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The Supporting a Teen's Effective Entry to the Roadway (STEER) Program: Feasibility and
Preliminary Support for a Psychosocial Intervention for Teenage Drivers with ADHD

Gregory A. Fabiano

Kevin Hulme

Stuart Linke

Chris Nelson-Tuttle

Meaghan Pariseau

Brian Gangloff

Kemper Lewis

William E. Pelham

Daniel A. Waschbusch

James G. Waxmonsky

Matthew Gormley

Shradha Gera

Melina Buck

University at Buffalo, SUNY

Address Correspondence to:

Gregory A. Fabiano, Ph.D.

University at Buffalo, Diefendorf Hall 106

Buffalo NY 14214

Abstract

Teenage drivers with attention-deficit/hyperactivity disorder (ADHD) are at considerable risk for negative driving outcomes including traffic citations, accidents, and injuries. Presently, no efficacious psychosocial interventions exist for teenage drivers with ADHD. The Supporting a Teen's Effective Entry to the Roadway (STEER) program is a multi-component intervention that was developed to help families with a teenager with ADHD negotiate the transition independent driving. The present report includes outcomes from seven teens with ADHD who enrolled in the eight-week program. Using a multiple baseline design across participants, teens had driving behavior continuously monitored using on-board monitors that measured driving behaviors (i.e., hard braking, speed), and the parents and teens reported on driving-related impairment each week. Results indicated promising effects across participants, though there were individual differences in treatment response within and across participants and measures. The STEER program was viewed as acceptable to participants as all families completed the STEER program and reported it to be a palatable intervention.

The Supporting a Teen's Effective Entry to the Roadway (STEER) Program: Feasibility and Preliminary Support for an Intervention for Teenage Drivers with ADHD

Americans drivers between 16-20 years old have by far the greatest injury and fatality rate compared to other age groups (National Highway Traffic and Safety Commission, 2005), and adolescent drivers are a prominent public health concern (American Academy of Pediatrics, 2006). Outcomes are even worse when one considers the driving records of adolescents diagnosed with attention-deficit/hyperactivity disorder (ADHD; Barkley & Cox, 2007; Jerome, Segal, & Habinski, 2006). There is now clear, converging evidence from multiple prospective studies with well-diagnosed adolescents with ADHD and comparison, non-ADHD adolescents, that teen drivers with ADHD have more accidents (Fischer et al., 2007; Nada-Raja et al., 1997; Thompson et al., 2007; Woodward, Fergusson, & Horwood, 2000) that result in greater costs (Fischer et al., 2007), injuries (Woodward et al., 2000), and fatalities (Lambert, 1995) than those without ADHD. Adolescent drivers with ADHD are also more likely to be cited for a traffic citation or reckless driving, driving without a license, having hit-and-run accidents, and having a revoked or suspended license (see Barkley & Cox, 2007 for a review). Adolescents with attention problems are also significantly more likely to drive under the influence of alcohol and to have been arrested for this behavior (Woodward et al., 2000) and alcohol has a strong negative effect on the driving of those with ADHD, more so than those without ADHD (Barkley, Murphy, O'Connell, Anderson, & Connor 2006; Weafer et al., 2008).

At the same time that these driving problems are occurring, parents of adolescents may find that parenting becomes more difficult and complex, with increased conflict during this developmental transition (Steinberg, 2001; Steinberg & Morris, 2001). Parenting adolescents with ADHD may be particularly challenging, given the increase in the intensity of negative

behaviors and potential consequences within the context of a long history of parent-child conflict (Robin & Foster, 2003). The initiation to independent driving is one developmental transition confronted by families during the teenage years. Given the untoward outcomes of teens with ADHD related to driving, efficacious interventions are needed to facilitate negotiation of this difficult developmental period and prevent negative outcomes related to driving. Driving is one of the last developmental hurdles an adolescent must clear before transitioning into adulthood, essentially making it one of the final opportunities to target parent-child relationships. Moreover, the teen may be more likely to be motivated for making a behavior change when it is linked to a desired outcome, such as access to a car.

There is a growing literature that demonstrates stimulant medication acutely improves the behavior (Evans et al., 2001), as well as driving outcomes, of teenagers with ADHD (e.g., Cox et al., 2006; Cox et al., 2004; Jerome et al., 2006). However, compliance with stimulant medication regimens may be poor (Marcus et al., 2005; Molina et al., 2009). Beyond medication, few efficacious psychosocial treatment programs for ADHD adolescents exist, relative to child treatments (Barkley, Edwards, & Robin, 1999; Evans et al., 2007; Pelham & Fabiano, 2008; Smith et al., 2000), and those that work are not widely available. There also does not appear to be a viable psychosocial treatment alternative specifically for adolescent drivers with ADHD. There is also a question about whether other interventions, such as driver's education classes, are effective for teen drivers with ADHD. Although commonly employed (Clinton & Lonero, 2006), systematic reviews suggest little to no benefit of these classes on driving outcomes with adolescents in general (Cochrane Injuries Group Driver Education Reviewers, 2001).

Thus, efficacious psychosocial approaches are needed. Such approaches for teen drivers with ADHD can be informed by the research literature on graduated driver licensing (GDL)

approaches. The GDL approach places limits and restrictions on novice drivers (e.g., no passengers allowed in the car; no nighttime driving), and it has resulted in reductions in car crashes where implemented (e.g., Shope & Molnar, 2003; Shope, Molnar, & Elliott, 2001). Coupled with this, there is limited but promising data on the impact of behavioral parent training for families with a teenager with ADHD (Barkley et al., 1992; Barkley et al., 2001). Both approaches emphasize parental monitoring and limit-setting (Barkley, Edwards, & Robin, 1999; Simons-Morton, Hartos, & Beck, 2003; Simons-Morton, Hartos, & Leaf, 2002; Simons-Morton, Hartos, Leaf, & Preeusser, 2005), and it is possible that combining these approaches may have a positive impact on teen drivers with ADHD.

