 2008) emphasizes inspecting the indirect effects separately as the total effect is not necessary for mediation to occur. Thus, standardized parameter estimates for the total and specific indirect effects for the association between ADHD symptoms and intention to text as mediated by the psychological factors are provided in Table 5.

The total indirect effect and the specific indirect effect of driver attitudes toward TWD were significant as evidenced by the bootstrapped confidence intervals that did not contain zero; the specific indirect effects of perceived crash risk, perceived driving competence, and perceived task performance were not significant. Overall, these results

provide evidence for both a direct association of ADHD symptoms with intention to TWD in the future, and an indirect effect of ADHD via attitudes toward TWD.

Intention to Intervene on TWD driver. The second multiple mediation model examined the direct and indirect effects of ADHD symptoms on the reported intention to intervene and tell a distracted driver to stop TWD (see Figure 5 for standardized parameter estimates; $R^2 = 0.15, p < .001$). The b paths in this model showed that attitudes had a significant negative association, risk perception had a significant positive association, and perceived driving competence had a significant positive association with intention to intervene in the future. These path coefficients suggest that higher ratings of acceptability were associated with a decreased likelihood of intervening in the future, and higher ratings of perceived crash risk and higher ratings of perceived competence as a driver were associated with an increased likelihood of TWD in the future. Perceptions of task performance did not influence this intention variable significantly. Driver age, gender, and driving experience were not significantly associated with intention to intervene (95% CI's included zero).

The total effect of ADHD symptoms, without the psychological factors included in the model, on intention to text was significant, $c = -0.13, p < .001$. When the indirect effects of the psychological factors were included in this model, the direct effect of ADHD symptoms on intention to intervene continued to be significant, $c' = -0.08, p = .003$. Both the total and direct effects of ADHD symptoms suggest that a higher number of symptoms was associated with a decreased intention of intervening and telling a distracted driver to stop TWD. Like the previous multiple mediation model, the indirect

effects of the mediators were assessed separately to inform mediation conclusions (standardized parameter estimates provided in Table 6).

The total indirect effect and the specific indirect effect of driver attitudes were significant as evidenced by the bootstrapped confidence intervals; the specific indirect effects of risk perception, perceived driving competence, and perceived task performance were not significant in this model. Similar to the findings from the previous model, these results suggest a direct association of ADHD symptoms, as well as indirect via attitudes toward TWD, with intention to intervene on a distracted driver in the future.

Aim 3: Two-Level Analysis of Program Effects

Model modifications. These models were originally intended to include a random intercept component, which would allow the participants to have their own intercept or starting point (i.e., pre-program rating). However, each of these models failed to converge due to the random effects structure of the models. Therefore, as recommended by Barr, Levy, Scheepers, and Tily (2013), the random intercept components were dropped. This decision was further supported by AIC and BIC model comparison indices, which were lower for each of the models in which the random intercepts were omitted (see Table 7 for the psychological factors and Table 8 for behavioral intentions), as well as non-significant model estimates for all random intercept values across models. Importantly, it is also conceptually justified to omit the random intercepts from these models given that there is no clustering, as is often the case in random effects models; rather, these models are primarily concerned with the random slope component to model rate of change over time by participant.

Attitudes toward TWD. The two-level regression model including driver attitudes toward TWD is detailed in Table 7. Regarding the within-level fixed effects in this model (level 1), the mean for driver attitude was significant, which corresponds to the predicted mean rating for an average-aged (for this sample, $m_{age} = 15.77$) female with an average number of ADHD symptoms ($m_{symptoms} = 4.33$) and an average number of miles driven per week ($m_{miles} = 164.01$) in this sample. In the reporting of these next models, this will be referred to as the “reference participant.” The intercept of the slope was not significant, which is the average regression slope of driver attitude over time for the reference participant.

There were significant cross-level interactions of time with ADHD symptoms, gender, and driving experience. The significant interaction of time and ADHD symptoms was positive ($\beta = .15$), which indicates that the relationship between attitudes and time tends to be more strongly positive for individuals with higher ADHD symptoms. This significant interaction was probed using Preacher and colleagues’ (2006) *MLR Two-Way Interaction* online tool using *ADHDlow* (= 1 *SD* below the mean), *ADHDmean* (= mean), and *ADHDhigh* (= 1 *SD* above the mean). According to the simple slopes, graphically depicted in Figure 6, the slope relating attitudes and time becomes more strongly negative for average and low levels of ADHD symptoms. The standardized simple slope was $-.22$ at *ADHDlow* ($p < .001$), $-.08$ at *ADHDmean* ($p = .02$), and $.07$ at *ADHDhigh* ($p = .20$).

The significant interaction of gender with time was probed using the dichotomous gender variable (0 = female, 1 = male). The slope relating attitudes and time becomes more strongly negative for females ($\omega_1 = -.08$, $p = .02$) relative to males ($\omega_1 = -.07$, $p = .10$), and the simple slope for males was not significantly different from zero. Regarding

driving experience, simple slopes showed that the rate of change was more strongly negative for average ($\omega I = -.19, p < .001$) and low ($\omega I = -.08, p = .02$) levels of driving experience. The slope for high levels of experience ($\omega I = .04, p = .43$) was positive but not significantly different from zero (i.e., no significant change in ratings over time).

Perceptions of Crash Risk. According to the results of the model examining changes in risk perception over the course of the TOT program (see Table 7), the mean risk perception score for the reference participants was significant and indicative of a “somewhat likely”/“likely” perception of crash risk when TWD. The intercept of the slope, or rate of change for this reference participant, was significant and positive, suggesting that ratings increased over the course of the program towards a “likely” perception of crash risk.

There was only a significant cross-level interaction of time with ADHD symptoms, which was negative ($\beta = -.10$). This interaction indicates that the relation between perceptions of crash risk and time tends to be more strongly negative, relative to the reference participant, as ADHD symptoms increase. According to the simple slopes run to probe this significant interaction (see Figure 7), the slope relating perceptions of crash risk and time becomes more strongly positive for average ($\omega I = .14, p < .001$) and lower ($\omega I = .24, p < .001$) levels of ADHD symptoms. The rate of change was steeper (i.e., more strongly positive) at lower levels of ADHD symptoms, which indicates stronger change towards a “likely” perception of crash risk with decreasing symptom endorsement. At higher levels of ADHD symptoms, the rate of change was not significantly different from zero ($\omega I = .05, p = .44$).

The non-significant effects of age and experience suggest that age and experience do not significantly influence the type of change in risk perception over the program. For gender, the non-significant effect suggests that males do not significantly differ from females in the type of change in perceptions of crash risk over the program.

Self-Perceptions of Competence as a Driver. The model assessing change in self-perception of driving competence over the course of the TOT program is detailed in Table 7. The mean driving self-perception score for the reference participant was significant, and so was the intercept of the slope. In other words, the average score on and the rate of change on the self-perception of driving competence variable for the reference participant were both significant. The rating for the reference participant was indicative of an “equally as”/“somewhat more” competent self-perception relative to same-aged drivers. The negative slope suggests that ratings tended to decrease over the program and move toward a self-perception that is “less competent” than same-age drivers.

There were significant cross-level interactions of time with age and gender, whereas the influence of ADHD symptoms and driving experience were not significant. The significant and negative cross-level interaction of time and age ($\beta = -.09$) indicates that the already-negative relation between self-perceptions and time is more strongly negative with increasing age. In other words, increasing age is associated with ratings that move closer to lower self-perceptions of competence as a driver over the program.

The significant and positive interaction of time and gender ($\beta = .21$) suggests that the self-perception ratings of male participants decrease at a less negative rate compared to females over the course of the program. Given the significant and negative slope for the female reference participant and the magnitude of the effect of gender, the predicted

rate of change for males remains negative. This reflects a rate of change over the program that still moves towards a less competent self-perception, yet this change is *less* strong relative to female participants.

Perceptions of Task Performance. According to the results of the model examining changes in perceived performance on the distracted driving task (see Table 7), the average rating for the reference participant was significant and indicative of an “equally as well” perception. On the other hand, the average rate of change was not significant. This finding suggests that perceptions of task performance tended not to change significantly from an “equally as well” rating over the course of the program.

There were significant cross-level interactions of time with age, gender, and driving experience, but the influence of ADHD symptoms was not significant. The significant interaction of time with age ($\beta = -.07$) in the association with perception of task performance was negative, and the interactions of time with gender and driving experience were both positive. The negative influence of age on the relation between time and task performance indicates that advancing age is related to a decreasing rate of change, with ratings moving more toward a “worse” perception of task performance.

The positive influences of gender ($\beta = .26$) and driving experience ($\beta = .13$) on the relation between time and task performance suggest that male gender and increasing driving experience are related to change in a more positive direction relative to the reference participant (i.e., female with average driving experience). Thus, ratings move closer to a “better” perception of task performance. Once again, it is important to note that the average regression slope, though not significantly different from zero, is

negative; as such, much of the influence of age, gender, and driving experience only produces a small amount of movement from no-change.

Intention to TWD. The first model examining behavioral intention, specifically the intention to TWD in the future, is detailed in Table 8. According to the estimated model, the score for the reference participant was significant and indicative of a “likely would not”/“definitely would not” intention to TWD in the future. The rate of change for the reference participant was significant and negative, which suggests that ratings tended to decrease over the program and move toward a “definitely would not” intention to TWD.

There were significant cross-level interactions of time with ADHD symptoms and gender, whereas the influences of age and experience on the relation between time and intent to TWD were not significant. The significant interaction of time with ADHD in the relation with intent to TWD was positive ($\beta = .12$), which suggests that higher symptom endorsement is related to a less negative rate of change given the already-negative slope for the reference participant. Simple slopes run to probe the significant interaction of time and ADHD (see Figure 8) showed that the slope relating intent to TWD and time is more strongly negative at lower ($\omega I = -.45, p < .001$) levels of ADHD symptoms relative to average ($\omega I = -.34, p < .001$) and high ($\omega I = -.22, p < .001$) symptoms. As each simple slope was significant and negative, these estimates indicate that at each level of ADHD symptoms the intent to TWD in the future moves toward a lower intention.

The significant cross-level interaction of time with gender in the relation with intent to TWD ($\beta = .16$) was probed using the dichotomous gender variable. The simple slopes showed that the relation between intent to TWD and time is more strongly negative for females ($\omega I = -.33, p < .001$) relative to males ($\omega I = -.18, p < .001$). The rate

of change for males remained negative and significant, which indicates that intentions to TWD for males decreases at a lesser rate than female participants but still moves toward a “definitely would not” intention to TWD in the future.

Intention to Intervene. The two-level regression model including intention to intervene is detailed in Table 8. According to the level 1 effects, the intention to intervene score for the reference participant was significant and suggestive of a “likely would” intent to intervene on a distracted driver in the future. The average regression slope for the reference participant was significant and positive, which indicates a positive change over the program with ratings moving closer to a “definitely would” intention.

There were significant cross-level interactions of time with ADHD symptoms and gender; similar to the previous intention model, the influences of age and experience on the relation between time and intent to intervene were not significant. The significant interaction of time with ADHD in the relation with intent to intervene was negative ($\beta = -.10$), which suggests that higher symptom endorsement is related to a less positive rate of change given the positive slope for the reference participant. Simple slopes run to probe the significant interaction of time and ADHD are depicted in Figure 9. The slope relating intent to intervene and time is more strongly positive (i.e., steeper rate of change) at lower ($\omega I = .56, p < .001$) levels of ADHD symptoms relative to average ($\omega I = .46, p < .001$) and high ($\omega I = .36, p < .001$) symptoms. As each simple slope was significant and positive, these estimates indicate that at each level of ADHD symptoms the intent to intervene on a distracted driver in the future moves toward a higher intention.

The significant cross-level interaction of time with gender in the relation with intent to intervene ($\beta = -.16$) was probed using the dichotomous gender variable. The

simple slopes showed that the relation between intent to intervene and time is more strongly positive (i.e., steeper) for females ($\omega I = .46, p < .001$) relative to males ($\omega I = .30, p < .001$), yet the rate of change for males remained positive and significant. These findings indicate that intentions to intervene for males still increases but at a lesser rate relative to female participants; in other words, intentions to intervene on a distracted driver in the future still move toward a “definitely would” intention for males.

Discussion

This research investigated the relations among ADHD symptoms, psychological factors proposed to underlie risky behavior, and reported intentions to engage in distracted driving and intervene on a distracted driver in the future. This work was driven by replicated findings implicating driver distraction as a primary factor in 58% of all MVCs, including 89% of road-departure crashes and 76% of rear-end crashes (AAA Foundation for Traffic Safety, 2016). In the recent past, sending or reading text messages has emerged as a particularly dangerous form of distracted driving given the inherent complexity of this secondary task. More recently, visual-based social media platforms (e.g., Instagram, Snapchat) have made their way into vehicles as another form of potent distraction from the primary driving task. Overall, it was the hope that the findings of the research reported here, discussed further below, may inform the development of effective driver education and training programs that may help curb the high rate of injury and death resulting from distracted driving.

Aim 1: Differences in psychological factors and intentions as a function of ADHD

The primary hypothesis for this Aim was partially supported; that is, a greater number of endorsed ADHD symptoms was associated with less safe attitudes toward

TWD, greater intentions to engage in TWD in the future, and lower intentions to intervene on a distracted driver in the future. These significant associations agree with past research that has found performance degradations and riskier driving in teenagers diagnosed with ADHD. For instance, in a sample of drivers aged 17 to 24 years who participated in a simulator-based distracted driving task, those diagnosed with ADHD displayed more speed fluctuation and speed limit exceedances than those without a diagnosis (Reimer et al., 2010). In addition, Narad and colleagues (2013) found that, in a similar simulated driving task, teen drivers with ADHD exhibited greater variability in both lane position and speed compared to teens without ADHD.

It was somewhat unexpected that ADHD symptoms were *not* significantly associated with a global self-perception of oneself as a driver nor a specific appraisal of one's predicted performance on the distracted driving task. This runs counter to a large body of evidence supporting overly positive self-perceptions (termed a "positive bias") in children and adolescents with ADHD (see Hoza et al., 2004; Hoza et al., 2011; Owens et al., 2007). In fact, Fabiano et al. (2015) specifically examined the presence of the positive bias in teenage drivers with ADHD in the context of a simulated driving task. These researchers found that teens diagnosed with ADHD inflated their self-perceptions of competence and task performance relative to both observer ratings and objective performance measures. Among the possible explanations for this discrepancy, it is important to keep in mind that the current sample of teenage drivers was not diagnosed with ADHD but rather was assessed based on their level of endorsement of ADHD symptoms, the mean of which was low and not indicative of clinical-level

symptomatology. These differences may have diminished the effects seen by other researchers.

The predictions made in regards to driver age, gender, and driving experience also were partially supported when the estimated path coefficients were significant; however, like the relations reported for ADHD symptoms, several of these paths were not significant for each of the independent variables. In regards to age, increasing age was associated with lower self-perceptions of competence as a driver and lower perceptions of task performance, which suggests that older participants, on average, reported self-perceptions that were less elevated relative to younger drivers, presumably a more objective perception. Thus, these findings for the younger drivers are in accordance with research on the “better than average” effect (e.g., see Guenther & Alike, 2010; Kruger, 1999). Although age was positively associated with driving experience, younger drivers saw themselves as more competent and viewed their performance as better, which is contrary to objective performance.

