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High School–Based Treatment for Adolescents With Attention-Deficit/Hyperactivity Disorder: Results From a Pilot Study Examining Outcomes and Dosage

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Abstract. The purpose of this study was to examine the efficacy and doseresponse relationship of a school-based treatment program for high school students with attention-deficit/hyperactivity disorder (ADHD). Two paraprofessionals provided interventions to 24 students with ADHD randomly assigned to the treatment condition at two public high schools. They met in dyadic coaching sessions during one school year. In addition, parents attended weekly parent meetings and adolescents attended group sessions targeting social functioning in the evenings for 10 weeks in the fall semester. Intent-to-treat analyses showed little statistically significant benefit for the participants; however, effect sizes indicated moderate improvements in parent ratings of inattention, relationships with peers, academic impairment, and family functioning. There was large variability in the dosage of services received across participants, and an analysis of outcomes by dosage suggests large differences in response based on the number of sessions attended. This school-based intervention provides a viable option for educators and school mental health professionals who wish to provide interventions for high school students with ADHD, but further development and evaluation are needed.

Longitudinal studies support the consensus that 50%–80% of children diagnosed with attention-deficit/hyperactivity disorder (ADHD) continue to meet diagnostic criteria in adolescence (Wolraich et al., 2005). The functional impairments associated with adolescents with ADHD have more serious consequences than impairment in children, partly as a function of emerging freedoms and responsibilities. For example, adolescents with chronic ADHD exhibit higher rates of school dropout and vocational impairment (Kuriyan et al., 2013), au-

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tomobile accidents (Fischer, Barkley, Smallish, & Fletcher, 2007), and difficulty in romantic relationships (Canu & Carlson, 2007) when compared with typically developing peers. Similarly, the severity and chronicity of ADHD in childhood appear to predict substance use and abuse in adolescence (Molina & Pelham, 2003). However, the impairment associated with adolescents with ADHD may be most consistently manifested at school. Although achievement test scores tend to fall in or near the average range, high school students with ADHD exhibit higher than expected rates of poor report card performance (even after controlling for cognitive ability), grade retention, suspension, expulsion, and dropout (Kent et al., 2011). Thus, many adolescents with ADHD experience considerable failure at school during a developmental period typically marked by increasing autonomy and self-reliance.

Despite the serious impairment shown by adolescents with ADHD, the psychosocial treatment literature for adolescents is less developed than the literature for young children with ADHD (Evans, Owens, & Bunford, 2013). One likely explanation for this lapse is the decline in hyperactivity and impulsivity symptoms as children enter adolescence (Evans, Brady et al., 2013), which led some investigators to believe that most children outgrew the disorder. We now know that even among adolescents who no longer meet the diagnostic criteria for combined presentation, large proportions continue to meet criteria for predominantly inattentive presentation in adolescence (Wilens et al., 2006). Most of the recent treatment development work regarding adolescents has involved middle schoolbased approaches (e.g., Evans, Schultz, De-Mars, & Davis, 2011; Gureasko-Moore, Du-Paul, & White, 2007; Langberg, Epstein, Becker, Girio-Herrera, & Vaughn, 2012), although the debilitating impairment associated with high school students with ADHD warrants the evaluation of treatments in high schools (Kent et al., 2011).

School districts are spending considerable funds to prevent these poor outcomes, with costs averaging between \$5,007 and \$6,510 per student per year for special education services, grade retention, and disciplinary procedures (Robb et al., 2011). Extrapolation of these figures to the rate of the disorder among school-aged children indicates that the U.S. education system is spending over \$13 billion per year for these youth. Remarkably, the school-associated costs per student with ADHD increase with age, resulting in the greatest expense to schools during the high school years because of the onset of comorbid conduct problems in many cases (Jones, Foster, & Conduct Problems Prevention Research Group, 2009). To optimize the value of these expenditures, there is a need to develop and evaluate school-based interventions for high school students with ADHD.