Technological innovations, such as in-vehicle recorders and on-board monitors of driving behavior may also support the safety of teen drivers (Toledo, Musicant, & Lotan, 2008). There are now a number of commercially available products that can monitor engine performance (i.e., speed), global positioning systems can track location and adherence to parental boundaries, and there are cameras that can record teen behavior and the roadway simultaneously before risky events (e.g., abrupt braking). It is clear, however, that simply monitoring teen driving, especially the driving of at-risk teens, such as those with ADHD, is insufficient, and that promising approaches include feedback to the teen and parent on driving performance (Farmer, Kirley, & McCartt, 2010). McGehee et al. (2007) reported that an event-triggered on-board video and data recording device supplemented with weekly report cards reviewed with parents resulted in reduced risky driving events. Importantly, these results were largely attributable to the 7 drivers in the study who exhibited high-rates of risky driving behaviors; the other 18 participants (also new drivers) had relatively unremarkable rates of risky driving throughout the study. Thus, these approaches may be especially useful with at-risk drivers, namely those with ADHD.

One limitation of the GDL approach and on-board monitors is that there is considerable variability in parents' oversight of the GDL limits and monitoring of driving-related data, which lessens the impact of these potentially efficacious interventions (e.g., Goodwin, Waller, Foss, & Margolis, 2006). In cases where educational or informational interventions are used alone, results are non-significant (e.g., Chaudary, Ferguson, & Herbel, 2004), suggesting the need for more intensive approaches. Parents may also have undeveloped plans for monitoring teen drivers during the entry to licensure when asked directly, and there may be some degree of ambivalence regarding driving/engine performance monitoring of teen driving behaviors in deference to the teen's privacy (McCartt, et al., 2007). Parents may also fail to follow-through on monitoring their teen's driving, even when monitors are installed (Farmer et al., 2010). Thus, alternative approaches that move beyond the non-intensive provision of information or tools are needed to help parents of teens with ADHD implement and monitor GDL approaches. Further, parents need tools such as on-board car driving monitoring technology (see McGehee, et al., 2007) to provide accurate feedback and facilitate the supervision of teen driving as parental impressions or teen report are likely to be insufficient (e.g., young adult samples of individuals with ADHD indicate poor insight into driving problems; Fischer, Barkley, Smallish, & Fletcher, 2007; Knouse et al., 2005).

Because of the serious negative outcomes related to teen drivers with ADHD, and that the initiation of driving is an important family transition, it may be an opportune time to engage parents and teens in an intervention. Parents may be motivated for treatment given concerns about their adolescent's safety. Further, adolescents, who are traditionally difficult to engage in treatment, may be optimally primed for participation due to a strong desire to drive. To address this area of impairment, the Supporting a Teen's Effective Entry to the Roadway (STEER)

program was developed. The STEER program integrates a *driving-targeted* behavioral parent training program, communication training for the teen and parents, supervised practice in a driving simulator facilitated by clinician coaching, parental monitoring of objective driving behaviors using innovative technology, and contingency management aimed at promoting safe driving behaviors. Preliminary outcomes on the feasibility and impact of the STEER program are presented in this paper.

Method

Participants

Participants in the study were seven teenagers with ADHD and their parent(s) who enrolled in the eight-week STEER program. Families with a 16-17 year old adolescent within a 30-mile radius of a western New York university were sent a direct mail recruitment flyer from a marketing company that described the STEER program, eligibility criteria, and asked interested families to contact the investigators for more information. The mailing resulted in 25 families who called and completed a telephone screening interview to determine eligibility, which included being licensed to drive, having the teen and at least one parent willing to participate in the study, and a history of behaviors and impairment consistent with ADHD. Teens could also have no conditions that would prohibit driving (e.g., seizures, suspended licenses). Eight families were determined to meet initial eligibility requirements and were invited for a meeting to complete the informed consent and intake procedures. Seven of these eight families followed through and were eventually enrolled in the study (the teen in one family refused to come with the mother into the clinic and therefore the family did not pursue the study). Eligibility criteria assessed at the intake included a diagnosis of ADHD, IQ over 80, and consent/assent to participate in the study.

Parents of teenagers in the study completed the Disruptive Behavior Disorders interview (Hartung, McCarthy, Milich, & Murphy, 2005), a semi-structured interview on Diagnostic and Statistical Manual (DSM) symptoms of ADHD (American Psychiatric Association, 2000) administered by advanced graduate students supervised by a Ph.D.-level psychologist. Parents and teachers were also asked to complete the Disruptive Behavior Disorders rating scale of ADHD symptoms (Pelham, Gnagy, Greenslade, & Milich, 1992) and the Impairment Rating Scale (Fabiano et al., 2006), and clinicians conducted a review of records (i.e., elementary and high school report cards, psychoeducational reports). Inclusion criteria included a DSM diagnosis of ADHD (American Psychiatric Association, 2000). Diagnoses were made by a Ph.D. level psychologist, and they were made using information collected via the DBD interview and the parent and teacher rating scales. Across the interview and ratings, at least six symptoms of inattention and/or hyperactivity-impulsivity had to be endorsed. Information on the age of onset of ADHD symptoms was obtained using the DBD interview, and cross-situational impairment in functioning was assessed using the Impairment Rating Scale (IRS; Fabiano et al., 2006). Following the intake four teenagers were diagnosed with ADHD, Primarily Inattentive Type and three teens were diagnosed with ADHD, Combined Type. Two of the teenagers were diagnosed with comorbid Oppositional Defiant Disorder. Participants also had an IQ greater than or equal to 80 as measured by the Wechsler Abbreviated Scale of Intelligence (Psychological Corporation, 1999), and they had no medical conditions that would prevent driving (e.g., seizure disorder). All participants were licensed to drive in New York State. Table 1 includes baseline assessment information for the seven adolescents in the study on the diagnostic measures.