Relative to female participants, males expressed greater acceptability, greater self-perceptions of competence as a driver, greater perceptions of task performance, greater intentions to TWD in the future, and lower intentions to intervene on a distracted driver in the future. These findings are consistent with past research. Sex and gender differences are consistently reported in driving research, with males found to exhibit riskier driving behaviors than females on driving simulator tasks (Kass et al., 2010; Lenné et al., 2010) and also to report engaging in riskier behaviors while driving independently (Dula & Ballard, 2003; Ellison-Potter, Bell, & Deffenbacher, 2001). A newer study from Cordellieri and colleagues (2016) also found gender differences in generalized road

safety attitudes (e.g., towards traffic rules and risky driving) and in risky driving behavior in a large sample of young drivers aged 18-22 years. However, these authors found that the level of risk *perception* during driving was *similar* for females and males, but they differed in the level of concern about this risk; in other words, male drivers acknowledged the risk but were not as concerned or worried as females about this elevated risk. Given that the results from Aim 1 did not support any gender differences in risk perception, it may be that, like the findings from Cordellieri and colleagues, it is a matter of concern about this risk rather than the absolute ratings of risk.

In regards to the findings on driving experience, as operationalized by the number of miles driven per week, the results imply that increasing experience was associated with greater self-perceptions of competence as a driver, greater perceptions of task performance, and a greater intention to TWD in the future. In addition, based on the preliminary analyses, advancing experience was significantly negatively correlated with actual task performance (i.e., faster driver times and fewer number of cones hit as age increases) on both the first drive and the second distracted drive; this pattern indicates safer overall performance and better ability to navigate the course by more experienced drivers while completing a secondary texting task. Incorporating all the data, these findings suggest that more experienced drivers performed better than less experienced drivers performed and could report on their self-perceptions of competence as drivers and on their task performance in a relatively accurate manner.

The striking detail in these results is that increased experience was also associated with an increased intention to TWD in the future, which is an unsafe intention; however, as will be described for Aim 2, there was no mediation found in this relation. Taken

together, the findings regarding experience are somewhat in accordance with empirical work showing that increased experience is associated with lower crash rates and better overall driving performance (Greenberg et al., 2003; Klauer et al., 2006; Olsen, Lerner, Perel, & Simons-Morton, 2005; Olsen, Simons-Morton, & Lee, 2006), *but* also with riskier attitudes (Rowe, Maughan, Gregory, & Eley, 2013).

Aim 2: Association of ADHD and behavioral intentions via psychological factors

The primary hypothesis for Aim 2 was somewhat supported by the study results. It was predicted that the total indirect effects of the four psychological factors would mediate the relation between ADHD symptoms and both intention to TWD in the future and intention to intervene on a distracted driver in the future. For neither of these behavioral intention variables was the association of ADHD fully mediated by the psychological factors; in other words, the association of ADHD symptoms with behavioral intention remained significant even when accounting for the psychological factors. In fact, given that ADHD symptoms were only significantly associated with attitudes toward TWD in the first path of these models (*a* paths), the remaining possibilities were for there to be a significant specific indirect effect of attitudes and, depending on the strength of this single specific indirect effect, a total indirect effect as well. This latter option turned out to be the case for both intention outcomes. In the context of these models, the results provided evidence that ADHD symptoms had a direct association with both types of behavioral intentions measured, but it also implied that ADHD symptoms have an indirect influence through driver attitudes toward TWD.

In regards to the associations between the psychological factors and intention to TWD in the future (path *b* in the first model), attitudes, perceptions of crash risk, and

perceptions of task performance were significant. For the model including intention to intervene on a distracted driver in the future (path *b* in the second model), attitudes, perceptions of crash risk, and self-perceptions of competence as a driver were significant. Furthermore, as indicated by the size of the standardized path coefficients, each of these psychological factors only had modest effects on each of the intended behaviors. Nevertheless, increasing acceptability of TWD, decreasing perception of crash risk when TWD, and increasing perception of task performance were associated with a higher intention to TWD in the future. A greater intention to intervene on a distracted driver in the future was associated with increasing acceptability of TWD, decreasing perception of crash risk, and increasing self-perception of competence as a driver. The inconsistent findings and smaller path coefficients for both self-perceptions of driving competence and perceptions of task performance suggest that these factors may play less of a role in their relations with intended behavior, at least when controlling for the effects of the other variables in these models.

This finding is surprising in the context of the work of Hoza and colleagues (2013) who, using a large dataset from the MTA study, found that the total indirect effect of inflated self-perceptions in the academic, behavioral, and social domains, as well as the specific indirect effect of this positive bias in the behavioral domain, either fully or partially mediated the relations between ADHD diagnosis and risky driving outcomes. However, a few key differences between this study and Hoza et al.'s need to be mentioned. First, their sample included older adolescents with and without a childhood diagnosis of ADHD. Second, the mean age of their sample was meaningfully greater than the mean age of this current study's sample (18.4 vs. 15.8). Additionally, positive bias in

their study was calculated from discrepancy ratings that were completed in childhood; for this current study, self-perceptions relative to “others your age” were used as a general marker for how “realistic” one’s self-views were. Finally, the sample in the MTA study was a diagnosed sample, not a school-based sample as it was for the current study; this difference is important given the higher prevalence of positive bias in individuals diagnosed with ADHD, of which there is a higher portion in clinical samples.

These findings partially support previous theory and empirical evidence from social cognition models (e.g., Theory of Planned Behavior and Health Belief Model) proposing that stable traits, ADHD in this context, influence behavior indirectly through the behavior’s psychological determinants. The findings from the current work suggest that the driver’s attitudes toward TWD explains the link between ADHD symptoms and risky behavioral intentions in this sample of high school students, most of whom held a learner’s permit. Taken together, these results imply that ADHD symptoms alone may not place young drivers at risk for distracted driving; rather, it may be that ADHD symptoms along with risky attitudes about the acceptability of TWD may together increase the likelihood of participation in TWD in the future.

It is also very possible that other psychological factors not included in these models may mediate the relations between ADHD symptoms and behavioral intentions. For instance, past studies have included social norms, moral norms, and perceived behavioral control when assessing the application of the Theory of Planned Behavior to risky driving (e.g., White, Cunningham, & Titchner, 2011; Walsh, White, Hyde, & Watson, 2008).

Regardless, these results are consistent with findings from Ulleberg and Rundmo (2003) wherein those researchers found that attitudes were the most consistent predictor of intention to use a mobile phone while driving. However, they did not find a significant association between perceived risk of using a mobile phone while driving and intentions to engage in this behavior, which was found in the context of this study in path *b*. Thus, although risk perceptions did not mediate the relation between ADHD symptoms and behavioral intentions, perceived risk of crashing when TWD did have a direct effect on both the intention to TWD in the future and the intention to intervene on a distracted driver in the future.

Importantly, it is problematic to make any claim such that attitudes or risk perceptions *predict* behavior because these psychological factors were measured at the same point in time as behavioral intentions. For the same reason, it generally is unwarranted to claim that the direction of these multiple mediation models represents real-world relations. Further, it could be, as was proposed by Ulleberg and Rundmo (2003), that attitudes and risk perceptions may correspond to intended behavior because these participants desired to justify previous actions or previous witnessed actions, not the other way around. However, this was not the conceptual nor statistical model tested in the multiple mediation models for Aim 2, and there is empirical support from longitudinal work for the predictive value of both attitudes and risk perceptions in relation to behavior and intended behavior (e.g., *drink-driving* from Greenberg, Morral, & Jain, 2005). Furthermore, the multiple mediation models tested in the current work are based on empirically supported social cognition models that support the directional

assertion. Nevertheless, this does not solve the core causal dilemma of directionality, and it would present a fruitful direction for future research.

Given the direct and indirect effects in the multiple mediation models for Aim 2, intervention efforts could be more deliberate in acknowledging and incorporating more stable personality-type traits into traffic safety campaigns and driver education and training programs. This is not to say that efforts should be aimed at decreasing symptoms of ADHD, as there are already many specialists working hard to reduce the functional limitations of those diagnosed with ADHD. Rather, programs and interventions could seek to target, specifically for young drivers with elevated symptoms of ADHD, attitudes toward TWD and other mobile phone-related secondary tasks and, more globally for all young drivers, their attitudes and perceptions of crash risk when TWD. Furthermore, strategies to reduce TWD in young drivers, and particularly those with elevated symptoms of ADHD, should focus on changing attitudes and perceptions of crash risk to become less supportive of this behavior and highlight the high likelihood of crashing when engaged in this risky secondary task.

Aim 3: The impact of the training program

The final aim was to investigate the effects of ADHD symptoms, age, gender, and driving experience on the rate of change of the psychological factors and behavioral intention variables over the course of the TOT program. The primary hypothesis that ADHD symptoms would be associated with less adaptive change (e.g., less improvement or change toward unsafe attitudes or perceptions) in these outcome variables from pre- to post-program was partially supported. ADHD symptoms significantly influenced change in attitudes toward TWD, perceptions of crash risk, intentions to TWD in the future, and

intentions to intervene on a distracted driver in the future. In other words, change over the course of the TOT program on these outcomes was significantly different based on increasing ADHD symptoms. The influence of ADHD symptoms on change over time indicated that greater ADHD symptoms either were associated with non-significant change over time (i.e., ratings do not significantly change for those endorsing a high number of symptoms) or less change in a favorable direction relative to average and lower levels of ADHD symptoms on these outcomes. The effects of ADHD symptoms on change for both self-perceptions of competence as a driver and perceptions of task performance were not significant. These findings suggest that for both self-evaluation outcomes the change over time was not influenced by differing levels of ADHD symptoms.

Specifically regarding change in driver attitudes over the program, increasing ADHD symptoms were associated with a less negative rate of change, where a negative rate of change reflects an adaptive or safe change in attitudes (i.e., towards an “unacceptable” attitude). The simple slope follow-up analyses showed that high levels of ADHD symptoms were associated with non-significant change over the course of the program, suggesting that attitudes toward TWD do not change for participants endorsing a greater number of ADHD symptoms. Low and average levels of ADHD symptoms were related to adaptive change in attitudes where ratings move toward a more *unacceptable* view of TWD. Both driving experience and gender also had significant influences on the change in ratings of attitudes toward TWD. The influence of driving experience was similar to that of ADHD symptoms whereby an increase in the average miles driven per week was associated with non-significant change, yet low and average

levels of experience were associated with adaptive changes in attitudes (i.e., toward an “unacceptable” attitude). Regarding the influences of gender, males tended to change their ratings in a mildly positive direction from pre- to post-program relative to females; however, simple slopes indicated that the change for males was not significant, indicating that ratings did not significantly change to reflect riskier attitudes for males.

It is important to place these specific influences in the context of a “typical” amount of change for this sample, reflecting an average change over the course of the program for an average-aged female driver with an average number of ADHD symptoms and an average number of miles driven per week. The change for this reference individual on driver attitudes was not significantly different than zero, perhaps reflecting a relatively stable belief; in addition, the mean rating on attitudes at the pre-program measurement point for this “average” participant reflected a view of TWD that is “somewhat unacceptable”/“unacceptable.” In a way, this finding is hopeful. However, despite the relatively stable change for the average participant on attitudes toward TWD, the findings that increased ADHD symptoms, increased driving experience, and male gender were associated with less safe change are concerning. In fact, for ADHD symptoms, this suggests that young drivers with *particularly* elevated symptoms are less responsive to this intervention and may have greater difficulty assimilating new information into existing attitude schemas. Regarding gender, these results are similar to those found in an evaluation of a general pre-driver safety intervention that showed attitudes toward unsafe driving behaviors (distracted driving was not included) became riskier over the course of their intervention program for both males and females, a pattern which was maintained six weeks after the program (Glendon et al., 2014). Future work

may seek to understand the reasons, or additional psychological factors, underlying the relatively lesser impact of this experiential training program for those young drivers with elevated ADHD symptoms, increasing driving experience, and of male gender.

Change in perceptions of crash risk from pre- to post-program was only significantly influenced by ADHD symptoms, and this influence suggested that increasing ADHD symptoms were associated with less positive change in perceptions of crash risk. Indeed, simple slope analyses showed that a high level of ADHD symptoms was associated with non-significant change over the course of the program, whereas average and low levels of ADHD symptoms were related to adaptive change toward a “likely” perception of crash risk.

Both the average risk perception rating and the average rate of change for the reference participant were significant in this model. The estimated values imply that drivers generally hold a “somewhat likely”/“likely” perception of crash risk when TWD and that this perception tends to increase and move closer to a likely perception of crash risk over the course of the program. Given that age, gender, and driving experience did not significantly influence this average rate of change, it is suggested that this change is to be expected across ages in this sample, males and females, and all levels of driving experience held by this group.

The findings for an influence of ADHD symptoms on this rate of change fit into the larger context of this study’s findings that only ADHD symptoms were significantly associated with perceived crash risk in Aim 1 and path *a* of Aim 2. This finding is consistent with a large body of work showing increased engagement of risky behaviors in individuals diagnosed with ADHD (risky driving: Thompson et al., 2007; risky sexual

behavior: Sarver, McCart, Sheidow, & Letourneau, 2014; gambling: Breyer et al., 2009). The findings of no gender effect on the rate of change through the program was somewhat surprising in light of a large body of evidence showing that young males report lower perceived risk about driving unsafely relative to females (e.g., Farrand & McKenna, 2001; Ginsburg et al., 2008; Glendon et al., 2014; Ivers et al., 2009). Change in perceived crash risk also was not influenced by age or driving experience, both of which were expected to influence change in ratings over the program, so this may highlight that young drivers generally hold a safe understanding of their risk of crashing when TWD, which is relatively stable.

ADHD symptoms did not significantly influence the rate of change on either self-perceptions of competence as a driver or perceptions of task performance. Age and gender had significant influences on the rate of change for self-perceptions of competence, and age, gender, and driving experience significantly influenced perception of task performance. The influence of these variables was as predicted, that is, increased age was associated with a decreased rate of change on perceptions of competence and performance, increased driving experience was associated with higher rates of change on perceptions of task performance, and male gender was associated with change towards higher self-perceptions as a driver and higher perceptions of performance.

For both of these outcomes, the mean average rating reflected a perception of competence and performance that was similar to same-aged drivers. The significant and negative average rate of change for self-perceived competence as a driver reflected that there was a general tendency for these appraisals to move in the direction of a less-competent self-perception. For perceived task performance, the average rate of change

was not significantly different from zero, which suggests that ratings generally stayed the same from pre- to post-program.

There are no assumptions made about how “realistic” or “safe” these self-perceptions are for this sample, but it is notable that the average ratings tended towards an “average” view of one’s competence and performance. It could be argued that this is the most realistic self-perception for a novel task where numerous cones tended to be struck, as well as a part of one’s identity that is just beginning to be formed given that most of these drivers held only learner permits. In addition, incorporating findings from previous Aims, neither of these psychological factors were significantly associated with ADHD symptoms, as would be expected based on a large body of evidence supporting a “positive bias,” nor were they associated with behavioral intentions.

The primary hypotheses for both behavioral intention variables were supported. ADHD symptoms had a significant positive influence on the rate of change for the intention to TWD in the future and a significant negative influence on the rate of change for the intention to intervene on a distracted driver in the future. These effects both suggest that increasing ADHD symptoms are associated with a rate of change that differs from the average program participant. Gender also influenced the rate of change on intention to TWD in the future in the expected direction, such that males tended to change towards an increasing intention to TWD in the future (or, rather, less of an intention *not* to TWD in the future), and age and driving experience did not. Regarding change on intention to intervene, gender influenced the rate of change in the expected direction, such that male gender was associated with a change towards a lower intention

to intervene on a distracted driver in the future; age did not significantly influence this change from pre- to post-program.

Of note, the average rates of change for both outcomes reflected that, for the reference participant, ratings became safer such that they changed to reflect a lesser intention to TWD in the future and a greater intention to intervene. Importantly, though ADHD symptoms, male gender, and increased driving experience influenced the rates of change to be less safe, this is not to say that these ratings fell to points on the dimensions reflecting that they would text while driving “regularly” and “definitely would not” tell a texting driver to stop.