Training Interventions With Adolescents

Effective treatments for children may provide a starting point for the development of interventions for adolescents. The vast majority of well-established evidence-based treatments for children with ADHD involve behavior management and generally involve training parents, teachers, or staff to apply behavior modification principles to the management of children (Evans, Owens et al., 2013). Findings indicate that while the adults are implementing the modified contingencies in the target environments, children's behavior can be effectively modified. However, there are serious limitations to solely relying on contingency management with adolescents. First, adolescents are without adult monitoring for much more of their day than are young children. Adolescents' transitions between classrooms at school are often inconsistently observed, and they independently congregate with friends in the community, transport themselves (e.g., bike, public transportation, driving), and are left home alone. Thus, monitoring-which is a prerequisite to effective implementation of behavioral interventions-is greatly reduced with adolescents. Second, it can be more difficult to identify salient consequences for adolescents than it is for children. Many of the privileges and tangible rewards that are desirable to adolescents are more expensive than the small items that can successfully motivate young children (e.g., stickers, candy). Third, in secondary schools there are far more adults interacting with students than is the case in elementary schools. Coordinating the implementation of a behavioral intervention across many classrooms can be quite challenging. In short, differences in characteristics of the individuals (adolescents versus children) and settings (elementary versus secondary schools) make the traditional behavior management approaches that form the foundation for child interventions not as feasible or possibly less effective with adolescents.

An alternative treatment approach that addresses some of the limitations of behavior management involves training interventions. The key difference between training approaches and behavioral techniques is that training interventions do not manipulate contingencies in the setting in which the target behavior occurs (Evans, Owens et al., 2013). Training interventions focus on teaching skills and usually include extensive practice and repetitions with the goal of creating a routine that will generalize outside of the training setting. Training interventions include some practices with little evidence to suggest that they work (e.g., traditional social skills training) and others that meet criteria for being well established (Evans, Owens et al., 2013). Of course, training approaches and behavioral techniques are not mutually exclusive (e.g., Pfiffner & McBurnett, 1997), but the distinction is especially important when considering interventions for adolescents. For example, one of the obstacles to using daily report cards (DRCs; Owens et al., 2012), a frequently used behavioral intervention in elementary schools, with adolescents is coordination among multiple teachers to complete the ratings and coordinate home contingencies with parents. As a result, the DRC is rarely used in high schools, and research on it has not been conducted at this level. Training interventions are less reliant than behavior management on the monitoring and coordination aspects of behavior management interventions.

In addition to avoiding some of the obstacles of implementing behavior management, training interventions are designed to enhance the skill sets of adolescents during a developmental period when autonomy and self-reliance are important milestones. As a result, it is important for adolescents to be engaged in their treatment and influence its focus and direction. Many training interventions, such as those used in this study, provide the adolescent with choices about intervention goals and strategies for achieving them. Their choices are respected such that when they make decisions about strategies that are unlikely to be successful, the provider does not apply coercive techniques. Rather, new choices are considered when measures indicate that previous approaches did not work. As a result, one of the main goals of the training interventions evaluated in this study is to train adolescents to use problem-solving techniques to improve their success in various domains of functioning and let the measurement of progress toward goals guide the process. Thus, this approach is consistent with the developmental challenges of adolescents by giving adolescents a central role in the decision-making process within the context of a problem-solving model that is informed by evidence.

Challenging Horizons Program and High School

During the past decade, we have primarily taken a training approach to intervention development with adolescents. Most of the interventions in the Challenging Horizons Program (CHP; Evans et al., 2011; Evans, Serpell, Schultz, & Pastor, 2007) involve training adolescents to perform specific skills and then promoting the application of those skills in targeted settings. These services have been provided as part of an after-school program and in the context of school consultation with a teacher who meets with the child weekly during the school day. Despite the absence of contingencies in the targeted settings, training interventions in the CHP have shown gains in both the social and academic functioning of middle school students with ADHD. For example, a homework management plan that we developed to address the unique situations of parents of adolescents with ADHD has been used in previous studies of the CHP and shown efficacy in a small standalone study (Raggi, Chronis-Tuscano, Fishbein, & Groomes, 2009). We also developed an intervention targeting social impairment called the Interpersonal Skills Group (ISG) that has been included in previous CHP studies. A study of the relationship between gains in proximal and distal measures of social functioning has suggested that the techniques used in the ISG may be effective (Sadler, Evans, Schultz, & Zoromski, 2011).