Participants who enrolled in the study were four girls and three boys, and all were Caucasian. The average age was 17.08 years ($SD=.40$). For five of the cases, the mother and

father enrolled in the study, and for two cases only the mother participated with the teen (i.e., Case 2 and Case 6). For the mothers in the study, one had a high school diploma, one had completed some college, four had bachelor's degrees, and one had a master's degree. For fathers who participated in the study, four had associate's degrees and one had a bachelor's degree. Teens in the study were in eleventh grade (2 teens), twelfth grade (4 teens), and home-schooled (one teen). Medication was not manipulated as part of this study, but participants were asked to hold all medication prescriptions constant, if possible, or report changes immediately; no changes were reported for any participant in the study. Three teens were unmedicated, three were prescribed stimulant medication and one was prescribed anti-depressant medication.

The driving histories of the participants are remarkable for considerable negative outcomes. For the five teens who had regularly drove without parental passengers, individual driving histories included two accidents (one of which caused injury), two driving citations and a minor accident, four speeding tickets, one minor accident, and a minor accident and a speeding ticket, respectively. The other two cases had no history of driving transgressions. It is important to note these teens, although licensed, always drove with a parent as a passenger at the initiation of the study.

Measures

Study measures related to driving were collected on a weekly basis, and included the teen and participating parents. Adolescents were provided a \$10.00 gift card for each weekly assessment completed, which included consistent use of the on-board driving monitors. Specific measures are described below.

Objective measurement of Driving Behaviors. Each teenager had his/her car equipped with the CarChipPro (http://www.davisnet.com/drive/products/CarChip_Teen.asp) and

TravelEyes global positional system (GPS; <http://www.traveleyes.com/>) monitoring devices. These devices yielded objective driving data for all teen trips each week. The data included top speed, the amount of time driving over 70 miles per hour, instances of abrupt and extreme braking, instances of abrupt and extreme acceleration, and whether the device was disconnected. In this paper we report representative outcomes on this measure, including the average top speed for one case (case 3) and the frequency counts of hard/extreme braking and hard/extreme acceleration for all cases. Because teenagers drove a different amount of miles each week, the weekly frequency was standardized by dividing by the total miles driven in an attempt to account for the time in the car. Teens and parents kept a log of teen driving events during the week for families where the car was shared. The log and the data print out were reviewed with the families each week, and discrepancies were clarified before data were included in weekly discussions. The devices also recorded any instances when it was disconnected during the week.

Disruptive Behavior Disorders (DBD) Rating Scale. ADHD, ODD, and CD Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 1994) symptoms were measured using the DBD rating scale (Pelham et al., 1992), which was administered to the child's parent and teacher during intake. The DBD is a 45-item measure that asks parents to rate the DSM symptoms of ADHD, ODD, and CD on a 0-3 point Likert scale (i.e., *Not at all, Just a little, Pretty Much, or Very Much*). The 0-3 ratings were summed across 18 ADHD symptoms and then an average score for ratings across symptoms was computed for each individual for the inattentive and hyperactive-impulsive subscales. For the present study, symptoms endorsed as occurring "pretty much" or "very much" were counted as present in diagnostic decision-making.

Impairment Rating Scale (IRS). The IRS (Evans, Allen, Moore, & Strauss, 2005; Fabiano et al., 2006) is a rating scale that asks parents and teens to rate the severity of the child's

problems and need for treatment and/or special services in important functional domains. The items on the measure were adapted for the present study to ask parents and teens about problems in the parent-teen relationship, family functioning, teen driving, and overall need for treatment/special services, and scores on the measure ranged from 0 (Not a problem/Definitely does not need treatment or special services) to 6 (Extreme problem/Definitely needs treatment or special services). In prior studies, test-retest reliability ranged from .60-.89 over a period of six months, and .54 to .76 over one year. Ratings on the IRS predict mental health or school services, and there is evidence of convergent and discriminant validity (Fabiano et al., 2006). For the present report, the item asking about impairment in the teen's driving was used in the analysis; scores could range from 0.0-6.0. In this study, the IRS was completed weekly, beginning on the day the car monitors were installed and continuing throughout the program.

Driving Behavior Questionnaire (DBQ). The U.S. version of the DBQ was administered to teens at baseline and post-treatment (Donovan, 1993; Reimer, et al., 2005). This measure assesses driving problems and has three factors: driving errors, attention lapses, and traffic law violations. It has good reliability and validity for adolescents (Reimer, et al., 2005).

Parent and Teen Satisfaction. To obtain a measure of parent and teen satisfaction with the intervention, raters completed a measure of consumer satisfaction at the end of the study. The measure was an adapted version of the satisfaction measure used in the Multimodal Treatments for ADHD study (Pelham et al., under review). The measure is divided into three factors: treatment satisfaction, perceived improvement, and demands of treatment. In prior studies, the internal consistency of the items were acceptable for the treatment satisfaction (coefficient alpha = .87), perceived improvement (coefficient alpha = .72), and demands of treatment (coefficient alpha = .84).