This finding does suggest that the intervention program still met its intentions even for individuals with elevated symptoms of ADHD. This was also true for male participants given that change on both intention outcomes was significant and also in an adaptive direction (though less adaptive change relative to females), suggesting some flexibility in these intentions that changed over the course of the brief TOT program. This is particularly hopeful given that this program did not target drivers with ADHD specifically but rather was designed as a generalized anti-texting-while-driving program for the larger population of young and inexperienced drivers. Certainly, the impaired resistance to distraction and difficulties sustaining attention that are characteristic of ADHD (e.g., Barkley, 1997) may have interfered with the assimilation of the program’s information and experiential training into the attitudes of the participants with elevated symptoms of ADHD. This idea is consistent with past research showing that individuals with ADHD have poor on-line processing, miss important cues, and show deficits in

goal-directed behavior (Barkley, 1997; Milch-Reich, Campbell, Pelham, Connelly, & Geva, 1999; Renz, Lorch, Milich, Lemberger, Bodner, et al., 2003).

Overall, the results from Aim 3 suggest that this experiential anti-texting-while-driving training program developed by the Youth Safety Council of Vermont was effective in its goal to change young drivers' perceptions of crash risk, self-perceptions of competence as a driver, intentions to TWD, and intentions to intervene on a distracted driver. These findings also suggest that this program did not change the young drivers' attitudes toward TWD nor their perceptions of task performance on the driving tasks. However, for both outcomes, average ratings reflected safe attitudes (i.e., TWD as less acceptable) and realistic perceptions of task performance (i.e., performed equally as well on the tasks) at the pre-program measurement time, thereby leaving little space for meaningful movement in ratings over the course of the two measurement points. Furthermore, the effects of ADHD symptoms, age, gender, and driving experience were largely as expected when these effects were significant, and they showed that increasing ADHD symptoms, increasing age, male gender, and increasing driving experience were associated with less adaptive or non-significant change over the course of the program.

In addition to the previously mentioned practical implication of these results from Aim 2 (i.e., address driver attitudes and risk perceptions), these findings also suggest that this experiential driver training program, which does not have an emphasis on any one particular psychological determinant of behavior, was effective in changing young drivers' perceptions of crash risk, self-perceptions of competence as a driver, and their behavioral intentions. As noted above, attitudes and perceptions of task performance were already reflective of safe and realistic views. Therefore, an alternative to the

traditional classroom-based instruction format of most school-based driver training programs, experiential programs may be a more effective and captivating format through which to engage young drivers and offer them a chance to learn, through direct feedback, of the consequences of their actions. Alternative formats that are similarly experiential could also provide alternative delivery methods; for instance, simulator-based participative programs could likely achieve the same goals as the TOT program yet require less physical space and staffing. Furthermore, given the notion that driver attitudes, risk perceptions, and self-perceptions are largely in a state of fluctuation at this age, pre-driver education and training initiatives could focus on creating more desirable and safer attitudes before these notions become established and less malleable.

Conclusions

This work was driven by the high rates of injury and death among young drivers resulting from distracted driving, and the public health challenge of developing effective and evidence-based intervention and training programs to address the elevated risk for young road users. With a particular focus on examining the influence of ADHD symptomatology on distracted driving among young drivers, the results showed that participants endorsing more ADHD symptoms drove the course faster—as expected—and hit fewer cones—unexpectedly—while distracted by text messaging. ADHD symptoms also were associated with increased acceptability of TWD, decreased perceptions of crash risk while TWD, increased intent to TWD in the future, and decreased intent to intervene on a distracted driver.

Mediation models were run to clarify these relations. The results supported past research showing a connection, per social cognition models, between psychological

determinants of distracted driving behavior and intentions to engage in TWD. Regarding the role of ADHD in these associations, ADHD symptoms were directly related to intentions to TWD (positive relation) and intentions to intervene on a distracted driver (negative relation) even when accounting for the psychological factors. However, an indirect effect also emerged such that ADHD symptoms also related to these intentions via attitudes toward TWD. These findings suggest that studies examining driving behaviors in drivers with ADHD, and young drivers, may be missing important mediators that explain actual behaviors. These mediators (e.g., attitudes toward TWD) may prove to be viable and important targets for intervention, training, or additional programming.

Finally, and as expected, ADHD symptoms reduced the change of the psychological factors and intention variables over the course of the TOT program. However, changes of these variables remained in an *adaptive* direction, suggesting that the program may have been effective but not *as effective* for young drivers endorsing a higher number of ADHD symptoms. The TOT program was not designed to target young drivers with ADHD specifically, so these findings suggest that additional modifications to the program's messages and experiences (e.g., more direct messages to influence attitudes toward TWD), as well as the format (e.g., longer and more boring tasks), may be warranted to produce additional positive and adaptive change for younger drivers with elevated ADHD symptoms.

The conclusion that ADHD drivers were safer, per the task performance metrics (i.e., drove faster and hit fewer cones), is not necessarily warranted for several key reasons. First, the experiential task in the TOT program was novel, exciting, engaging, and short. This is contrasted with much of real-world driving that requires a longer time

behind the wheel and oftentimes low stimulus (i.e., few road hazards to which to attend). As *sustaining* attention over time is a core deficit associated with ADHD (e.g., APA, 2013; Fosko & Hawk, 2015), it could be that this distracted driving task was too short for these attention deficits to impair performance. A second possibility for these results relates to the low mean and median symptoms endorsed by this sample. The median number of symptoms endorsed was three, which is far below the number of symptoms required for a clinical diagnosis. As such, the relations between ADHD symptoms and the task performance measures reflect faster driver times and fewer cone hits based on a low degree of ADHD symptoms. In other words, despite there being a relation between ADHD symptoms and task performance, a possible conclusion that is warranted is that participants endorsing four symptoms (still below diagnostic levels) drove faster and hit fewer cones than participants endorsing two symptoms. The majority of previous studies examining driving among drivers with ADHD have included road users *diagnosed* with ADHD, which may explain the differences between previous work and the current findings related to task performance.

These findings showed that these high school student learner drivers generally hold safe and adaptive views regarding the acceptability of TWD, likelihood of crashing while TWD, self-perceptions of themselves as drivers, and perceptions of their task performance. This is a hopeful message. However, it also suggests that this work may be missing important determinants of risky and distracted driving in young road users given that the literature and crash databases consistently show that these young drivers *do* engage in distracted driving. Ratings on the psychological factors and intention variables

still changed over the course of the program, pointing to the viability and effectiveness of employing alternative information delivery methods for driver training.

Limitations

These results should be understood within the limitations of the study. As this was an evaluation study of a community-developed and community-run anti-texting-while-driving training program, there were constraints imposed on the involvement of the researcher to randomly assign participants to conditions to assess differences between teens who did or did not participate in this program. This could have offered a chance to compare more directly the impact of the TOT program.

This study included only measures of behavioral intentions and not an actual report of the extent to which these young novice drivers were texting on the road after the program. Obtaining reports of actual behavior would have strengthened these results substantially, particularly in the context of a long-term follow-up of these participants after the program and after licensure.

ADHD in this study did not represent a clinical diagnosis; rather this construct reflected a count of symptoms endorsed out of the 18 symptoms that comprise ADHD Combined Presentation. It was not possible within the constraints of this program evaluation to determine actual diagnoses of ADHD given that there are several key pieces of information needed, such as age of onset of symptoms and functional impairment resulting from these symptoms. Nevertheless, as ADHD was treated as a dimensional variable in these analyses, this allowed meaningful results to be produced in terms of the impact of a one-symptom increase from the average symptom count endorsement of this sample.

Another limitation to note is the cross-sectional nature of the mediational analyses completed for Aim 2. As there was no longitudinal follow-up from which to gather information pertaining to actual distracted driving and texting-while-driving behaviors after the program, it was not possible to infer directionality of the influence of the psychological factors in the association between ADHD symptoms and behavior; rather, behavioral intentions were measures that asked about future behavior but were assessed at the same time as the psychological factors. It is also difficult to make confident claims regarding the directionality or causality between ADHD symptoms and the psychological factors; however, based on well-grounded theoretical models, it was assumed that ADHD symptoms are part of a more stable construct that creates a different level of attitudes, risk perception, and self-perception relative to those who do not have elevated symptoms. A longitudinal study design may certainly be warranted for future work in program evaluation of the TOT program and other driver training programs, and these designs will be able to address these concerns in a strong methodological manner.

Lastly, the large size of the sample included in this project certainly was a strength, but it also could have produced statistically significant associations given that many of the correlations were in the low range. However, in the context of driving safety and real-world implications of these results, even a small effect can be important when it comes to reducing crashes and rates of death and injury.

Implications

This work showed that differences based on ADHD symptoms, age, and gender can be seen in learner drivers before they are on the road driving independently. Certainly, this is a hopeful message for intervention efforts that there is a chance to

address these risky attitudinal determinants of dangerous driving practices prior to when these young drivers act independently on the road. Additionally, road safety campaigns and advertisements may never be sufficient in attempts to curb distracted driving across any driver demographic given how early these attitudes and perceptions are developed. Such preconceptions about appropriate and safe driving behaviors likely come from parents or caregivers, as suggested by previous work that has reported on the inter-generational transmission of driving behaviors from parent to child (self-reported driving behavior: Bianchi & Summala 2004; self-reported perceived driving risk: Lahatte & Le Pape, 2008; self-reported driving style: Taubman-Ben-Ari et al., 2005). Therefore, policy makers should consider interventions aimed at two new levels: toward young adolescents before they have begun to learn how to drive and toward parents of these future road users.

One central reason why driver education programs are unsuccessful in reducing young drivers' involvement in distraction-related crashes is that these programs do not address the antecedents of unsafe driving behaviors (Durbin, McGehee, Fisher, & McCartt, 2014; McCartt, Kidd, & Teoh, 2014). Rather, existing driver education and training programs rely on classroom-based instruction and the use of written materials to change behaviors. Educators therefore rely on novice drivers to translate the base knowledge from written materials and classroom instruction to real-world situations in which they are confronted with the choice to engage in distracted driving (e.g., checking or sending a text message). If at the core of learning how to drive safely is the accumulation of direct feedback (Peck, 2011; Beanland, Fitzharris, Young, & Lenné, 2013), then the driver education and training programs currently in use have not

adequately designed their mechanism of delivery in a way that may produce the greatest shifts in attitudes, perceived risk, and driving behaviors. For instance, a driver learns to slow down before taking a sharp turn by first experiencing the drastic decrease of vehicle control that results from taking a similar turn too quickly. Novice drivers who lack experience have difficulty comprehending the amount of information and vehicle control missed when their eyes are focused on reading or sending text messages; thus, experiential training programs are needed to provide these opportunities and to target the novice driver's attitudes and perceived risk. Greater attention and deliberation ought to be placed on program format, duration, and delivery source as these are key factors to consider when designing an effective intervention program for young drivers. Developed education and training programs that meet the program design requirements to engage young drivers are limited, and ongoing evaluation of these programs is critical to isolate the most effective strategies. Without experiential and engaging driver programs designed specifically for young novice drivers, the disparity in driving risk and MVC rates is likely to be maintained or widened.

A strength of this study was that it was placed in the context of a community-developed and community-run experiential anti-TWD training program designed specifically for learner, young, and inexperienced drivers. These are the types of efforts that are likely to make the largest impact towards addressing the high rates of injury and death resulting from distracted driving. Specifically, this program targets a population of heavy cell-phone messaging application users (Greenwood, Perrin, & Duggan, 2016) at a time in their personal development and driving training when they may be most susceptible to learning, in an experiential manner, the real-world dangers and

consequences of their actions. As some research has shown, health-promotion efforts are best targeted when adolescents are ready to receive the message and before problematic habits have been established (see Maggs, Schulenberg, & Hurrelmann, 1997). As such, this program sought to target those young, adolescent drivers who are beginning their journey in learning how to drive and are formulating attitudes about appropriate and inappropriate driving behavior.

An additional strength of the TOT program is that it sought to address a specific risky driving behavior, i.e., texting-while-driving, given the complexity of this secondary task and the high rates of injury and death suspected to arise out of situations where a driver is distracted by mobile phone use. Although this program did not seek to directly address any particular psychological determinant of risky behavior that was analyzed, the messages provided throughout the training were focused on performance deficits and hitting cones as a result of texting while also operating the vehicle; this structure is in contrast to some programs that seek to address unsafe driving as a broader category. As has been proposed by previous researchers (e.g., Ulleberg & Rundmo, 2002), safety efforts and campaigns aimed at influencing general attitudes have been unsuccessful because they do not focus on specific behaviors and specific antecedents of that behavior; in fact, some research has obtained empirical evidence supporting the assertion that general attitudes are a poor predictor of specific behaviors, such as unsafe driving (e.g., Iversen, 2004; Iversen et al., 2005). This limitation of previous programs was addressed by the TOT program, and the results from Aim 3 provide support for the efficacy of addressing specific causes of a specific risky behavior.

Currently, neither legislative measures nor driver education programs that address distracted driving, and specifically mobile phone use while driving, have proved to be effective over the long term; rates of MVCs that cite driver distraction as a primary factor remain high (NHTSA, 2013). Indeed, with more and more automobiles equipped with wireless communication and entertainment devices, legislation alone is unlikely to be sufficient; in addition, the designs of widely used driver education programs are not satisfactory in engaging young drivers and encouraging safe behaviors when using an automobile. Specifically, countermeasures such as driver training and education that focus on helping drivers realize the risks associated with distracted driving and their own limitations could help mitigate the dangers of young inexperienced road users. Many policy makers and researchers have lamented that the field of young driver education is “stuck” in that no programs seem effective in reducing the disproportionately high rates of MVCs for this group (Peck, 2011; Zhao et al., 2006; Glendon et al., 2014). Research that critically examines and evaluates the impact of novel programs can significantly advance the field of driver education to create safer roadways and prevent “accidental deaths,” yet methodologically strong program evaluations are sparse in the transportation safety domain. The evaluation of YSCVT’s TOT program, an engaging and experiential driver training program that targets attitudes toward and perceived risk of texting while driving, is a creative departure from existing programs and approaches.

Table 1. Descriptive statistics for all study variables

Variable	<i>n</i>	Mean	Standard Deviation	Minimum	Maximum
Total ADHD Symptom Count	1056	4.33	4.26	0.00	18.00
ADHD-HI Symptom Count	1056	2.44	2.38	0.00	9.00
ADHD-IA Symptom Count	1056	1.89	2.36	0.00	9.00
Age	1203	15.78	0.81	14.00	20.00
Gender	1203	0.56	0.82	0.00 (female)	3.00 (“don’t want to say”)
Experience	1203	164.98	152.12	0.00	1200.00
Pre-Program					
t1 Attitudes	1203	1.34	0.71	1.00	5.00
t1 Risk	1203	4.36	0.90	1.00	5.00
t1 Competence	1203	3.31	0.90	1.00	5.00
t1 Performance	1203	2.97	0.78	1.00	5.00
t1 Text	1203	1.58	0.83	1.00	4.00
t1 Intervene	1203	3.97	1.02	1.00	5.00
t1 Time (sec)	1080	74.73	29.06	16.00	260.00
t1 Hits	1080	5.14	5.33	0.00	50.00
Post-Program					
t2 Attitudes	1064	1.34	0.82	1.00	5.00
t2 Risk	1064	4.48	0.97	1.00	5.00
t2 Competence	1064	3.17	0.94	1.00	5.00
t2 Performance	1064	3.03	1.02	1.00	5.00
t2 Text	1064	1.39	0.72	1.00	4.00
t2 Intervene	1064	4.35	0.94	1.00	5.00
t2 Time (sec)	1073	92.50	33.25	21.00	312.00
t2 Hits	1073	10.20	8.17	0.00	68.00

Note. t1 corresponds to the pre-program measurement point; t2 corresponds to the post-program measurement point; includes all participants.