Unfortunately, the after-school version of the CHP is labor intensive and has some feasibility problems related to costs and student attrition (Evans, van der Oord, & Langberg, 2013). As a result, we developed an in-school version of the CHP that involved recruiting school staff to serve as mentors and primarily provide the organization interventions during brief weekly meetings with a student (Evans et al., 2007). Attrition has not been a problem in this mentoring model; however, the dosage of services has varied among participants because some mentors were more likely to meet regularly with students than others. In addition, even when mentors met regularly with their students, the mentoring model provided a much smaller dosage of interventions than is provided in the afterschool program (generally meeting twice per week after school for 2 hr per meeting). As a result, it is not surprising that recent data suggest that the mentoring benefits for students may be less than those resulting from participation in the after-school program (Evans, van der Oord et al., 2013). These attrition and outcome data suggest that there is a tradeoff between dosage and feasibility.

When developing a model for high schools, we wanted a model that could provide a higher dosage than the consulting version but occur during the school day to limit attendance problems and attrition. As in the other versions of the CHP, coaching for high school students was designed to be provided over an entire academic year, resulting in services that are more extensive than typical clinic-based services. Also consistent with the middle school model of CHP, we designed the high school version of the program to take place during the school day because these interventions have the potential to eventually replace many of the services that are currently provided at schools that are unlikely to be effective (Harrison, Bunford, Evans, & Owens, 2013). Finally, although we believe that the after-school program provides an adequate dosage and the consulting model provides a dosage that is too little, we wanted to examine dosage to determine how much coaching is needed to provide meaningful benefits.

Current Study

This pilot study examined the impact of the CHP coaching intervention on the academic and social outcomes of high school students. Because our previous studies have shown considerable variability in dosage that interacts with outcomes, it is important to evaluate the results of this study in an intentto-treat and dose–response manner. The treatment was provided for one academic year, and parent- and teacher-rated outcomes and grades were evaluated. To evaluate outcomes and dosage effects in this study, we analyzed results in an intent-to-treat outcome analysis, followed by a regression analysis examining dosage effects.

Method

Participants

Thirty-six adolescents with ADHD were recruited from two public high schools (18 from each school) in rural Virginia to participate in a yearlong study of school-based CHP coaching. At intake, participants were between 13 and 17 years old (M = 15.4 years, SD = 1.0 years). Boys (83.3%) outnumbered girls at a ratio slightly higher than expected among children with ADHD. Most participants (80.6%) met the diagnostic criteria for the predominately inattentive subtype of ADHD, and the remainder met the diagnostic criteria for the combined subtype of ADHD. In addition, semistructured clinical interviews with the primary caregiver suggested

that 16.7% of the participants met the diagnostic criteria for comorbid oppositional defiant disorder, and another 5.6% met the criteria for comorbid conduct disorder. Most participants (75.0%) had previously taken medications for ADHD, and half (50.0%) were using medications to treat ADHD at the time of intake. One third of the sample (33.3%) had previously received special education services in some capacity, and at the time of intake, one quarter (25.0%) were receiving services. Most participants (69.4%) lived in two-caregiver households (including blended families), followed by divorced caregivers living separately (27.8%) and single, never-married caregivers (2.8%). Most participants were White (91.7%), two were biracial (5.6%), and one was Hispanic (2.8%).

Procedures

Recruitment. Program announcement flyers were mailed to the families of all students attending the two participating high schools 6 months before the start of the school year. Respondents to these flyers were screened via telephone to ensure the likelihood of eligibility (i.e., parent report of the adolescent suggested clinically significant levels of inattention) and then, if likely to be eligible, were invited to complete a clinical evaluation. The intake evaluations included psychoeducational testing of the adolescent, a semistructured interview with the primary caregiver and the adolescent, and behavior rating scales collected from the primary caregiver and the adolescent. Intake evaluations started in late March and continued through September.

Inclusion criteria required that participants (a) consented to participation; (b) attended one of the participating schools; (c) anticipated 80% or more attendance for study activities; (d) met the criteria for ADHD (any subtype) based on caregiver report in a semistructured clinical interview (Kiddie Schedule for Affective Disorders and Schizophrenia; Kaufman et al., 1997) or the Disruptive Behavior Disorders Rating Scale (DBD; Pelham, Gnagy, Greenslade, & Milich, 1992); (e) showed a full-scale IQ over 80 as determined by the Kaufman Brief Intelligence Test, Second Edition (Kaufman & Kaufman, 2004); (f) showed evidence of functional impairment as reported by the primary caregiver (e.g., Impairment Rating Scale, IRS, scores >3; Fabiano et al., 2006); and (g) reported no history of substance dependence, psychosis, obsessive-compulsive, or bipolar disorders. The intake evaluation took approximately 2.5 hr, and families were paid \$100. Graduate students supervised by a licensed clinical psychologist administered these assessments along with the Wechsler Individual Achievement Test, Second Edition (WIAT-II; The Psychological Corporation, 2001). Eligibility for inclusion in the study required unanimous agreement between a licensed clinical psychologist and a certified school psychologist in diagnostic consensus conferences.