Procedures

Mixed methods were utilized in this study. Some measures (i.e., teen report of driving behaviors) were collected before and after treatment. Other measures were collected at post-treatment only (i.e., measures of treatment satisfaction). A multiple-baseline design across participants was also used in this study (Kazdin, 1982). Participants had baseline data on functioning and objective driving outcomes collected for between 2-5 weeks before the STEER program was initiated. Study procedures included collecting data until a stable baseline was obtained, or a worsening trend was observed. However, this procedure was not able to be used across all cases, as intervention was implemented as soon as possible following the observation of very risky driving behaviors (e.g., Case 2), or there was missing data during baseline (e.g., Case 1). It was also not possible to obtain consistent baseline data across measures and raters, an issue common in ADHD samples (Pelham, Fabiano, & Massetti, 2005). Following the baseline period, data collection continued once the STEER program started. To add additional information on outcomes, results also include pre-treatment and post-treatment scores on measures as well as illustrative effect size estimates. The University at Buffalo Child and Youth Institutional Review Board approved the study.

STEER Program

The STEER program is an eight-week, parent-teen intervention focused on improving outcomes for adolescent drivers with ADHD. During each week of the STEER program, sessions are divided into two, 45-minute meetings with the first half including individual parent and teen meetings that occur in parallel and the second half including a joint activity. The specific components of the STEER program are reviewed below.

Motivational Enhancement. During the first session, the adolescent and parents participated in a motivational enhancement exercise. Using procedures related to a motivational interviewing approach (Baer & Peterson, 2002; Miller & Rollnick, 2002; Stormshak & Dishion, 2002), the parent and the adolescent were asked to identify the benefits of participating in the program and potential costs of non-participation using a decisional balance worksheet. Data on the common outcomes for adolescent drivers with ADHD were also presented and discussed.

Teen Portion of Sessions. During the first portion of the meeting, the teen met individually with a counselor to review safe driving behaviors and learn about effective communication and social skills (Robin & Foster, 1989; Smith, Molina, & Eggers, 1997). The content of the teen sessions is listed in Table 2.

Parent Portion of Sessions. In parallel, the parent met with a clinician to review effective parental monitoring, contingency management, and communication skills (Barkley, 1999; Barkley et al., 1992; Barkley et al., 2001; Forgatch & Patterson, 1989; Patterson & Forgatch, 1989; Robin & Foster, 1989). Table 2 lists parent session content.

Parent and Teen Combined Session Portion. Following these individual meetings, the family participated for the second 45 minutes in a joint activity – during three weeks this was practice on a driving simulator, and during these and other weeks a review of objective driving data. During all weeks, families created or reviewed a behavioral contract that targeted issues related to driving or other areas of impairment, and the contract was linked to specific contingences for meeting/not meeting targeted goals. The timing and content of each of these joint sessions is listed in Table 2. Contingency contracts linked objective driving behaviors to rewards and punishments (Smith et al., 1999). Parents and teens were encouraged to generate issues related to driving, operationally define the issue and establish a criterion for solving the

issue, and create a reward for meeting the issue or a punishment for missing the goal. Parents and teens could also include issues and criteria peripheral to driving. For instance, for one of the cases, the teen was often noncompliant with taking stimulant medication. Part of the family's contract included that the teen had to take the morning medication dose in order to use the car. Parents and teens then agreed on how the contract would be monitored and set a date for evaluating and modifying the contract. A sample contract is presented in Figure 1.

During the driving simulation exercises, the teen drove and the parent rode as a passenger. The purpose of these simulations was two-fold: (1) it was expected that these simulations provided additional practice and experience in a safe environment for a novice driver; and (2) for adolescents, and those with ADHD in particular, it is well-documented that they are poor evaluators of their own behavioral weaknesses (Fischer et al., 2007; Hoza, et al., 2002; Hoza, et al., 2004; Knouse et al., 2005; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007). Therefore, the simulations provided the adolescents with concrete behavioral evidence of driving strengths and limitations. To this end, there were a number of hazards developed to challenge the teen drivers, promote discussion between the parent, teen, and clinician, and permit the teen to practice safe and effective driving behaviors. Following the participation in the simulator exercise, parents and teens discussed the experience, problem-solved issues that occurred, and parents were instructed to comment positively on safe driving behaviors exhibited by the teen.

Illustrative content of the joint sessions is conveyed through three brief video vignettes. Video 1 (SteerSimulator.mp4.zip) illustrates the teen and parent engaging in a simulator session. Video 2 (SteerFeedback.mp4.zip) illustrates a feedback session following the simulator practice.

Finally, Video 3 (SteerContract.mp4.zip) provides an example of a parent-teen negotiation session.

Treatment Integrity and Fidelity. A protocol for the STEER program was developed from parent and adolescent program procedures found to be efficacious in controlled outcome studies (Barkley et al., 1999; Barkley et al., 2001; Barkley et al., 1992; Robin & Foster, 1989; Smith et al., 1997). All sessions were taped and treatment integrity was assessed by a review of these tapes and weekly supervision with therapists (Waltz et al., 1993). Integrity checks indicated 100% of planned intervention components were conducted. The integrity of the monitoring system in the teen's cars was also assessed. Teens were compliant with this, in general, with five teens using the devices consistently. Two teens disconnected the system on one occasion the first week, but not thereafter.

Results

Overview

Because this was a study to demonstrate proof-of-concept and feasibility, it was not powered for efficacy analyses. To illustrate any potential treatment effects, effect sizes were calculated for all the outcomes of interest by subtracting the baseline phase mean from the treatment phase mean and dividing by the baseline standard deviation (e.g., Busk & Serlin, 2005; Fabiano et al., 2009). The IRS item related to impairment in driving and objective driving data were combined into panels that illustrate the multiple-baseline across participants design (Figures 2 and 3). These panels were visually analyzed. Teen ratings on the DBQ were collected at baseline and the end of the intervention, and effect sizes were calculated. Finally, treatment palatability data are presented to provide a description of participants' ratings of the intervention.