Table 2. Intercorrelations among independent and dependent variables for all analyses

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Total ADHD ^a	---										
2. ADHD-HI ^a	.90*	---									
3. ADHD-IA ^a	.90*	.62*	---								
4. Age	.05	.04	.06	---							
5. Gender	.08*	.05	.08*	.08*	---						
6. Experience	.06	.08*	.02	.14*	.12*	---					
7. t1 Attitudes	.11*	.10*	.10*	-.01	.10*	.06*	---				
8. t1 Risk	-.07*	-.08*	-.04	-.05	-.07*	-.06	-.22*	---			
9. t1 Competence	-.03	.02	-.07*	-.03	.19*	.22*	.02	-.01	---		
10. t1 Perform	.03	.05	-.00	-.07*	.21*	.18*	.08*	-.05	.48*	---	
11. t1 Text	.16*	.16*	.13*	.02	.10*	.16*	.45*	-.22*	.03	.13*	---
12. t1 Intervene	-.13*	-.13*	-.11*	.00	-.08	-.05	-.32*	-.22*	.08*	.01	-.35*
13. t1 Time (sec)	-.13*	-.13*	-.11*	-.03	-.22*	-.16*	-.08*	.04	-.09*	-.09*	-.18*
14. t1 Hits	-.05	-.08*	.00	-.00	-.15*	-.13*	.00	-.01	-.18*	-.17*	-.02
15. t2 Attitudes	.20*	.19*	.17*	.00	.14*	.15*	.49*	-.16*	.05	.13*	.44*
16. t2 Risk	-.12*	-.13*	-.08*	.00	-.07*	-.05	-.15*	.31*	-.04	-.13*	-.24*
17. t2 Competent	-.01	.01	-.03	-.10*	.21*	.16*	.03	-.02	.60*	.42*	.05
18. t2 Perform	.01	.04	-.03	-.05	.19*	.18*	.04	-.03	.36*	.39*	.09*
19. t2 Text	.23*	.21*	.20*	.04	.16*	.19*	.36*	-.21*	.12*	.17*	.55*
20. t2 Intervene	-.18*	-.15*	-.17*	-.03	-.13*	-.11*	-.31*	.21*	-.03	-.10*	-.36*
21. t2 Time (sec)	-.16*	-.16*	-.13*	-.06	-.19*	-.20*	-.10*	.03	-.14*	-.12*	-.20*
22. t2 Hits	-.07*	-.10*	-.03	.00	-.13*	-.20*	-.01	-.00	-.20*	-.20*	-.04

Variable	12	13	14	15	16	17	18	19	20	21	22
12. t1 Intervene	---										
13. t1 Time (sec)	.12*	---									
14. t1 Hits	-.03	.03	---								
15. t2 Attitudes	-.24*	-.14*	-.08*	---							
16. t2 Risk	.19*	.07*	.06	-.25*	---						
17. t2 Competent	.06	-.09*	-.31*	.08*	-.00	---					
18. t2 Perform	.00	-.06*	-.42*	.14*	-.05	.62*	---				
19. t2 Text	-.27*	-.13*	-.09*	.51*	-.27*	.13*	.18*	---			
20. t2 Intervene	.44*	.09*	.08*	-.40*	.30*	-.03	-.11*	-.40*	---		
21. t2 Time (sec)	.14*	.77*	.09*	.18*	.07*	-.14*	-.15*	-.23*	.15*	---	
22. t2 Hits	.03	.05	.62*	-.09*	.08*	-.36*	-.49*	-.18*	.15*	.20*	---

Note. t1 corresponds to the pre-program measurement point; t2 corresponds to the post-program measurement point; ^a denotes count variable; Gender: 0 = female, 1 = male; Attitudes, Risk, Competence, and Perform refer to the four psychological factors; Text and Intervene refer to the two behavioral intention variables; Time and Hits refer to the two performance variables; * $p < .05$.

Table 3. Results from path *a* of the multiple mediation models for psychological factors in Aim 1

Variable	Outcomes							
	Attitudes toward TWD		Perception of Crash Risk		Self-Perception of Competence as Driver		Perception of Task Performance	
	<i>b</i> (CI)	β	<i>b</i> (CI)	β	<i>b</i> (CI)	β	<i>b</i> (CI)	β
ADHD Symptoms	0.02** (0.01, 0.03)	0.11	-0.01 (-0.03, 0.00)	-0.06	-0.01 (-0.02, 0.00)	-0.05	0.00 (-0.01, 0.01)	0.01
Age	-0.03 (-0.07, 0.02)	-0.03	-0.05 (-0.12, 0.03)	-0.04	-0.08** (-0.15, -0.02)	-0.07	-0.10** (-0.16, -0.04)	-0.11
Gender	0.12** (0.05, 0.19)	--	-0.10 (-0.21, 0.01)	--	0.31*** (0.20, 0.41)	--	0.30*** (0.21, 0.39)	--
Experience	0.00 (0.00, 0.00)	0.05	0.00 (-0.00, 0.00)	-0.04	0.00*** (0.00, 0.00)	0.21	0.00*** (0.00, 0.00)	0.01

Note. β = standardized regression weight; *b* = unstandardized regression weight; CI = bias-corrected (bootstrapped) confidence interval (lower limit, upper limit); TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$; -- standardized regression weight not computed for categorical predictor.

Table 4. Results from the multiple mediation models for behavioral intentions in Aim 1

Variable	Outcomes			
	Intention to TWD in the Future		Intention to Intervene in the Future	
	<i>b</i> (CI)	β	<i>b</i> (CI)	β
ADHD Symptoms	0.03*** (0.02, 0.04)	0.15	-0.03*** (-0.05, -0.02)	-0.13
Age	-0.02 (-0.08, 0.04)	-0.02	0.03 (-0.05, 0.10)	0.02
Gender	0.11** (0.02, 0.21)	--	-0.13* (-0.25, -0.01)	--
Experience	0.00*** (0.00, 0.00)	0.15	0.00 (-0.00, 0.00)	-0.03

Note. β = standardized regression weight; *b* = unstandardized regression weight; CI = bias-corrected (bootstrapped) confidence interval (lower limit, upper limit); TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$; -- standardized regression weight not computed for categorical predictor.

Table 5. Indirect effects of ADHD symptoms on intention to TWD for Aim 2

Intention to TWD in the Future			
Mediator	Parameter Estimate (β/b)	Standard Error (β/b)	95% CI of β/b (Lower, Upper)
Total	0.05 / 0.01**	0.02 / 0.00	(0.02, 0.08) / (0.00, 0.02)
Attitudes toward TWD	0.04 / 0.01**	0.02 / 0.00	(0.01, 0.07) / (0.00, 0.01)
Perception of Crash Risk	0.01 / 0.00	0.00 / 0.00	(-0.00, 0.02) / (-0.00, 0.00)
Self-Perception of Competence as Driver	0.00 / 0.00	0.00 / 0.00	(-0.00, 0.01) / (-0.00, 0.00)
Perception of Task Performance	0.00 / 0.00	0.00 / 0.00	(-0.01, 0.01) / (-0.00, 0.00)

Note. β = standardized regression weight; b = unstandardized regression weight; CI = bias-corrected (bootstrapped) confidence interval with lower limit, upper limit; TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 6. Indirect effects of ADHD symptoms on intention to intervene for Aim 2

Intention to Intervene in the Future			
Mediator	Parameter Estimate (β/b)	Standard Error (β/b)	95% CI of β/b (Lower, Upper)
Total	-0.04 / -0.01***	0.01 / 0.00	(-0.07, -0.02) / (-0.02, -0.00)
Attitudes toward TWD	-0.03 / -0.01**	0.01 / 0.00	(-0.05, -0.01) / (-0.01, -0.00)
Perception of Crash Risk	-0.01 / -0.00	0.01 / 0.00	(-0.02, 0.00) / (-0.01, 0.00)
Self-Perception of Competence as Driver	-0.01 / -0.00	0.00 / 0.00	(-0.01, 0.00) / (-0.00, 0.00)
Perception of Task Performance	0.00 / 0.00	0.00 / 0.00	(-0.00, 0.00) / (-0.00, 0.00)

Note. β = standardized regression weight; b = unstandardized regression weight; CI = bias-corrected (bootstrapped) confidence interval with lower limit, upper limit; TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 7. Results from the two-level regression models for psychological factors in Aim 3

Model Parameter	Outcome			
	Attitudes toward TWD	Perception of Crash Risk	Self-Perception of Competence as Driver	Perception of Task Performance
AIC/BIC for Intercept Model	4583.67/ 4657.10	5612.86/ 5686.28	5495.34/ 5568.76	5340.41/ 5413.84
AIC/BIC for Study Model	4320.17/ 4371.00	5511.18/ 5562.01	5098.53/ 5149.36	5230.33/ 5281.16
<i>Cross-Level Interactions</i> (β , b , CI of b)				
Slope on ADHD	0.15/0.03*** (0.02, 0.03)	-0.10/-0.02*** (-0.03, -0.01)	-0.00/0.00 (-0.01, 0.01)	-0.02/-0.00 (-0.02, 0.01))
Slope on Age	-0.02/-0.02 (-0.07, 0.03)	0.03/0.04 (-0.03, 0.11)	-0.09/-0.11*** (-0.17, -0.05)	-0.07/-0.07* (-0.15, -0.00)
Slope on Gender[^]	0.11** (0.03, 0.20)	-0.08 (-0.19, 0.04)	0.21*** (0.10, 0.28)	0.26*** (0.01, 0.35)
Slope on Experience	0.11/0.00*** (0.00, 0.00)	-0.03/0.00 (-0.00, 0.00)	0.04/0.00 (-0.00, 0.00)	0.13/0.00*** (0.00, 0.00)
<i>Level 1 Fixed Effects</i> (b , CI of b)				
Intercept of Outcome	1.33*** (1.29, 1.37)	4.40*** (4.34, 4.45)	3.32*** (3.27, 3.38)	2.97*** (2.92, 3.02)
Intercept of Slope	-0.06 (-0.12, 0.01)	0.13** (0.04, 0.23)	-0.26*** (-0.33, -0.19)	-0.06 (-0.15, 0.03)

Note. Cross-Level Interactions = statistical interaction of level 1-*Time* and level 2-*ADHD, Age, Gender, Experience*. β = standardized regression weight; b = unstandardized regression weight; CI = 95% confidence interval (lower limit, upper limit); TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$; [^] standardized regression weight not computed for categorical predictor.

Table 8. Results from the two-level regression models for behavioral intentions in Aim 3

Model Parameter	Outcome	
	Intention to TWD in the Future	Intention to Intervene in the Future
AIC/BIC for Intercept Model	4701.77/ 4755.20	5773.12/ 5846.55
AIC/BIC for Study Model	4434.87/ 4485.70	5574.97/ 5625.80
<i>Cross-Level Interactions</i> (β , b , CI of b)		
Slope on ADHD	0.12/0.02*** (0.01, 0.03)	-0.10/-0.02** (-0.04, -0.01)
Slope on Age	-0.00/-0.00 (-0.06, 0.05)	-0.00/-0.00 (-0.07, 0.07)
Slope on Gender[^]	0.16*** (0.06, 0.19)	-0.16** (-0.26, -0.06)
Slope on Experience	0.07/0.00 (-0.00, 0.00)	-0.07/0.00*** ⁺ (-0.00, 0.00)
<i>Level 1 Fixed Effects</i> (b , CI of b)		
Mean of Outcome	1.58*** (1.53, 1.63)	3.99*** (3.93, 4.05)
Intercept of Slope	-0.26*** (-0.31, -0.20)	0.45*** (0.37, 0.5)

Note. Cross-Level Interactions = statistical interaction of level 1-*Time* and level 2-*ADHD*, *Age*, *Gender*, *Experience*. β = standardized regression weight; b = unstandardized regression weight; CI = 95% confidence interval (lower limit, upper limit); TWD = texting-while-driving; * $p < .05$, ** $p < .01$, *** $p < .001$; [^] standardized regression weight not computed for categorical predictor; ⁺ cross-level interaction taken as non-significant given CI containing zero.

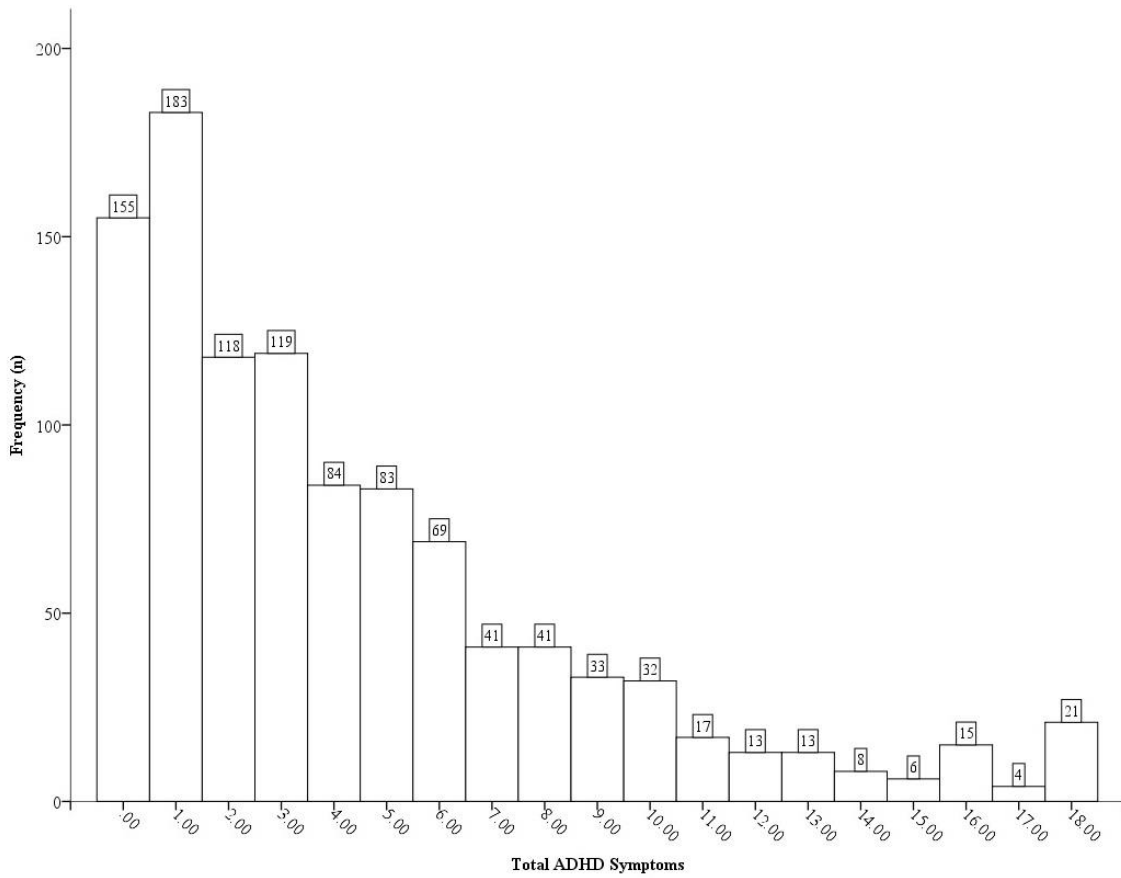


Figure 1. Distribution of ADHD symptoms

Note. Frequency (n) on y-axis corresponds to number of participants, shown above each bar, endorsing each symptom count total out of 18 symptoms of ADHD.