Eligible participants were randomly assigned to either a treatment condition (n = 24)or community control condition (n = 12), by use of a weighted 2:1 assignment ratio favoring the treatment condition, at both schools (12 treatment and 6 control participants per school). To test the equivalency of the groups after random assignment, we conducted Bayesian t tests on the intake measures and demographic indicators. The resulting JZS Bayes factors (BFs; Rouder, Speckman, Sun, & Morey, 2009) using an uninformative prior (ES = 1.0) provided at least anecdotal evidence for group similarities across symptom, cognitive ability, and academic achievement measures, with the exception of the Spelling subtest of the WIAT-II. On this measure, the treatment group appeared to appreciably outperform the control group. No credible differences were noted between groups in terms of age, sex, family income, medication status, or mother's or father's education level because the evidence suggests group similarities (BFs > 1.9) in all instances (see Table 1).

Treatment group. Adolescents and families randomly assigned to the treatment group received the three interventions that comprise CHP coaching: parent training, ISG, and coaching. In the fall semester, parents of treatment-group participants were invited to a

	Treatment Group $(n = 24)$				Control Group $(n = 12)$				
	М	SD	Min	Max	М	SD	Min	Max	BF ^a
Age	15.4	1.1	13.9	17.3	15.4	0.9	14.2	16.8	3.9
Income	57.5	25.5	10.0	110.0	66.7	39.8	10.0	130.0	3.4
Mother's education level	14.3	2.2	12.0	18.0	15.3	2.7	10.0	18.0	2.4
Father's education level	13.8	2.2	10.0	18.0	14.9	2.6	12.0	18.0	1.9
Diagnosis (symptom counts)	A. Here								
ADHD inattention	7.8	1.2	6	9	7.5	1.2	6	9	3.2
ADHD hyperactivity-impulsivity	3.8	2.9	0	9	2.6	1.4	1	5	1.2
ODD JI JI J	1.9	2.4	0	8	1.2	1.6	0	4	2.7
CD	0.5	1.3	0	6	0.5	1.4	0	5	3.9
IQ/achievement									
KBIT-2 Full Scale IO	105.5	12.4	83	120	107.4	12.1	80	127	3.6
WIAT-II									
Reading subtest	104.4	15.4	71	124	96.4	12.9	83	120	1.5
Numerical Operations subtest	96.6	18.6	49	126	101.1	11.0	90	125	3.0
Spelling subtest	101.3	13.0	71	119	93.0	11.5	73	111	0.9
Written Expression subtest	102.6	11.6	81	126	98.7	14.1	67	119	2.8

Table 1 Participant Diagnostic, IQ, and Achievement Data at Intake

Note. Income is reported in \$1,000 increments. Education levels are reported in grade equivalents (e.g., high school diploma = 12; associate degree = 14). Diagnostic data were provided by the primary caregiver during a semistructured clinical interview with a trained clinican. BF = JZS Bayes Factor; KBIT-2 = Kaufman Brief Intelligence Test, Second Edition; Max = maximum; Min = minimum; WIAT-II = Wechsler Individual Achievement Test, Second Edition. ^aValues greater than 1 suggest evidence in favor of the group-equivalence hypotheses (e.g., a BF of 3.0 suggests group equivalence is 3 times more likely than the alternative hypothesis). Only one measure produced a BF < 1.0 (WIAT-II Spelling subtest), but the value provides only anecdotal evidence for differences between the groups (Rouder et al., 2009).