Driving Outcomes

Table 3 lists descriptive information for the weekly driving data and participant ratings collected during the study, separated by baseline and treatment conditions and averaged across participants. Effect sizes were calculated by subtracting the treatment phase mean from the baseline phase mean and dividing by the baseline standard deviation (Busk & Serlin, 2005). As Table 3 illustrates, the trend in the effect size data was toward improvement during treatment on all measures except hard/extreme acceleration. In addition, the average mean and standard deviation across participants for these objective measures was calculated to obtain an indication of the overall effect of the intervention. Effect sizes across driving measures ranged from .00 to .30 with a median effect size of .28. For ratings on the IRS, results indicated the largest effects on the primary outcome of the intervention, impairment in driving. The effect sizes for the IRS driving impairment item were .35, .59, and 1.87 for the teen, mother, and father ratings, respectively. For secondary targets of the intervention, the parent-teen relationship and family functioning, the results were more modest, with teens ratings' suggesting no effect of the intervention, mothers' ratings suggesting a modest effect, and only fathers' ratings (N=4) suggesting a positive effect of the intervention. On ratings of improvement in overall impairment, mothers ($d=.31$) and teens ($d=.20$) reported a small effect and fathers reported a large effect of intervention ($d=.77$).

For the cases in the study, only one teen demonstrated inappropriate speed during any portion of the study (case 2). In this case, the average top weekly speed during baseline was 96 MPH (SD=2.83) and during treatment it was 77.5 MPH (SD=2.65) – a 20% reduction in top speed. These results may have been even more pronounced, except that the parent was immediately informed of these reckless speeds collected during baseline in the interest of the teen's safety. This feedback resulted in a decrease in overall speed during the baseline phase

(represented in the graph by triangle data-points), and these weeks were not included in the baseline average.

Figure 2 illustrates the results across cases for the hard braking and hard acceleration measures. All data were standardized by dividing the number of events by miles driven during the week. Data were analyzed in a multiple baseline design. Data from the objective driving measures suggested modest improvement for some cases (Case 2, 3, 6). One case (Case 7) appeared to worsen during the treatment phase, which coincided with increased independent driving. Notably, for the cases that exhibited no change, there appeared to be a general floor effect for the measure. None of the participants had a collision during baseline or treatment phases.

The ratings of driving impairment on the IRS is suggestive of treatment effects for most teenagers enrolled in the study (see Figure 3). Using the multiple baseline design for these parent and teen ratings, positive changes in ratings typically occurred after the initiation of the treatment phase, with some cases evincing pronounced and sustained improvement (Case 1, 4, 5). Similar to the objective driving data, case 7 appeared to worsen over the course of treatment.

Teens rated their driving behaviors on the DBQ at their initial intake and at post-treatment. On the Driving Errors factor, the average score was .91 ($SD=.46$) at baseline and .68 ($SD=.47$) at end of treatment. For the Attention Lapses factor the average score was 1.09 ($SD=1.03$) at baseline and .64 ($SD=.36$) at end of treatment. For the Driving Violations factor the average score was .96 ($SD=.87$) at baseline and .70 ($SD=.73$) at end of treatment. These translate into effect sizes of .51, .44, and .31, respectively.

Palatability of the STEER program. At post-treatment, parents and teens completed a measure of satisfaction. Across raters, the STEER intervention was rated as highly palatable,

with no ratings averaging below “neutral.” The mean scores for mothers were 6.36 (SD=.69), 6.64 (SD=.48), and 5.95 (SD=.30) for the improvement, satisfaction, and demands of treatment factors, respectively. Fathers also rated improvement (M=5.90, SD=.65), satisfaction (M=6.20, SD=.27), and demands of treatment (M=6.07, SD=.60) as acceptable. Finally, teens rated improvement (M=6.14, SD=1.07), satisfaction (M=6.43, SD=.79), and demands of treatment (M=5.57, SD=.66) as acceptable. As a further indicator of palatability, all families completed the STEER program (i.e., no families dropped out of the intervention), and missing data were minimal, suggesting parents and teens did were able to comply with the data collection methods.

Discussion

Teenagers with ADHD are at the greatest risk for negative driving outcomes (Barkley & Cox, 2007), and the present paper presents initial findings from a trial aimed at demonstrating the feasibility of a psychosocial parent-teen intervention to promote safe driving behaviors. The present study indicated that the STEER program is feasible, palatable, and there were some promising indications that it may be effective in supporting safe driving behavior. Each of these major results will be discussed below.

In contrast to the large and positive literature on behavior modification interventions for children with ADHD (Fabiano et al., 2009; Pelham & Fabiano, 2008), there has been relatively less study of behavior modification treatments for adolescents with ADHD (i.e., Barkley et al., 1992; Barkley et al., 2001; Jerome et al., 2006; McCleary & Ridley, 1999). In the present investigation, multiple aspects of the STEER program were constructed to accommodate the needs of teen drivers with ADHD including an initial motivational enhancement component, parent and teen sessions, the use of objective monitors of driving behavior, an engaging and action-oriented driving simulation component to enhance awareness and self-efficacy on the part

of the teen and parent(s), and the establishment of clear behavioral contingencies in families, all components consistent with recommendations for chronic disease management (Lorig, 1996). Based on the preliminary data collected as part of this study, teen self-report measures of driving outcome generally reflect improved driving on the part of the teens. The objective driving data for the hard braking and top weekly speed measures also supported improved driving for those with abnormal rates at baseline, whereas the hard acceleration measure did not when averaged across participants. An inspection of individual effects for participants highlights differences in response to the intervention depending on the measure and rater, consistent with other investigations of ADHD treatments in middle childhood (Fabiano et al., 2009). However, even during this relatively brief intervention with a small number of participants, the outcomes on driving behaviors appear promising and would warrant efforts toward replication and extension. Of note, one case (Case 7) appeared to worsen as the treatment phase progressed, and this suggests for some teens, intervention may need to last longer, particularly if the teen drove little beforehand, or intervention may require additional modification to address key areas of weakness.