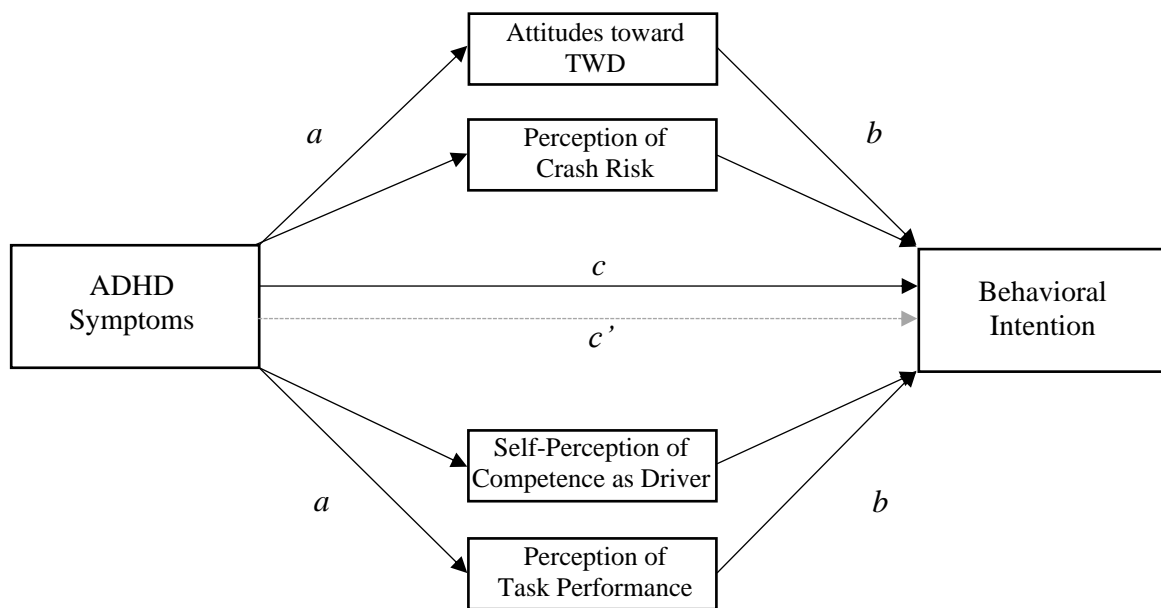


Figure 2. Hypothesized multiple mediation model. *a* path = mediators regressed on independent variable; *b* path = dependent variable regressed on mediators; *c* path = dependent variable regressed on independent variable; *c'* path = dependent variable regressed on independent variable while controlling for indirect effect of mediators.

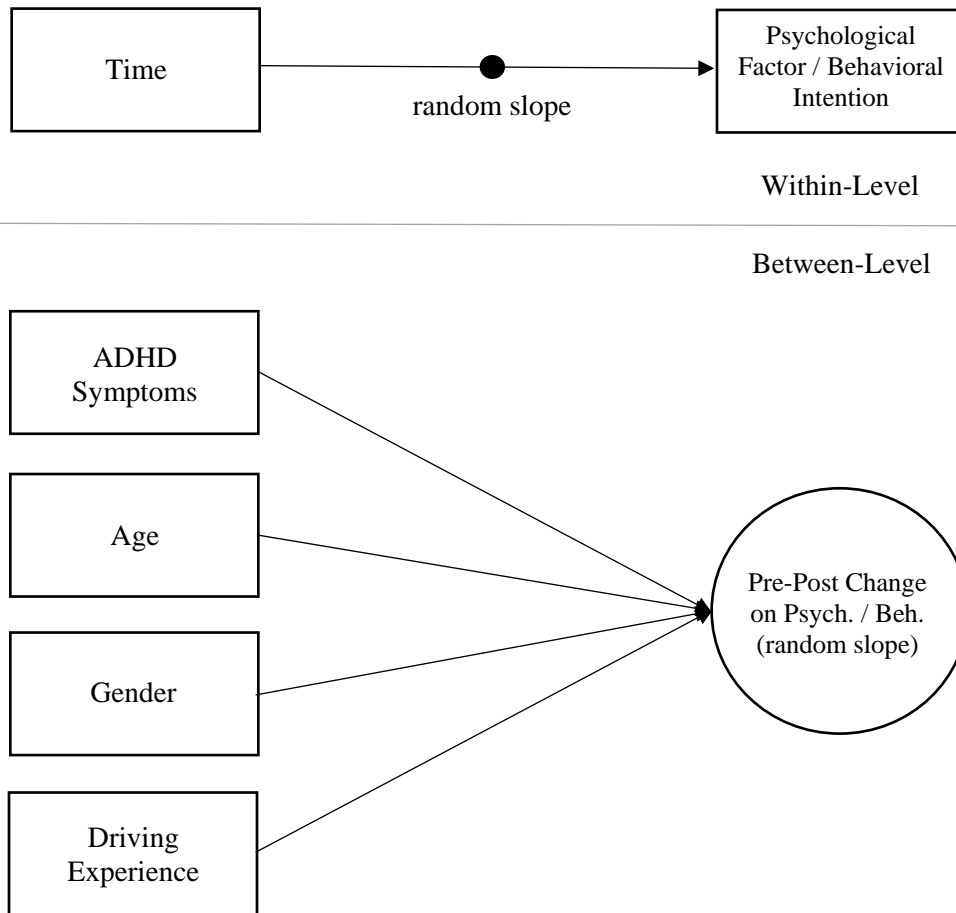


Figure 3. Hypothesized two-level regression model without a random intercept. The random slope is shown in a circle because it represents a continuous latent variable that varies by cluster (participant ID). The within-level is level 1 of a conventional multilevel model, and the between-level is level 2. The random slope of the within-level is defined by the linear regression of the psychological factor or behavioral intention variable (different for each model) on time, that is, pre- to post-program. The default estimator is maximum likelihood with robust standard errors (MLR).

Note. This is a standard hypothesized model so each model run for Aim 3 has a distinct psychological factor (“Psych.” in the model) or behavioral intention variable (“Beh.” in the model) as the outcome (on the right side of these figures).

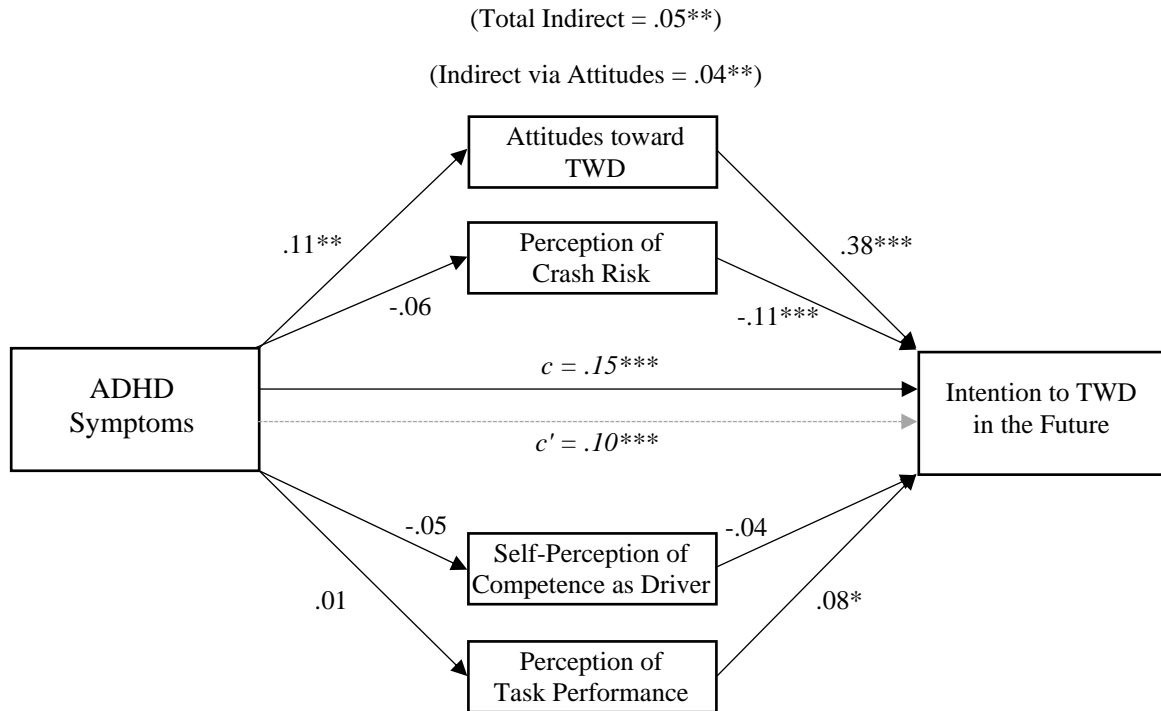


Figure 4. Multiple mediation model of the association between ADHD symptoms and intention to TWD in the future via psychological factors. Driver age, gender, and driving experience were included as covariates.

Note. Standardized regression coefficients are provided along the paths; * $p < .05$, ** $p < .01$, *** $p < .001$, significance in these models implies 95% CI that does not include zero; c path = intention variable regressed on ADHD symptoms; c' path = intention variable regressed on ADHD symptoms while controlling for indirect effect of psychological factors; significant indirect effects are provided in parentheses.

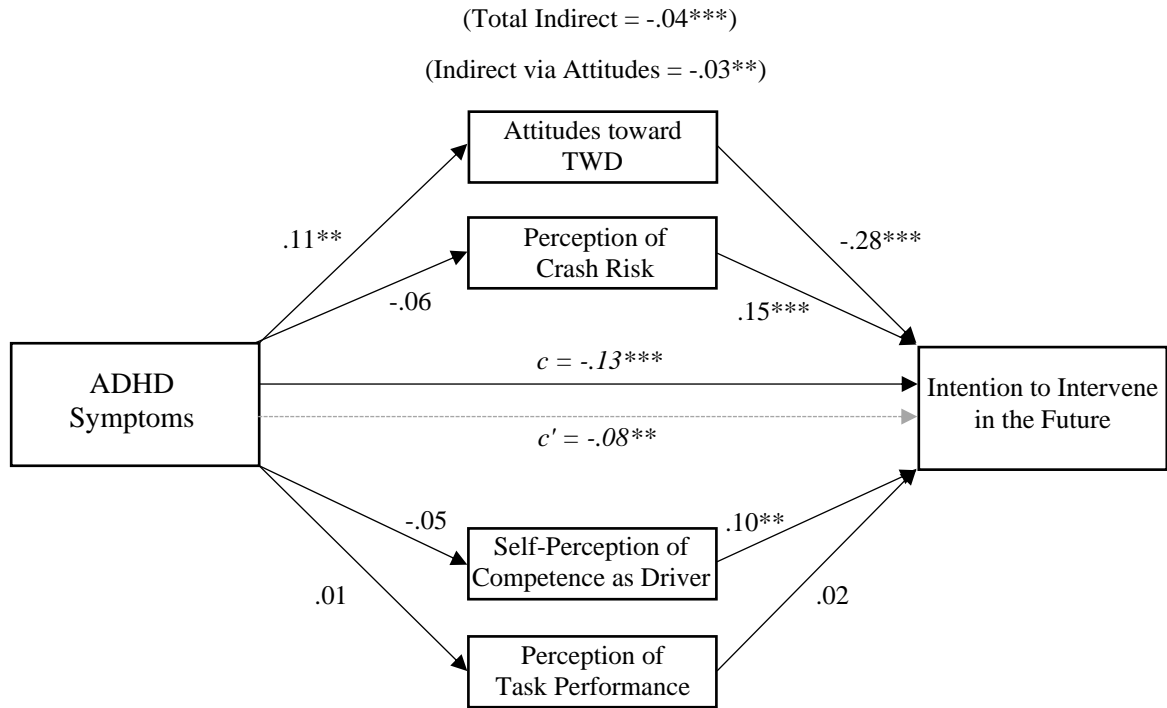


Figure 5. Multiple mediation model of the association between ADHD symptoms and intention to intervene on a distracted driver in the future via psychological factors. Driver age, gender, and driving experience were included as covariates.

Note. Standardized regression coefficients are provided along the paths; * $p < .05$, ** $p < .01$, *** $p < .001$, significance in these models implies 95% CI that does not include zero; c path = intention variable regressed on ADHD symptoms; c' path = intention variable regressed on ADHD symptoms while controlling for indirect effect of psychological factors; significant indirect effects are provided in parentheses.

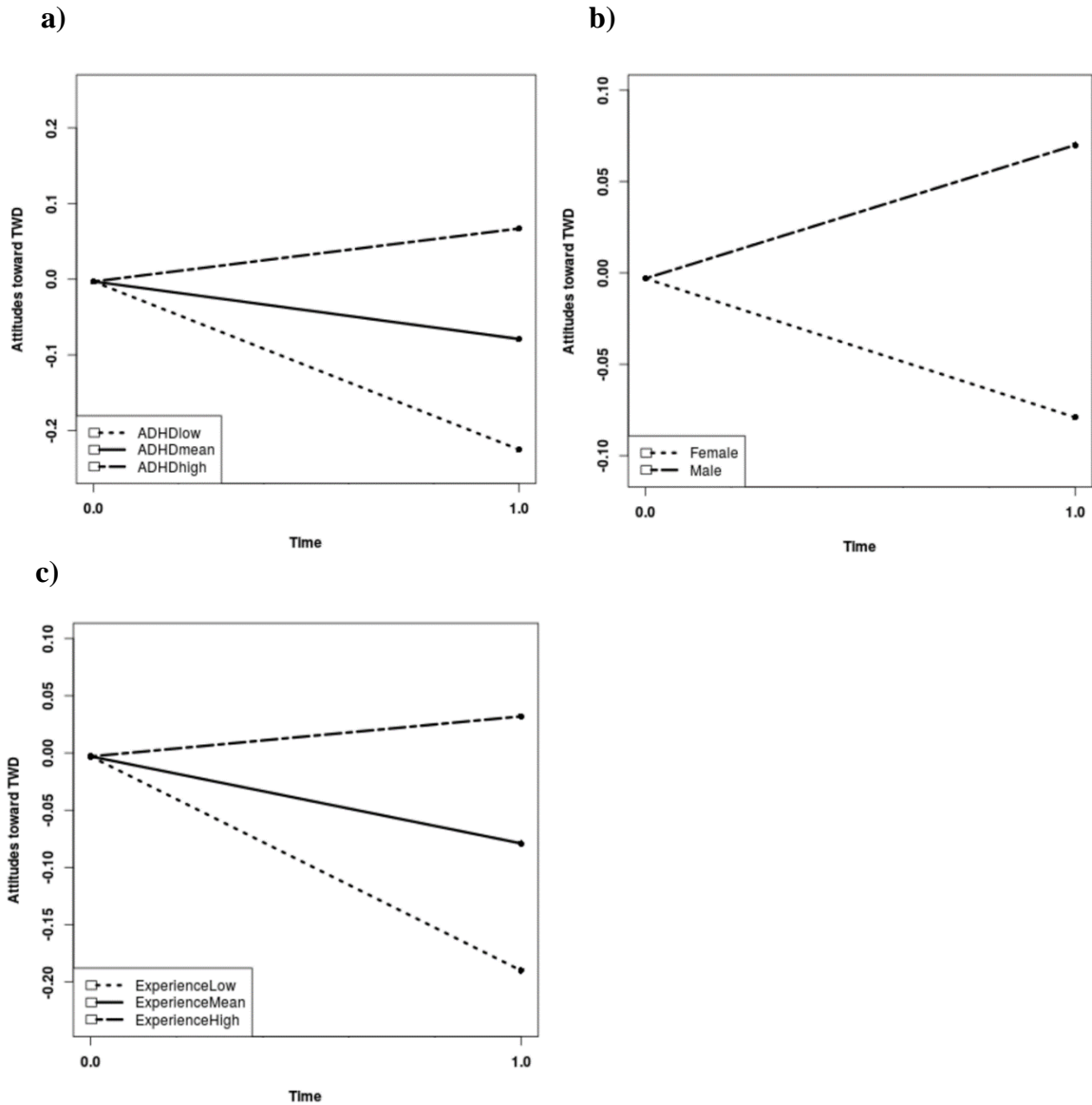


Figure 6. Simple slopes from the fully-standardized model for the significant cross-level interactions of level 1-time and level 2-ADHD (a), -gender (b), and -experience (c) for y = attitudes toward TWD.

Note. Time 0 = pre-program, Time 1 = post-program; “variable”-low = 1SD below sample mean, “variable”-high = 1SD above sample mean.