10-session parent training group that met weekly at the schools in the evenings. The parent training groups were led by a doctorallevel school psychologist with the primary goal of assisting parents to create behavior contracts at home. To guide these efforts, parents were taught basic information about ADHD, communication, and problem solving and then introduced to an approach for monitoring homework compliance called the Homework Management Plan (HMP). The HMP was developed as part of the CHP and has shown promise when evaluated in a small trial (Raggi et al., 2009). Parents received manuals and videos that describe the HMP, including goal setting, progress monitoring, selection of effective consequences, and negotiation strategies. Parents who did not voice concerns regarding homework compliance

were encouraged to use the basic parent-adolescent negotiation procedures to develop behavior contracts targeting other behavior problems. Participating families attended an average of approximately seven sessions (SD = 3.4, range = 0-10), with only one family never attending at least a single session.

When the parents attended the parent training meeting, the adolescents attended ISG sessions. Like the parent meetings, these sessions lasted 90 min per week for 10 weeks. Given the lack of evidence supporting traditional social skills training programs, the ISG was developed approximately 10 years ago to improve the social functioning of adolescents with ADHD (see Sadler & Evans, 2011, for more information about the HMP and ISG). The group consists of three phases, with the

first phase involving teaching the vocabulary and problem-solving steps used in the intervention. The first phase ends with participants creating operational definitions of how they would like to be perceived by others (i.e., "ideal self"). As noted earlier, the adolescents were able to choose any goals and make changes to them in relation to progress as they wished. Practice sessions in Phase 2 focus on teaching the adolescents to exhibit behavior consistent with their goals in group social activities and to attend to and accurately interpret the feedback of others for information about whether the adolescents' behavior is consistent with their goals. Phase 3 involves helping the adolescents extend their goals to a variety of actual social situations including interactions with adults, peers, and strangers and critiquing the adolescents' interactions with others using this framework. The first two phases were completed in the evening group sessions, and Phase 3 was completed by the CHP coaches.

Beginning at the same time as the parent training and ISG sessions, CHP coaching was delivered to the treatment participants at their schools. The two coaches were female bachelors-level former teachers who worked in the schools 18 hr per week, under the supervision of the parent training group leader. The coaches completed 8 hr of training on the organization and other interventions of the CHP. To ensure consistency, these elements were outlined in a treatment manual targeting common academic needs: book bag and binder organization, assignment tracking, study skills, and self-monitoring. The coaches met with their supervisor weekly at the school to review documentation and directly observe sessions with the students. Feedback based on the observations and documentation was provided along with support for taking the next steps with interventions for each student. The coaches met with participants during regular school hours, typically in one-on-one meetings in private offices during class transitions, elective classes, study hall, or resource room time (where applicable). On average, these meetings lasted approximately 22.1 min (SD = 13.6 min, range = 1-120 min), and

each participant in the treatment condition met with the CHP coach an average of 26.8 times $(SD = 8.4; \text{ range} = 3-41)^1$ over the course of the school year, which is roughly equivalent to one coaching session every seven school days. The variability in the frequency of meetings was due to a variety of issues including student schedules, attendance, and teachers' and students' willingness. During meetings, coaches balanced the direct provision of the CHP academic interventions with helping the adolescents learn to develop their own solutions. The priority was to implement the interventions in the manual, but students were given flexibility in some of the details of how these were provided. For example, coaches were trained to offer ideas from the treatment manual for participants to consider but to do so tentatively (e.g., "Would you consider trying _____ for a period of time?") and with an emphasis on participant preferences (e.g., "How could you make this work for you?").

Control group. Parents of participants randomly assigned to the control group were provided with a list of services available in the community and encouraged to pursue care. Control participants were monitored over time and identical midyear and end-of-year measures were collected for both the treatment and control groups, but no study-specific interventions were provided. Consistent with the treatment group, 33.3% of control participants had received special education services at some point before entry into this study and 25.0% planned to continue such services during the study period. Also consistent with the treatment group, 75.0% of control participants had previously used medications to treat ADHD; however, control-group participants were using medications at a lower rate than treatment participants (41.7% as compared with 54.2%) at the initiation of treatment, and their rate of taking medication was constant throughout the study. Interestingly, the percent of participants taking medication in the treatment condition declined from 54.2% to 37.5%.

Treatment Fidelity

Trained research assistants assessed fidelity in the treatment condition by listening to and coding audio recordings of a subset of coaching sessions (N = 106). To measure treatment adherence, two research assistants randomly selected 45 recordings (42%) of the organization intervention and coded the audio on the presence or absence of specific techniques prescribed in the treatment manual. The average agreement estimate for these sessions was 92.5% (SD = 7.0%), with the results suggesting that coaches adhered to an average of 75.8% (SD = 16.3%) of the items evaluated for adherence based on the procedures in the treatment manual.