The results of the palatability measures in the study are also worth mentioning. The fact that 100% of teens and families who enrolled in the study completed treatment is remarkable (and 88% of eligible families participated). Further, the teens, mothers, and fathers who participated rated the treatment as resulting in improvement, as acceptable, and that the demands of the intervention were manageable. These results can be cast in the light of other studies of ADHD treatment for teenagers, where the families have not persisted with both pharmacological (Meichenbaum et al., 2001; Molina, et al., 2009) and psychosocial (Barkley et al., 2001)

treatments. Although clearly preliminary, the results suggest there may be merit to targeting ADHD treatment within the context of a desired teen activity, such as learning to drive.

As a preliminary pilot study, this report has multiple limitations. First, the participants in the study were all licensed drivers who had for the most part experienced untoward driving outcomes – how the STEER intervention would work as a preventative program for drivers with learner’s permits is an area in need of future study. Second, the small sample size and brief baselines for some cases make causal inferences regarding treatment efficacy tentative. Third, the baselines for some participants, on some measures were of too brief of a duration to demonstrate stability, or were not stable across all raters and measures when intervention commenced. Fourth, baseline driving data were collected during the fall or early winter for all subjects with treatment-related data being collected during the winter. This approach may have confounded the results as for the teens in the study, their first experiences with independent driving in snow occurred during the treatment phase. The participants provided some anecdotal reports that their hard braking and accelerations reviewed during data review sessions were due to getting stuck in the snow or slipping on ice. Although driving in inclement weather is a critical driving skill, this aspect of the study may have had the effect of increasing negative driving outcomes in the treatment phase relative to the baseline phase. Further, the objective driving data were divided by the miles driven during the week, which may have highlighted negative events, such as hard braking, during weeks when teens drove very little. Finally, these results were generated by teens and parents who consented to the study and agreed to participate. It is not known how the results generalize to families where participation in the study was mandated. However, it is possible that the STEER intervention could be an effective diversion program for

teenagers who have exhibited a series of risky behaviors or experienced negative driving outcomes, and this is an area that warrants future investigation.

It is also worth discussing the feasibility of this intervention for practicing clinicians. Some components of this intervention are long-standing interventions for teens, including the contingency management contracts and parent-teen negotiation strategies (e.g., Robin & Foster, 1989; Smith et al., 1997) as well as the parent training in behavior modification strategies (Barkley, et al., 1999). Other components, such as the engine performance monitor represent new technologies, yet are of relatively low cost and suitable for use by parents of teen drivers. The driving simulator represents the least feasible component of the STEER intervention due to its high cost and specialized technology. However, given the considerable cost of risky teen driving, especially for teens with ADHD (Fischer et al., 2007; Jerome et al., 2006), it is possible that one could justify the costs of the driving simulator, especially for the riskiest drivers. For clinicians without access to a driving simulator, future studies might develop parent-teen interactions that could be conducted while practicing driving in lieu of the simulator portion of the intervention. Further studies that dismantle the STEER intervention package to determine “active ingredients” of the intervention may also highlight the intervention components that are most important for the practicing clinician. Finally, future studies might consider a longer course of treatment, given the chronic nature of ADHD and the inconsistent behavior observed on some measures, for some cases. For the practicing clinician, most components of the STEER intervention could be effectively implemented in a clinic setting with a computer. Clients could purchase the on-board monitoring equipment (approximately \$100), and data could be downloaded and discussed at each session just as it was in the STEER program. The interventions for parents and parent-teen contracting are published in manuals for clinicians

(Barkley, Edwards, & Robin, 1999; Robin & Foster, 1989). Thus, the majority of intervention components could be easily integrated into a clinical treatment setting.

In spite of the limitations, the STEER program appears to be a promising addition to the collection of interventions for adolescents with ADHD. STEER is the first psychosocial treatment study designed specifically for adolescent teen drivers with ADHD. It is important to acknowledge that the STEER program is not a new intervention, but rather a re-packaging and focusing of a large evidenced-based behavior modification literature (Barkley et al., 1992, 2001; Fabiano et al., 2009; Pelham & Fabiano, 2008; Smith et al., 2000) on teenagers with ADHD implemented during a prominent developmental transition. As such, it may be an important component of comprehensive treatment for teen drivers with ADHD (Barkley & Cox, 2007; Jerome et al, 2006).

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*Table 1.**Participant Characteristics at the Time of Enrollment.*

Demographic Variable	M (SD)
Mother DBD Rating	
Inattentive Subtype	1.98 (0.38)
Hyperactive-Impulsive Subtype	1.06 (0.46)
ODD	1.30 (0.97)
CD	0.31 (0.28)
Father DBD Rating	
Inattentive Subtype	1.78 (0.68)
Hyperactive-Impulsive Subtype	0.88 (0.53)
ODD	1.28 (0.87)
CD	0.25 (0.24)
Teacher DBD Rating	
Inattentive Subtype	1.35 (0.46)
Hyperactive-Impulsive Subtype	0.40 (0.36)
ODD	0.38 (0.43)
CD	0.13 (0.21)
Mother Average IRS Rating	3.15 (0.49)
Father Average IRS Rating	3.07 (1.07)
Teacher Average IRS Rating	1.49 (0.82)
Teen IQ	102.71 (12.88)
Teen Achievement	
Reading	104.43 (9.18)
Math	99.29 (8.86)
Spelling	99.71 (11.41)

Note: DBD=Disruptive Behavior Disorders rating scale. ADHD=Attention-deficit/hyperactivity disorder. ODD=Oppositional Defiant Disorder. CD=Conduct Disorder. IRS=Impairment Rating Scale. Achievement was measured using the Wechsler Individual Achievement Test Second Edition (1999).