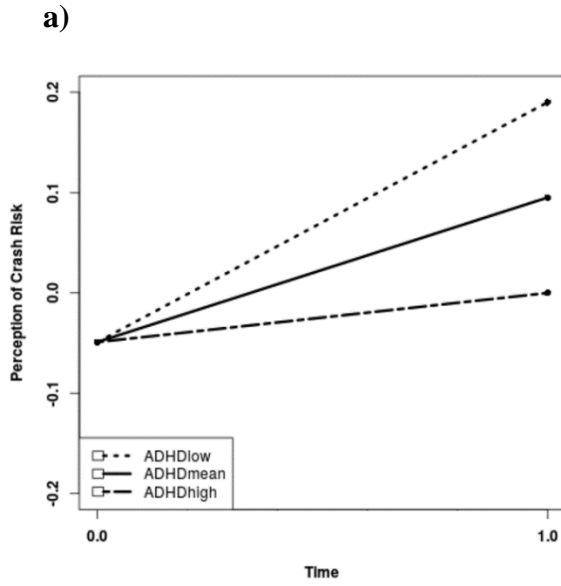


Figure 7. Simple slopes from the fully-standardized model for the significant cross-level interactions of level 1-time and level 2-ADHD (a) for y = perceptions of crash risk. Note. Time 0 = pre-program, Time 1 = post-program; “variable”-low = 1SD below sample mean, “variable”-high = 1SD above sample mean.

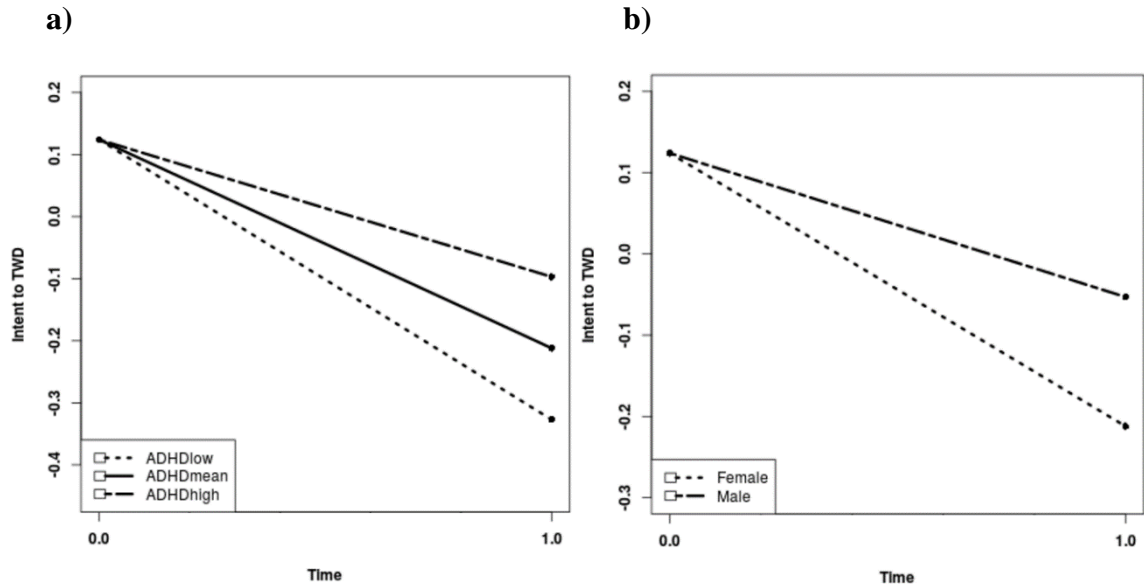


Figure 8. Simple slopes from the fully-standardized model for the significant cross-level interactions of level 1-time and level 2-ADHD (a) and -gender (b) for y = intent to TWD. Note. Time 0 = pre-program, Time 1 = post-program; “variable”-low = 1SD below sample mean, “variable”-high = 1SD above sample mean.

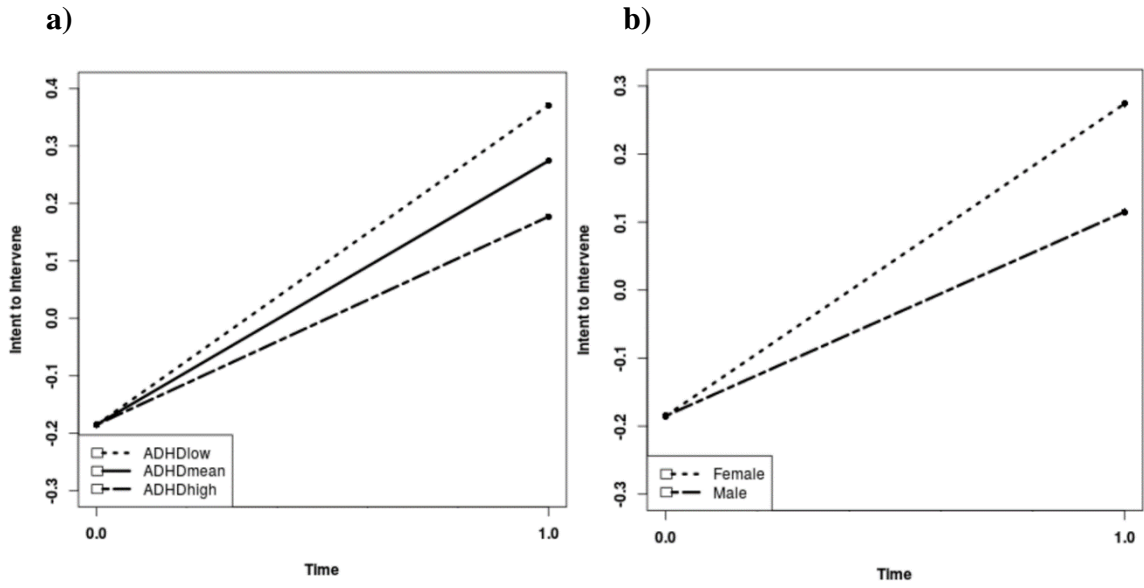


Figure 9. Simple slopes from the fully-standardized model for the significant cross-level interactions of level 1-time and level 2-ADHD (a) and -gender (b) for y = intent to intervene.

Note. Time 0 = pre-program, Time 1 = post-program; “variable”-low = 1SD below sample mean, “variable”-high = 1SD above sample mean.

References

- AAA Foundation for Traffic Safety (2016). *2015 Traffic safety culture index*. Washington, DC: AAA Foundation.
- Abelson, R. (1995). Making claims with statistics. In R. P. Abelson (Ed.), *Statistics as Principled Argument* (pp. 69-79). Hillsdale, NJ.
- Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, *84*, 888-918.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211.
- Alicke, M.D. & Govorun, O. (2005). The better-than-average effect. In M.D. Alicke, D.A. Dunning, & J.I. Krueger (Eds.), *The self in social judgment* (pp.85-106). New York, NY: Psychology Press.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Barkley, R. A., & Cox, D. (2007). A review of driving risks and impairments associated with attention-deficit/hyperactivity disorder and the effects of stimulant medication on driving performance. *Journal of Safety Research*, *38*(1), 113-128.
- Barkley, R. A., Guevremont, D. G., Anastopoulos, A.D., DuPaul, G. J., & Shelton, T. L. (1993). Driving-related risks and outcomes of attention deficit hyperactivity disorder in adolescents and young adults: A 3–5 year follow-up survey. *Pediatrics*, *92*(2), 212–218.
- Barkley, R. A., Murphy, K. R., & Kwasnik, D. (1996). Motor vehicle driving competencies and risks in teens and young adults with attention deficit hyperactivity disorder. *Pediatrics*, *98*(6), 1089-1095.
- Barkley, R. A., Murphy, K. R., DuPaul, G. J., & Bush, T. (2002). Driving in young adults with attention deficit hyperactivity disorder: Knowledge, performance, adverse outcomes, and the role of executive functioning. *Journal of the International Neuropsychological Society*, *8*(5), 655–672.
- Barr, D.J., Levy, R., Scheepers, C., & Tily, H.J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*(3). doi: 10.1016/j.jml.2012.11.001.

- Beanland, V., Fitzharris, M., Young, K., & Lenné, M. (2013). Driver inattention and driver distraction in serious causality crashes: Data from the Australian National Crash In-Depth Study. *Accident Analysis and Prevention*, *54*, 99-107.
- Beyth-Marom, R., Austin, L., Fischhoff, B., Palmgren, C., & Jacobs-Quadrel, M. (1993). Perceived consequences of risky behaviors: Adults and adolescents. *Developmental Psychology*, *29*(3), 549-563.
- Bianchi, A. & Summala, H. (2004). The “genetics” of driving behavior: Parents’ driving style predicts their children’s driving style. *Accident Analysis and Prevention*, *36*(4), 655-659.
- Biederman, J., Faraone, S., Spencer, T. J., Wilens, T., Norman, D., Laper, K. A., . . . & Doyle, A. (1993). Patterns of psychiatric comorbidity, cognition, and psychosocial functioning in adults with attention deficit hyperactivity disorder. *American Journal of Psychiatry*, *150*, 1792-1798.
- Biederman, J., Fried, R., Monuteaux, M. C., Reimer, B., Coughlin, J. F., Surman, C. B., . . . & Spencer, T. J. (2007). A laboratory driving simulation for assessment of driving behavior in adults with ADHD: A controlled study. *Annals of General Psychiatry*, *6*(1), 4.
- Breyer, J.L., Botzet, A.M., Winters, K.C., Stinchfield, R.D., August, G. & Realmuto, G. (2009). Young adult gambling behaviors and their relationship with the persistence of ADHD. *Journal of Gambling Studies*, *25*(2), 227-238.
- Boccaro, V., Delhomme, P., Vidal-Gomel, C., & Rogalski, J. (2011). Development of self-assessment abilities for the driving task in general and three specific driving situations amongst driving-learners during their initial training. *Accident Analysis and Prevention*, *43*, 1488–1496.
- Center for Disease Control. (2016). Deaths: Leading causes for 2013. *National Vital Statistics Reports*, *65*(2), 1-92.
- Center for Disease Control. (2015). *Teen drivers: Get the facts*. Retrieved from http://www.cdc.gov/MotorVehicleSafety/Teen_Drivers/teendriversfactsheet.html.
- Cordellieri, P., Baralla, F., Ferlazzo, F., Sgalla, R., Piccardi, L., & Giannini, A.M. (2016). Gender effects in young road users on road safety attitudes, behaviors and risk perception. *Frontier Psychology*, *7*, 1412.
- Corso, P., Finkelstein, E., Miller, T., Fiebelkorn, I., & Zaloshnja, E. (2006). Incidence and lifetime costs of injuries in the United States. *Injury Prevention*, *12*(4), 212-218.

- Crisler, M.C., Brooks, J.O., Ogle, J.H., Guirl, C.D., Alluri, P., & Dixon, K.K. (2008). Effect of wireless communication and entertainment devices on simulated driving performance. *Transportation Research Record, 2069*, 48-54.
- Deery, H.A., & Fildes, B.N. (1999). Young novice driver subtypes: Relationship to high-risk behavior, traffic accident record, and simulator driving performance. *Human Factors, 41*, 628-643.
- Dingus, T., Klauer, S., Neale, V., Petersen, A., Lee, S., Sudweeks, J., . . . & Knipling, R. (2006). *The 100-Car Naturalistic Driving Study: Phase II—Results of the 100-Car Field Experiment*. Interim Project Report for DTNH22-00-C-07007, Task Order 6, Report No. TBD. Washington, D.C.: National Highway Traffic Safety Administration.
- Dowson, J. H. & Blackwell, A. D. (2010). Impulsive aggression in adults with attention-deficit/hyperactivity disorder. *Acta Psychiatrica Scandinavica, 121*(2), 103–110.
- Drews, F. A., Pasupathi, M., & Strayer, D. L. (2008). Passenger and cell phone conversations in simulated driving. *Journal of Experimental Psychology: Applied, 14*, 392-400.
- Dula, C.S., & Ballard, M.E. (2003). Development and evaluation of a measure of dangerous, aggressive, negative emotional, and risky driving. *Journal of Applied Social Psychology, 33*, 263-282.
- Dula, C.S., Martin, B.A., Fox, R.T., & Leonard, R.L. (2012). *Keep your dorsolateral prefrontal cortex on the road: Examining relationships between impulsivity and dangerous driving*. Unpublished manuscript.
- Dula, C., Martin, B., Fox, R., & Leonard, R. (2011). Can you hear me now? Relationship between conversation types and dangerous driving. *Accident Analysis and Prevention, 43*(1), 187-193.
- Durbin, D.R., McGehee, D.V., Fisher, D., & McCartt, A.T. (2014). Special considerations in distracted driving with teens. *Annals of Advances in Automotive Medicine, 58*, 69-83.
- Elder, R.W., Shults, R.A., Sleet, D.A., Nichols, J.L., Thompson, R.S., Rajab, W., & Task Force on Community Preventive Services. (2004). Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-involved crashes: A systematic review. *American Journal of Preventative Medicine, 27*(1), 57-65.
- Ellison-Potter, P., Bell, P., & Deffenbacher, J. (2001). The effects of trait driving anger, anonymity, and aggressive stimuli on aggressive driving behavior. *Journal of Applied Social Psychology, 31*, 431-443.

- Fabiano, G., Schatz, N., Hulme, K., Morris, K., Vujnovic, R., Willoughby, M., . . . & Pelham, W. (2015). Positive bias in teenage drivers with ADHD within a simulated driving task. *Journal of Attention Disorders*. doi: 10.1177/1087054715616186.
- Faraone, S. V., Biederman, J., & Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: A meta-analysis of follow-up studies. *Psychological medicine*, 36(2), 159-166.
- Farmer, J.E. & Peterson, L. (1995). Injury risk factors in children with attention deficit hyperactivity disorder. *Health Psychology*, 14(4), 325-332.
- Ferguson, S., Teoh, E., & McCartt, A. (2007). Progress in teenage crash risk during the last decade. *Journal of Safety Research*, 38, 137-145.
- Fischer, M., Barkley, R. A., Smallish, L., & Fletcher, K. (2007). Hyperactive children as young adults: Driving abilities, safe driving behaviors and adverse driving outcomes. *Accident Analysis and Prevention*, 39(1), 94–105.
- Forster, S., Robertson, D. J., & Jennings, A. (2014). Plugging the attention deficit: Perceptual load counters increased distraction in ADHD. *Neuropsychology*, 28(1), 91–97.
- Fosco, W.D. & Hawk, L.W. (2015). Relating lab to life: Decrements in attention over time predict math productivity among children with ADHD. *Child Neuropsychology*, 23(2), 148-158.
- Fox, R.T., Dula, C.S., Martin, B.A., & Leonard, R.L. (2012). *Understanding the role of impulsiveness in dangerous driving behaviors*. Unpublished manuscript.
- Fried, R., Petty, C., Surman, C., Reimer, B., Aleari, M., Martin, J., . . . & Biederman, J. (2006). Characterizing impaired driving in adults with attention deficit/hyperactivity disorder: A controlled study. *Journal of Clinical Psychiatry*, 67(4), 567–574.
- Gjervan, B.R., Torgersen, T., Nordahl, H.M., & Rasmussen, K. (2012). Functional impairment and occupational outcome in adults with ADHD. *Journal of Attention Disorders*, 16(7), 544-552.
- Glendon, A.I. (2011). Traffic psychology: A state-of-the-art review. In Martin, P.R., Cheung, F.M., Knowles, M. C., Kyrios, M., Littlefield, L., Overmier, J.B., Prieto, J.M. (Eds.), *The IAAP handbook of applied psychology* (pp. 545–558). Oxford: Wiley-Blackwell.
- Glendon, A.I., McNally, B., Jarvis, A., Chalmers, S.L., & Salisbury, R.L. (2014). Evaluating novice driver and pre-driver road safety intervention. *Accident Analysis and Prevention*, 64, 100-110.