To assess competence, the research assistants rated the coaches' use of common factors of counseling (cf., Lambert, 2003) using 58 randomly selected audio files (55%). To this end, we designed a rating scale consisting of eight 3-point Likert-type responseformatted items, with each item targeting a common factor of counseling (e.g., openended questioning, reflective listening). The items are scored as follows: 1, no evidence of the factor; 2, one or two examples of the factor; and 3, several clear examples of the factor. The average agreement estimate on this measure was 78.4% (SD = 13.2%), with the results suggesting that coaches typically exhibited one or two examples of each skill in their sessions (M = 1.92, SD = 0.42). Both coders' scores suggested differences between the coaches on the item measuring active listening techniques (BF = 0.23 and 0.22); otherwise, there were no consistent dissimilarities (BFs > 1.0).

Dependent Measures

In addition to the intake assessment, all participating families were invited to return to a university-based clinic for midyear and endof-year evaluations, resulting in three measurement occasions. Midyear evaluations were completed between January and March of the study year, and end-of-year evaluations were conducted between April and June, as family availability permitted. The instruments administered at all three time points are briefly described below.

Disruptive Behavior Disorders Rating Scale. The DBD (Pelham et al., 1992) is a narrow-band rating scale that requires parents to rate children on symptoms of ADHD, oppositional defiant disorder, and conduct disorder according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 2000). DBD items measuring ADHD fit a two-factor structure (inattention and hyperactivity-impulsivity), consistent with the DSM-IV, with high internal consistency within each subscale with adolescents $(\alpha \ge 0.88)$ (Van Eck, Finney, & Evans, 2010). Symptom severity was calculated by summing the scores for each item (1-4) on each factor.

Impairment Rating Scale. The IRS (Fabiano et al., 2006) is a brief rating scale that assesses several broad areas of impairment, including academic and social impairment. Most items on the IRS use a 7-point response format, anchored on one end by (a) no problem, definitely does not need treatment, and on the other end by (b) extreme problem, definitely needs treatment. In this study, we used the parent version of the IRS, which focuses on impairment mainly exhibited in the home. The parent version of the IRS has been found to be sensitive to treatmentrelated changes, with good test-retest reliability (r = 0.76 - 0.93 over a period of 4 months). Furthermore, the IRS was found to have moderate to high correlations when compared with other instruments that measure impairment (Fabiano et al., 2006). For our purposes, we focused on items measuring relationship with peers (Item 1), parent-child relationship (Item 4), academic impairment (Item 5), family impairment (Item 7), and overall impairment (Item 8).

Classroom Performance Survey. The Classroom Performance Survey (CPS; Brady, Evans, Berlin, Bunford, & Kern, 2012) is a 20-item teacher survey designed to measure the unique performance demands of secondary schools. Each item on the CPS inquires about classroom behavior, such as participation in activities, paying attention, and completing class work, using a 5-point Likert response format ranging from 1, always, to 5, never. Thus, higher scores on the CPS represent poorer classroom performance. There are two factors, consisting of items related to academic performance and others relating to interpersonal performance (reliability coefficient omegas = 0.98 and 0.91, respectively). In this study, we analyzed each of the two factor scores on the CPS. Analyses were conducted for teacher ratings from language arts, math, social studies, and science classes (hereafter core courses) separately, as well as averaged together. We examined only the four core courses because these classes are typically most influential on grade-retention decisions and most students are likely to be enrolled in these classes throughout the school year.

School grades. Grades for each participant were collected from the school counseling offices at both sites. Grades were converted into grade point averages for each of the core courses, where A = 4.0, B = 3.0, C = 2.0, D = 1.0, and F = 0.0.