Table 2.

Overview and Description of the Parent, Teen, and Joint Sessions in the Supporting a Teen's Effective Entry to the Roadway (STEER) program.

Session	Teen Content (first 45 min)	Parent Content (first 45 min)	Joint Session (second 45 min)
Session 1	Motivational Enhancement; House Rules and Rules of the Road Discussion	Motivational Enhancement; House rules and Rules of the Road Discussion; Introduction to Parent-teen negotiation; Psychoeducational introduction	Establishment of house rules and rules of the road; Review of objective monitoring of adolescent driving measure
Session 2	Expressing Feelings and Knowing the feelings of others	Noticing and Attending to Positive Driving Behaviors	Establishment of monitoring behaviors; Simulation exercise
Session 3	Making a Complaint	Using Instructions that work while teaching driving skills	Review of house rules/monitoring; Review of objective monitoring of adolescent driving measure
Session 4	Answering a Complaint	Planned Ignoring/Parental inhibition of nagging or prompting to promote independent driving	Parent-teen negotiation; Simulation exercise
Session 5	Accepting Limits set by others	Punishment (e.g., Privilege Removal) for violations of Road Rules	Parent-teen negotiation; Review of objective monitoring of adolescent driving measure
Session 6	Introduction to Communication Skills	Introduction to Communication Skills and how to discuss driving related limits and issues with the teen	Parent-teen negotiation; Simulation exercise
Session 7	Unreasonable Beliefs	Unreasonable Beliefs about adolescent driving behavior and their impact on parenting	Parent-teen negotiation; Review of objective monitoring of adolescent driving measure
Session 8	Negotiation strategies review	Negotiation strategies review programming for maintenance/monitoring of independent teen driving	Parent-teen negotiation; Establishing Rules of the Road for independent driving; Ongoing monitoring using CarChip

Table 3.

*Descriptive Statistics and Effect Size Estimates for Driving-Related Weekly Outcome Measures**Averaged Across Seven Cases.*

	Baseline Phase Mean	Baseline Phase SD	Treatment Phase Mean	Treatment Phase SD	Effect Size
Hard Braking ^a	0.09	0.10	0.06	0.04	0.30
Hard Acceleration ^a	0.03	0.02	0.03	0.03	0.00
Top Speed	64.98	14.36	61.01	9.88	0.28
IRS – Relationship with Parent					
Mother	2.92	0.88	2.71	0.96	0.23
Father	3.25	0.54	2.46	0.63	1.47
Teen	2.22	0.96	2.24	1.14	-0.01
IRS – Relationship with Family					
Mother	2.69	0.74	2.68	0.90	0.02
Father	2.94	0.85	2.33	0.61	0.71
Teen	1.91	0.68	1.97	0.88	-0.10
IRS - Driving					
Mother	2.94	0.84	2.44	0.90	0.59
Father	3.44	0.72	2.10	0.51	1.87
Teen	1.28	0.66	1.05	1.31	0.35
IRS – Overall					
Mother	2.97	0.68	2.76	0.73	0.31
Father	3.13	1.01	2.35	0.62	0.77
Teen	2.64	1.02	2.44	1.26	0.20

Notes. ^a Calculated for each condition by dividing the frequency of the event by the total miles

driven. Effect sizes were calculated by subtracting the treatment condition mean from the

baseline condition mean and dividing by the baseline standard deviation. Effect sizes are

standardized such that a positive sign indicates improvement during treatment, and a negative

sign indicates worsening during treatment. IRS=Impairment Rating Scale. N=7 for Mother and

Teen Ratings and N=4 for father ratings

Figure 1. Sample Contingency Contract.

Figure 2. Graphical representation of weekly averages for objective driving outcomes. The left panel represents the average number of hard and extreme braking events divided by the total number of miles driven for the week. The right panel represents the average number of hard and extreme acceleration events divided by the total number of miles driven for the week. The y-axis indicates the average number of events divided by the total miles driven, and the x-axis indicates week in the program,

Figure 3. Graphical representation of weekly averages for the Impairment Rating Scale item that asked about impairment in the teen's driving. The left-hand panel represents the mother's response to the item on a seven point scale (0=No problem at all, definitely does not need treatment or special services to 6=Extreme problem, definitely needs treatment or special services), the middle panel represents father responses, and the right-hand panel represents teen responses. The y-axis indicates the score on the IRS, and the x-axis indicates week in the program,

Written Contract

Date: January 15, 2010

Issue: Driving within the speed limit. This is defined as being no more than three miles above the posted speed limit for a roadway.

Agreement: There will be no more than one instance of recorded speed that exceeds the speed limit by four miles per hour or more.