- Governor's Highway Safety Alliance (2010). *Curbing Distracted Driving: 2010 Survey of State Safety Programs*. Washington, DC: Governors Highway Safety Association.
- Greenberg, J., Tijerina, L., Curry, R., Artz, B., Cathey, L., Grant, P., . . . & Blommer, M. (2003). *Evaluation of driver distraction using an event detection paradigm*. Paper Presented at the 2003 Annual Meeting of the Transportation Research Board.
- Greenwood, S., Perrin, A., & Duggan, M. (2016). *Social media update 2016*. Washington, DC: Pew Research Center.
- Grinter, R. E. & Eldridge, M. (2001). 'y do tngrs luv 2 txt msg?'. In W. Prinz, M. Jarke, Y. Rogers, K. Schmidt and V. Wulf (Eds.), *Proceedings of the Seventh European Conference on Computer Supported Cooperative Work ECSCW '01* (pp. 219-238). Dordrecht, Netherlands: Kluwer Academic Publishers.
- Guenther, C.L. & Alike, M.D. (2010). Deconstructing the better-than-average affect. *Journal of Personality and Social Psychology, 99*(5), 755-770.
- Harré, N., Brandt, T., & Dawe, M. (2000). The development of risky driving in adolescence. *Journal of Safety Research, 31*, 185–194
- Harré, N., Foster, S., & O'Neill, M. (2005) Self-enhancement, crash-risk optimism and the impact of safety advertisement on young drivers. *British Journal of Psychology, 96*, 215-230.
- Hechtman, L., Swanson, M., Sibley, S., Arnold, L., Owens, E., Mitchell, J., . . . & Nichols, J.Q. (2016). Functional adult outcomes 16 years after childhood diagnosis of attention-deficit/hyperactivity disorder: MTA results. *JAMA Psychiatry, 55*(11), 945-952.
- Hatfield, J. & Fernandes, R. (2009). The role of risk-propensity in the risky driving of young drivers. *Accident Analysis and Prevention, 41*, 25–35.
- Hosking, S., Young, K., & Regan, M. (2009). The effects of text messaging on young drivers. *Human Factors, 51*, 582-592.
- Hosking, S., Young, K., & Regan, M. (2006). *The Effects of Text Messaging on Young Novice Driver Performance*. Report funded by The National Roads and Motorists' Association (NRMA) Motoring and Services and NRMA Insurance.
- Howell, D.C. (2010). *Statistical methods for psychology*. Belmont, CA: Thomson Wadsworth.
- Hoza, B., Gerdes, A. C., Hinshaw, S. P., Arnold, L. E., Pelham, W. E., Molina, B. S. G., . . . & Wigal, T. (2004). Self-perceptions of competence in children with ADHD

- and comparison children. *Journal of Consulting and Clinical Psychology*, 72, 382–391.
- Hoza, B., McQuade, J.D., Murray-Close, D., Shoulberg, E., Molina, B.S., Arnold, L.E., Swanson, J., & Hechtman, L. (2014). Does childhood positive self-perceptual bias mediate adolescent risky behavior in youth from the MTA study? *Journal of Consulting and Clinical Psychology*, 81(5), 846-848.
- Hoza, B., Murray-Close, D., Arnold, L.E., Hinshaw, S.P., Hechtman, L., & the MTA Cooperative Group. (2011). Time-dependent changes in positively biased self-perceptions of children with ADHD: A developmental psychopathology perspective. *Developmental Psychopathology*, 22(2), 375-390.
- Hoza, B., Pelham, W.E., Dobbs, J., Owens, J.S., & Pillow, D.R. (2002). Do boys with attention-deficit/hyperactivity disorder have positive illusory self-concepts? *Journal of Abnormal Psychology*, 111(2), 268-278.
- IBM Corp. Released 2014. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.
- Insurance Institute of Highway Safety (2015). *Teenagers*. Retrieved from <http://www.iihs.org/iihs/topics/t/teenagers/fatalityfacts/teenagers>.
- Ivers, R., Senserrick, T.M., Boufous, S., Stevenson, M., Chen, H.Y., Woodward, M., & Norton, R. (2009). Novice drivers' risky driving behavior, risk perception, and crash risk: Findings from the DRIVE study. *American Journal of Public Health*, 99, 1638–1644.
- Iversen, H. (2004). Risk-taking attitudes and risky driving behaviour. *Transportation Research Part F*, 7, 135–150.
- Iversen, H., Rundmo T., & Klempe, H. (2005). Risk attitudes and behaviour among Norwegian adolescents. *European Psychologist*, 10, 25–38.
- Jerome, L., Segal, A. U., & Habinski, L. (2006). What we know about ADHD and driving risk: A literature review, meta-analysis, and critique. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, 15(3) 105-125.
- Jovanovic, D., Stanojevic, P., & Stanojevic, D. (2011). Motives for, and attitudes about, driving related anger and aggressive driving. *Social Behavior and Personality*, 39, 755–764.
- Kass, S.J., Beede, K.E., & Vodanovich, S.J. (2010). Self-report measures of distractibility as correlates of simulated driving performance. *Accident Analysis and Prevention*, 42, 874-880.

- Kass, R.E. & Raftery, A.E. (1995). Bayes factors. *Journal of the American Statistical Association*, 90(430), 773-795.
- Kenny, D.A. (1987). *Statistics for the social and behavioral sciences*. Little, Brown and Company Limited.
- Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., . . . & Secnik, K. (2006). The prevalence and correlates of adult ADHD in the United States: Results from the National Comorbidity Survey Replication. *The American Journal of Psychiatry*, 163(4), 716-723.
- Klauer, S. G., Dingus, T. A., Neale, V. L., Sudweeks, J. D., & Ramsey, D. J. (2006). *The Impact of Driver Inattention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Driving Study Data*. Blacksburg, Virginia: Virginia Tech Transportation Institute.
- Klauer, S.G., Feng, G., Simons-Morton, B.G., Ouimet, M.C., Lee, S., & Dingus, T.A. (2014). Distracted driving and risk of road crashes among novice and experienced drivers. *New England Journal of Medicine*, 370, 54-59.
- Klauer, S.G., Olsen, E.C., Simons-Morton, B.G., Dingus, T.A., Ramsey, D.J., & Ouimet, M.C. (2008). Detection of road hazards by novice teen and experienced adult drivers. *Transportation Research Record*, 2078, 26-32.
- Knouse, L. E., Mitchell, J. T., Brown, L. H., Silvia, P. J., Kane, M. J., Myin-Germeys, I., & Kwapil, T. R. (2008). The expression of adult ADHD symptoms in daily life: An application of experience sampling methodology. *Journal of Attention Disorders*, 11(6), 652-663.
- Knouse, L. E., Bagwell, C. L., Barkley, B. A., & Murphy, K. R. (2005). Accuracy of self-evaluation in adults with ADHD: Evidence from a driving study. *Journal of Attention Disorders*, 8(4), 221-234.
- Kraus, S.J. (1995). Attitudes and the prediction of behavior: A meta-analysis of the empirical literature. *Personality and Social Psychology Bulletin*, 21, 58-75.
- Kruger, J. (1999) The “below-average effect” and the egocentric nature of comparative ability judgments.” *Journal of Personality and Social Psychology*, 77, 221-232.
- Lahatte, A. & Le Pape, M-C. (2008). Is the way young people drive a reflection of the way their parents drive? An econometric study of the relation between parental risk and their children’s risk. *Risk Analysis*, 28(3), 627-634.
- Lavie, N. (2005). Distracted and confused? Selective attention under load. *Trends in Cognitive Sciences*, 9(2), 75-82.

- Lee, J. (2007). Technology and Teen Drivers. *Journal of Safety Research*, 38(2), 203-213.
- Lee, S.E., Simons-Morton, B.G., Klauer, S.E., Ouimet, M.C., & Dingus, T.A. (2011). Naturalistic assessment of novice teenage crash experience. *Accident Analysis and Prevention*, 43, 1472-1479.
- Lenné, M.G., Dietze, P.M., Triggs, T.J., Walmsley, S., Murphy, B., & Redman, J.R. (2010). The effects of cannabis and alcohol on simulated arterial driving: Influences of driving experience and task demand. *Accident Analysis and Prevention*, 42, 859-866.
- Lerner N. & Boyd, S. (2005). *Task Report: On-Road Study of Willingness to Engage in Distracting Tasks*. Report Jointly Funded Under National Highway Safety Administration and National Institute of Child Health and Human Development.
- Lesch, M. & Hancock, P. (2004). Driving Performance during Concurrent Cell-Phone Use: Are Drivers Aware of their Performance Decrements? *Accident Analysis and Prevention*, 36, 471-480.
- Levine, T.R., Weber, R., Hullett, C., Park, H.S., & Lindsey, L.L. (2008). A critical assessment of null hypothesis significance testing in quantitative communication research. *Human Communication Research*, 38, 171-187.
- Lonero, L.P. & Mayhew, D.R. (2010). *Teen driver safety: Large-scale evaluation of driver education review of the literature on driver education evaluation (2010 update)*. AAA Foundation for Traffic Safety, Washington, DC.
- Lund, I.O. & Rundmo, T. (2009). Cross-cultural comparisons of traffic safety, risk perception, attitudes, and behaviour. *Safety Science*, 47, 547-553.
- Maggs, J.L., Schulenberg, J., & Hurrelmann, K. (1997). Developmental transitions during adolescence: Health promotion implications. In Maggs, J.L., Schulenberg, J., & Hurrelmann, K. (Eds.), *Health Risks and Developmental Transitions during Adolescence* (pp. 522-546). New York: Cambridge University Press.
- Mallinckrodt, B., Abraham, W.T., Wei, M., & Russel, D.W. (2006). Advances in testing the statistical significance of mediation effects. *Journal of Counseling Psychology*, 53(3), 372-378.
- Mayhew, D.R. & Simpson, H.M. (1995). *The role of driving experience: Implications for training and licensing of new drivers*. Occasional report, Insurance Bureau of Canada.
- Mayhew, D.R., Simpson, H.M., & Pak, A. (2003). Changes in collision rates among novice drivers during the first months of driving. *Accident Analysis and Prevention*, 35, 683-691.

- Mayhew, D.R. (2007). Driver education and graduated licensing in North America: Past, present, and future. *Journal of Safety Research*, 38, 229–235.
- McCartt, A.T., Kidd, D.G., & Teoh, E.R. (2014). Driver cellphone and texting bans in the United States: Evidence of effectiveness. *Annals of Advances in Automotive Medicine*, 58, 99-114.
- McCartt, A.T., Shabanova, V.I., & Leaf, W.A. (2003). Driving experience, crashes, and traffic citations of teenage beginning drivers. *Accident Analysis and Prevention*, 35(3), 311-320.
- Milch-Reich, S., Campbell, S.B., Pelham, W.E., Connelly, L.M., & Geva, D. (1999). Developmental and individual differences in children's on-line representations of dynamic social events. *Child Development*, 70(2), 413-431.
- Moeller, C. W., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., & Swann, A. C. (2001). Psychiatric aspects of impulsivity. *American Journal of Psychiatry*, 158, 1783-1793.
- Murphy, K., & Barkley, R. A. (1996). Prevalence of DSM-IV symptoms of ADHD in adult licensed drivers: Implications for clinical diagnosis. *Journal of Attention Disorders*, 1(3), 147-161.
- Mynttinen, S., Sundström, A., Koivukoski, M., Hakuli, K., Keskinen, E., & Henriksson, W. (2009). Are novice drivers overconfident? A comparison of self-assessed and examiner-assessed driver competences in a Finnish and Swedish sample. *Transportation Research Part F*, 12, 120–130.
- Mynttinen, S., Sundström, A., Vissers, J., Koivukoski, M., Hakuli, K., & Keskinen, E. (2009). Self-assessed driver competence among novice drivers: A comparison of driving test candidate assessments and examiner assessments in a Dutch and Finnish sample. *Journal of Safety Research*, 40, 301–309.
- Nada-Raja, S., Langley, J. D., McGee, R., Williams, S.M., Begg, D.J., & Reeder, A.I. (1997). Inattentive and hyperactive behaviors and driving offences in adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36(4), 515–522.
- Narad, M.E., Garner, A.A., Antonini, T.N., Kingery, K.M., Tamm, L., Calhoun, H.R., & Epstein, J.N. (2015). Negative consequences of poor driving outcomes reported by adolescents with and without ADHD. *Journal of Attention Disorders*. doi: 10.1177/1087054715575063.
- Narad, M., Garner, A. A., Brassell, A. A., Saxby, D., Antonini, T. N., O'Brien, K. M., ... & Epstein, J. N. (2013). Impact of distraction on the driving performance of adolescents with and without attention deficit/ hyperactivity disorder. *JAMA Pediatrics*, 167(10), 933-938.

- National Highway Traffic Safety Administration. (2008). *National Motor Vehicle Crash Causation Survey: Report to Congress*. Washington, DC.
- National Highway Traffic Safety Administration (2012). *Novice driver education and training administration standards*. National Center for Statistics and Analysis, Washington: U.S. Department of Transportation.
- National Highway Traffic Safety Administration (2013). *Traffic safety facts: Distracted driving 2011*. National Center for Statistics and Analysis, Washington: U.S. Department of Transportation.
- National Highway Traffic Safety Administration (2015). *Traffic safety facts: Distracted driving 2013*. National Center for Statistics and Analysis, Washington: U.S. Department of Transportation.
- Nickerson, R.S. (2000). Null hypothesis significance testing: A review of an old and continuing controversy. *Psychological Methods*, 5(2), 241-301.
- Olsen, E., Lerner, N., Perel, M., & Simons-Morton, B. (2005). *In-Car Electronic Device Use Among Teen Drivers*. Paper Presented at the 2005 Annual Meeting of the Transportation Research Board.
- Olsen, E., Simons-Morton, B., & Lee S. (2006). *Novice Teen and Experienced Adult Drivers on the Smart Road Intersection: Does Six Months of Experience Matter?* Paper Presented at the 2006 Annual Meeting of the Transportation Research Board.
- Owens, J. S., Goldfine, M. E., Evangelista, N. M., Hoza, B., & Kaiser, N. M. (2007). A critical review of self-perceptions and the positive illusory bias in children with ADHD. *Clinical Child and Family Psychology Review*, 10(4), 335-351.
- Owsley, C., McGwin, G., & McNeal, S.F. (2003). Impact of impulsiveness, venturesomeness, and empathy on driving by older adults. *Journal of Safety Research*, 34, 353-359.
- Paaver, M., Eensoo, D., Kaasik, K., Vaht, M., Maestu, J., & Harro, J. (2013). Preventing risky driving: A novel and efficient brief intervention focusing on acknowledgment of personal risk factors. *Accident Analysis and Prevention*, 50, 430-437.
- Peck, R.C. (2011). Do driver training programs reduce crashes and traffic violations? A critical examination of the literature. *IATSS Research*, 34, 63-71.
- Pew Research Center (2011). *Americans and text messaging*. Pew Research Center. Retrieved from <http://www.pewinternet.org/files/old-media/Files/Reports/2011/Americans%20and%20Text%20Messaging.pdf>.