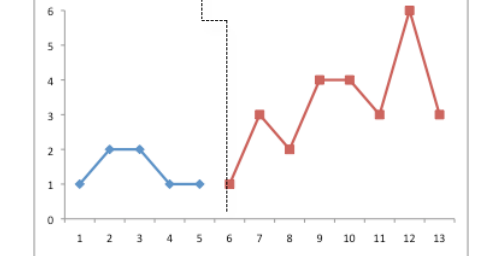
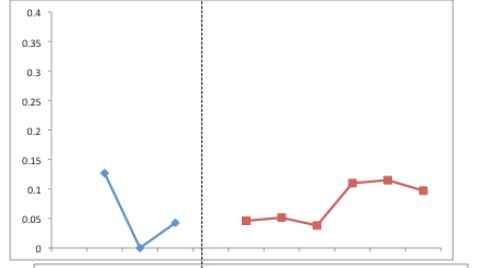
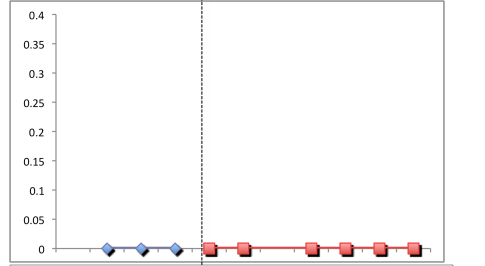
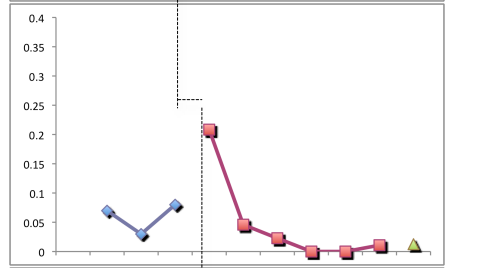
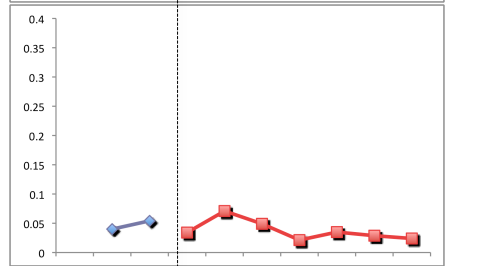
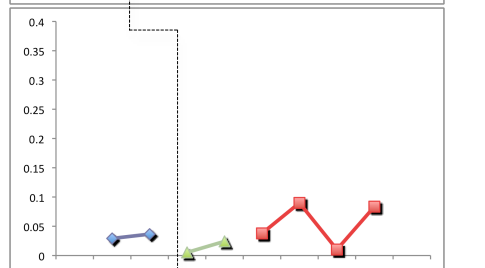
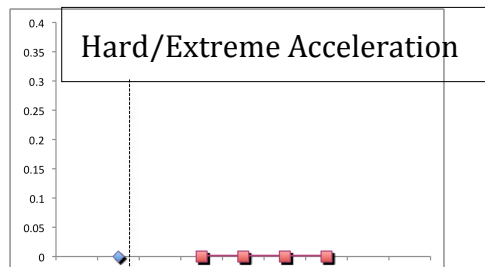
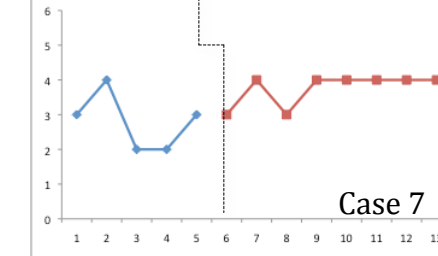
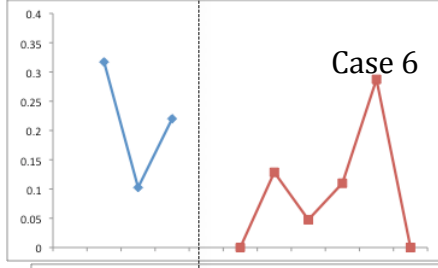
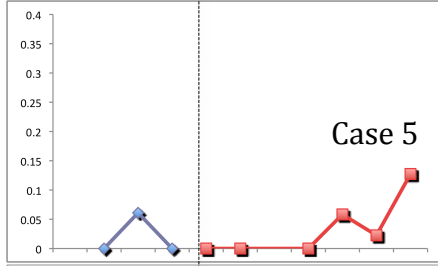
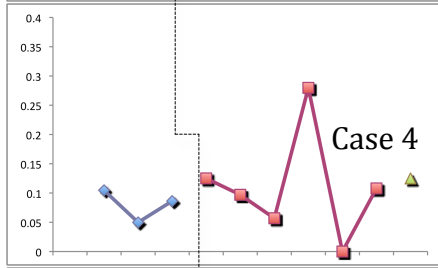
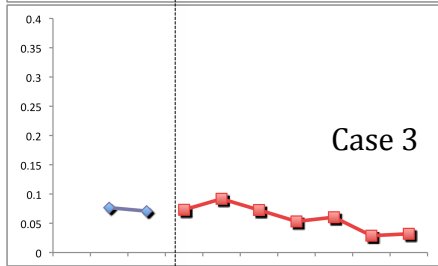
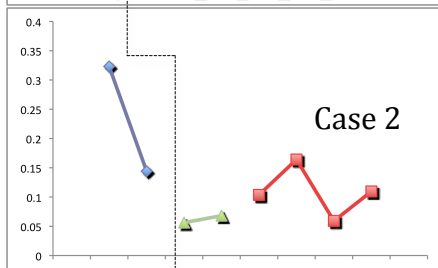
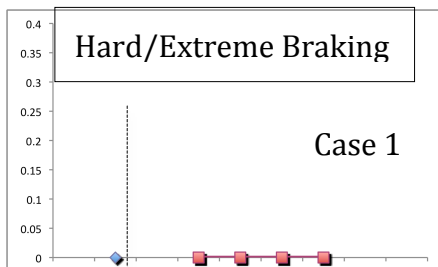
Positive consequence(s) for following agreement: If the goal is met, the car can be used to drive to the shopping mall on Saturday afternoon.

Negative consequence(s) for violating agreement: If the goal is not met, driving privileges will be suspended for Saturday.

Re-evaluation date: January 22, 2010

Teen signature

Parent signature(s)



Mother

Father

Teen

Case 1

Case 2

Case 3

Case 4

Case 5

Case 6

Case 7