- Phillips, R.O., Ulleberg, P., & Vaa, T. (2011). Meta-analysis of the effect of road safety campaigns on accidents. *Accident Analysis and Prevention*, *43*, 1204–1218.
- Preacher, K.J. & Hayes, A.F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879-891.
- Prevatt, F., Proctor, B., Best, L., Baker, L., Van Walker, J., & Taylor, N.W. (2011). The positive illusory bias: Does it explain self-evaluations in college students with ADHD? *Journal of Attention Disorders*, *16*(3), 235-243.
- Price, P.C. (2001). A group size effect on personal risk judgments: Implications for unrealistic optimism. *Memory and Cognition*, *29*, 578–586.
- Rakauskas, M. Gugerty, L., & Ward, N. (2004). Effects of naturalistic cell phone conversations on driving performance. *Journal of Safety Research*, *35*, 453-464.
- Randell, N.J., Charlton, S.G., & Starkey, N.J. (2016). Driving with ADHD: Performance effects and environment demand in traffic. *Journal of Attention Disorders*. doi: 10.1177/1087054716658126.
- Reimer, B., D’Ambrosio, L. A., Coughlin, J. E., Fried, R., & Biederman, J. (2007). Task-induced fatigue and collisions in adult drivers with attention deficit hyperactivity disorder. *Traffic Injury Prevention*, *8*, 290–299.
- Reimer, B., Mehler, B., D’Ambrosio, L. A., & Fried, R. (2010). The impact of distractions on young adult drivers with attention deficit hyperactivity disorder (ADHD). *Accident Analysis and Prevention*, *42*(3), 842-851.
- Renz, K., Lorch, E.P., Milich, R., Lemberger, C., Bodner, C., & Welsh, R. (2003). On-line story representation in boys with attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology*, *31*(1), 93-104.
- Richards, T. L., Deffenbacher, J. L., Rosen, L. A., Barkley, R. A., & Rodricks, T. (2006). Driving anger and driving behavior in adults with ADHD. *Journal of Attention Disorders*, *10*(1), 54-64.
- Rowe, R., Maughan, B., Gregory, A.M., & Eley, T.C. (2013). The development of risky attitudes from pre-driving to fully-qualified driving. *Injury Prevention*. doi: 10.1136/onjryprev-2012-040551.
- Rundmo, T. (1999). Perceived risk, health and consumer behavior. *Journal of Risk Research*, *2*, 187–200.
- Safren, S.A., Sprich, S., Mimiaga, M.J., Surman, C., Knouse, L., Groves, M., & Otto, M.W. (2010). Cognitive behavioral therapy vs. relaxation with educational support for medication-treated adults with ADHD and persistent symptoms: A

- randomized controlled trial. *Journal of the American Medical Association*, 304(8), 875-880.
- Sarkar, S. & Andreas, M. (2004). Acceptance of and engagement in risky driving behaviors by teenagers. *Adolescence*, 39, 687-700.
- Sarver, D.E., McCart, M.R., Sheidow, A.J., & Letourneau, E.J. (2014). ADHD and risky sexual behavior in adolescents: Conduct problems and substance use as mediators of risk. *Journal of Child Psychology and Psychiatry*, 55(12), 1345-1353.
- Schwebel, D.C., Severson, J., Ball, K.K., & Rizzo, M. (2006). Individual differences factors in risky driving: The roles of anger/hostility, conscientiousness, and sensation-seeking. *Accident Analysis and Prevention*, 38, 801–810.
- Senserrick, T.M. (2007). Recent developments in young driver education, training and licensing in Australia. *Journal of Safety Research*, 38, 237–244.
- Senserrick, T.M., Ivers, R., Boufous, S., Chen, H.Y., Norton, R., Stevenson, M., van Beurden, E., & Zask, A. (2009). Young driver education programs that build resilience have potential to reduce road crashes. *Pediatrics*, 124, 1287–1292.
- Shanmugaratnam, S., Kass, S.J., & Arruda, J.E. (2010). Age differences in cognitive and psychomotor abilities and simulated driving. *Accidence Analysis and Prevention*, 42(3), 802-808.
- Sheehan, M., Siskind, V., & Schonfeld, C. (2004). *A longitudinal study of adolescent drink driving and other risk taking behaviors: Challenges for the change process*. Paper presented at the 17th International Conference on Alcohol Drugs and Traffic Safety, Glasgow, Scotland.
- Shope, J.T. (2006). Influences on youthful driving behavior and their potential for guiding interventions to reduce crashes. *Injury Prevention*, 12, i9–i14.
- Sjoberg, L., Moen, B.E., & Rundmo, T. (2004). *Explaining risk perception. An evaluation of the psychometric paradigm in risk perception research*. Retrieved from www.svt.ntnu.no/psy/Torbjorn.Rundmo/Psychometric_paradigm.pdf.
- Sleet, D.A. & Baldwin, G. (2010). Lost in translation: Translating injury research into effective interventions. In Doll, L.S., Bonzo, S.E., Mercy, J.A., Sleet, D.A., (Eds.), *Handbook of injury and violence prevention* (pp. 493–510). New York, NY: Springer.
- Stanton, N.A., Walker, G.H., Young, M.S., Kazi, T., & Salmon, P.M. (2007). Changing drivers' minds: The evaluation of an advanced driver coaching system. *Ergonomics*, 50, 1209– 1234

- Strayer, D., Drews, F., & Crouch, J. (2006). A Comparison of the cell phone driver and the drunk driver. *Human Factors*, *48*(2), 381-391.
- Strecher, V.J., Bauermeister, J.A., Shope, J., Chang, C., Newport-Berra, M., Giroux, A., & Guay, E. (2006). Interventions to promote safe driving behaviour: Lessons learned from other health-related behaviours. *Behavioural Research in Road Safety 2006*. United Kingdom Department for Transport.
- Stutts, J., Feaganes, J., Reinfurt, D., Rodgman, E., Hamlett, C., Gish, K., & Staplin, L. (2005). Driver's exposure to distractions in their natural driving environment. *Accident Analysis and Prevention*, *37*, 1093-1101.
- Sumer, N., Ozkan, T., & Lajunen, T. (2006). Asymmetric relationship between driving and safety skills. *Accident Analysis and Prevention*, *38*(4), 703-711.
- Sundström, A. (2011). The validity of self-reported driver competence: Relations between measures of perceived driver competence and actual driving skill. *Transportation Research Part F*, *14*, 155-163.
- Svenson, O., Fischhoff, D., & MacGregor, D. (1985). Perceived driving safety and seatbelt usage. *Accident Analysis and Prevention*, *17*, 119-133.
- Swanson, J.M., Arnold, L.E., Brooke, S.G., Sibley, M.H., Hechtman, L.T., Hinshaw, S.P., . . . & Kraemer, H. (under review). *Young adult outcomes in the follow-up of the Multimodal Treatment Study of Attention-Deficit/Hyperactivity Disorder: Symptoms persistence, source discrepancy, and height suppression*.
- Swanson, J.M., Kraemer, H.C., Hinshaw, S.P., Arnold, L.E., Conners, C.K., . . . & Wu, M. (2001). Clinical relevance of the primary findings of the MTA: Success rates based on severity of ADHD and ODD symptoms at the end of treatment. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*(2), 168-179.
- Taubman-Ben-Ari, O. (2008). Motivational sources of driving and their associations with reckless driving cognitions and behavior. *European Review of Applied Psychology*, *58*(1), 51-64.
- Taubman-Ben-Ari, O., Mikulincer, M., & Gillath, O. (2005). From parents to children: Similarity in parents and offspring driving styles. *Transportation Research Part F*, *8*, 19-29.
- Teese, R., & Bradley, G. (2008). Predicting recklessness in emerging adults: A test of a psychosocial model. *The Journal of Social Psychology*, *148*(1), 105-126.
- Thompson, A. L., Molina, B. S., Pelham, W. Jr., & Gnagy, E.M. (2007). Risky driving in adolescents and young adults with childhood ADHD. *Journal of Pediatric Psychology*, *32*(7), 745-759.

- Thornton, B., Faires, A., Robbins, M., & Rollins, E. (2014). The mere presence of a cell phone may be distracting: Implications for attention and task performance. *Social Psychology, 45*(6), 479-488.
- Treat, J.R., Tumbas, N.S., McDonald, S.T., Shinar, D., Hume, R.D., Mayer, R.E., Stansifer, R.L., & Castellano, N.J. (1979). *Tri-level study of the causes of traffic accidents: Final report*. U.S. Department of Transportation, National Highway Traffic Safety Administration, Contract No. DOT HS-034-535.
- Ulleberg, P. & Rundmo, T. (2002). Risk-taking attitudes among young drivers: The risk taking psychometric qualities and dimensionality of an instrument to measure young drivers' attitudes. *Scandinavian Journal of Psychology, 43*, 227–237.
- Ulleberg, P. & Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science, 41*, 427–443.
- Ulleberg, P. (2004). Social influence from the back-seat: Factors related to adolescent passengers' willingness to address unsafe drivers. *Transportation Research Part F, 7*, 17–30.
- Vaa, T. (2014). ADHD and relative risk of accidents in road traffic: A meta-analysis. *Accident Analysis and Prevention, 62*, 415–425.
- Vermont Department of Motor Vehicles. (2016). *Graduated License Law*. Retrieved from <http://dmv.vermont.gov/licenses/drivers/GDL>.
- Vlingo Corporation (2009). Consumer text messaging habits. *Distracted Driving*. Retrieved from <http://www.vlingo.com/sites/default/files/Texting%20Survey%20Results%20FINAL5.21v2.pdf>.
- Walsh, S. P., White, K. M., Hyde, K. M., & Watson, B. (2008). Dialing and driving: Factors influence intentions to use a mobile phone while driving. *Accident Analysis and Prevention, 40*(6), 1893–1900.
- Watabe, Y., Owens, J.S., Serrano, V., & Evans, S.W. (2017). Is positive bias in children with attention deficit hyperactivity disorder a function of low competence or disorder status. *Journal of Emotional and Behavioral Disorders*. doi: 10.1177/1063426616683376.
- Weafer, J., Camarillo, D., Fillmore, M.T., Milich, R., & Marczyński, C.A. (2008). Simulated driving performance of adults with ADHD: Comparisons with alcohol intoxication. *Experimental Clinical Psychopharmacology, 16*(3), 251-263.
- Weiss, G., Hechtman, L., Perlman, T., Hopkins, J., & Werner, A. (1979). Hyperactives as young Adults: A controlled prospective ten-year follow-up of 75 children. *Archives of General Psychiatry, 36*(6), 675-681.

- West, S.G., Finch, J.F., & Curran, P.J. (1995). Structural equation models with non-normal variables: Problems and remedies. In Hoyle, R. (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp.56-75). Thousand Oaks, CA: Sage.
- White, M.J., Cunningham, L.C., & Titchener, K. (2011). Young drivers' optimism bias for accident risk and driving skill: Accountability and insight experience manipulations. *Accident Analysis and Prevention*, 43, 1309–1315.
- Williams, A. (2003). Teenage drivers: Patterns of risk. *Journal of Safety Research*, 34, 5-15.
- Williams, J. & MacKinnon, D.P. (2008). Resampling and distribution of the product methods for testing indirect effects in complex models. *Structural Equation Modeling*, 15(1), 23-51.
- Williamson, A. (2003). *Why are young drivers over represented in crashes?* New South Wales Motor Accidents Authority, Sydney.
- Woodward, L.J., Fergusson, D. M., & Horwood, L.J. (2000). Driving outcomes of young people with attentional difficulties in adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39(5), 627–634.

Appendix A

Pre-Program Survey

[Four-digit serialized NUMBER]

TURN OFF TEXTING.COM

Anonymous BEFORE-Demo Survey
(Complete this survey before participating in the golf cart activity)



Today's date: _____ Your school's name: _____

What is your age? _____ What is your gender? Female Male Non-binary Don't want to say

Which of the following is true about your licensing status?

- I do not have a Learner Permit, Junior Operator License, or Operator License.
- I currently have a Learner Permit.
 - I have held a Learner Permit for _____ months (or _____ years).
- I currently have a Junior Operator License.
 - I have held a Junior Operator License for _____ months (or _____ years).
- I have an Operator License.
 - I have held an Operator License for _____ months (or _____ years).

- 1) If you are a **passenger in a vehicle** driven by someone texting or emailing, do you (or would you) ask them to stop?
 - Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.
- 2) Do you think that **texting or emailing** while driving is acceptable?
 - Unacceptable. Somewhat unacceptable. Uncertain. Somewhat acceptable. Acceptable.
- 3) Do you think that **talking on the phone** (hands-free) while driving is acceptable?
 - Unacceptable. Somewhat unacceptable. Uncertain. Somewhat acceptable. Acceptable.
- 4) How likely is someone to be in a crash if they are **texting or emailing** while driving?
 - Definitely unlikely. Somewhat unlikely. Uncertain. Somewhat likely. Likely.
- 5) How likely is someone to be in a crash if they are **talking on the phone** (hands-free) while driving?
 - Definitely unlikely. Somewhat unlikely. Uncertain. Somewhat likely. Likely.
- 6) Compared to others your age, how competent are you as a driver?
 - Less competent than others. Somewhat less competent than others. Equally as competent as others. Somewhat more competent than others. More competent than others.
- 7) How likely is it that you will text and drive in the future? Never Not very likely Once in a while Regularly
- 8) How well do you think you will do on this drive compared to other participants your same age?
 - Worse than others my age. Somewhat worse than others my age. Equally as well as others my age. Somewhat better than others my age. Better than others my age.
- 9) How many cones do you think you will hit or knock over during your drive today? _____
- 10) Will you **text or email** while driving in the future?
 - Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.
- 11) Will you talk on the phone while driving in the future?
 - Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.

Run 1		Run 2 (Texting)	
Time	Errors	Time	Errors

Appendix B

Post-Program Survey

[Four-digit serialized NUMBER]

TURN OFF TEXTING.COM

Anonymous AFTER-Demo Survey
(Complete this survey after participating in the golf cart activity)



- 1) If you are a **passenger in a vehicle** driven by someone texting or emailing, do you (or would you) ask them to stop?
 Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.
- 2) Do you think that **texting or emailing** while driving is acceptable?
 Unacceptable. Somewhat unacceptable. Uncertain. Somewhat acceptable. Acceptable.
- 3) Do you think that **talking on the phone** (hands-free) while driving is acceptable?
 Unacceptable. Somewhat unacceptable. Uncertain. Somewhat acceptable. Acceptable.
- 4) How likely is someone to be in a crash if they are **texting or emailing** while driving?
 Definitely unlikely. Somewhat unlikely. Uncertain. Somewhat likely. Likely.
- 5) How likely is someone to be in a crash if they are **talking on the phone** (hands-free) while driving?
 Definitely unlikely. Somewhat unlikely. Uncertain. Somewhat likely. Likely.
- 6) Compared to others your age, how competent are you as a driver?
 Less competent than others. Somewhat less competent than others. Equally as competent as others. Somewhat more competent than others. More competent than others.
- 7) How likely is it that you will text and drive in the future? Never. Not very likely. Once in a while. Regularly.
- 8) How well do you think you did on this drive compared to other participants your same age?
 Worse than others my age. Somewhat worse than others my age. Equally as well as others my age. Somewhat better than others my age. Better than others my age.
- 9) How many cones do you think you hit or knocked over during your drive today? _____
- 10) Was the text sent: Yes No
- 11) Did you find this useful? Yes Somewhat No
- 12) Will you **text or email** while driving in the future?
 Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.
- 13) Will you talk on the phone while driving in the future?
 Definitely would not. Likely would not. Uncertain. Likely would. Definitely would.

Turn the survey over to continue...

14) To what extent are the following true about you? Be honest and choose only one response:

	Not at all or never	Just a little or once in a while	Pretty much or often	Very much or frequently
I lose things necessary for tasks or activities (e.g. to-do lists, pencils, books, or tools).				
I have trouble keeping my attention focused when working.				
I am forgetful in my daily activities.				
I have trouble listening to what other people are saying.				
I make careless mistakes or have trouble paying close attention to details.				
I don't like homework or job activities where I have to think a lot.				
I have trouble finishing job tasks or schoolwork.				
I am distracted when things are going on around me.				
I have problems organizing my tasks and activities.				
I talk too much.				
I have trouble doing leisure activities quietly.				
I leave my seat when I am not supposed to.				
I have trouble waiting in line or taking turns with others.				
I am always on the go.				
I fidget (with my hands or my feet) or squirm in my seat.				
I am restless or overactive.				
I give answers to questions before the questions have been completed.				
I interrupt others when they are working or playing.				

Please give this survey to the golf cart demo presenter or your instructor. Thanks!

Comments, suggestions and personal statements are welcome! Or, for 100 karma points, draw a flattering portrait of your golf cart demo presenter:

Note. Survey instruments included with permission from Jim Lockridge of Youth Safety Council of Vermont