Statistical Analyses

Two sets of analyses were completed to address the research questions. The first involved an intent-to-treat analysis of outcomes using measures of symptoms and functioning. The second involved analyses of the effect of dosage on parent-reported outcome measures. Given the variability among teachers' ratings of students and missing data within teachers, we were unable to consider teacher ratings for the dose-response analyses. For the intent-totreat analysis, the outcomes on the DBD, IRS, CPS, and grade point average were modeled separately using hierarchical linear modeling (HLM). Although this is a small sample size for this type of analysis, the data met necessary assumptions for HLM. Each analysis began with modeling the dependent variable as a function of an intercept (predicted midpoint rating, to reduce multicollinearity between the linear and quadratic trends), condition, and time. Control variables including mother's education level, school, student sex, IQ, family structure, medication status at intake, and household income were entered into each HLM model individually because of limited degrees of freedom. We anticipated that these factors may influence outcomes based partly on previous research (e.g., Mullis, Rathge, & Mullis, 2003) but also on clinical judgment regarding influences on academic performance. The focus was not on the effects of the control variables but was on whether each one affected the Condition \times Time interaction, either as a moderator or by controlling for differences between groups. For brevity, only the covariates that proved statistically significant on the outcome will be discussed below.

To address the research question pertaining to dosage, we examined dosage effects on outcomes. Conceivably, participants in the treatment condition who attended few sessions may have achieved little benefit from the interventions and thereby diluted the group differences. To assess this potential, we used probit response regression to regress the dichotomous occurrence of reliable clinical improvement (reliable change, RC, Formula c; Jacobson & Truax, 1991) across each parentrated symptom and impairment measure onto the total number of intervention sessions attended (coaching and ISG training²; Garson, 2012). Although the RC is considered a conservative threshold for determining clinical significance, we chose to use it because of its use in the literature and recognition as a unit of meaningful change. Questions regarding psychotherapeutic dosage have been addressed using similar procedures (e.g., Kopta, Howard, Lowry, & Beutler, 1994) because these data often produce a curvilinear relationship with outcomes that are difficult to model using traditional linear analyses.

When rating scales had missing items, we imputed the mean score on the corresponding factor from that same individual's rating at the same time point (<2% of all scales). When parents or teachers failed to complete assessments, we handled these situations differently based on the analyses. Overall, we had 100% of DBD and IRS ratings at intake, 86.1% of data at midyear, and 75% of data at end of

year. For the intent-to-treat analyses (HLM), data from all 36 cases were included and the missing data were omitted because one of the advantages of HLM is that it handles missing data without having to alter the analytical procedures or use imputation that may compromise confidence in the findings. Three cases were removed case-wise from the probit response model because of missing data at the midyear and end-of-year evaluations (two control and one treatment). In addition, six families (17%) provided midyear ratings but not end-of-year ratings, and in those instances we calculated reliable change using the last data point collected (four treatment and two control). Thus, these procedures reduced the likelihood of finding reliable change for these participants, leading to conservative estimates of benefit.

Results

Intent-to-Treat Analyses

For brevity, we will focus on statistically significant findings, including our primary interest, Condition \times Time interactions, as well as the linear and quadratic time trends. We will note only those control variables that had a significant impact on outcomes. Statistically significant and clinically meaningful findings emerged on 4 of the 10 outcome measures, and means, standard deviations, and effect sizes for all measures at all time points are shown in Table 2. Table 2 also shows the percent of participants in each condition who showed RC improvement at the end of treatment.

To assess the degree to which the treatment condition reduced symptoms of ADHD, we first examined the change in parents' ratings of their child's behavior over time using the DBD. HLM analyses were conducted separately for DBD subscales measuring inattention and hyperactivity-impulsivity. For both subscales, ADHD symptoms significantly decreased over time across both conditions (ps < .05), with some rebound in inattention symptoms at the last time point, creating a significant quadratic trend (p = .03); however, no significant Condition × Time interactions emerged for either subscale. When covariates were added to the model, a significant Condition \times Time \times Mother's Education interaction was noted for ratings of inattention (t = 3.03, p = .004). Specifically, the predicted Condition \times Time interaction was larger for relatively less educated mothers. When the effect of mother's education was controlled, a significant Condition \times Time interaction emerged (t = -2.08, p = .042), suggesting that the treatment group had significantly greater improvements than the control group. No other control variables changed the Condition \times Time interaction to any meaningful extent.

Next, we examined the change in parent ratings of impairment over time on the IRS. For the item measuring family impairment, there was a significant Condition × Time interaction (t = -2.07, p = .043), suggesting that the treatment group improved more than the control group over time. For all other subscales of the IRS, the linear and quadratic effects of time were not statistically significant (p > .05), suggesting that trends for the treatment and control groups were similar over time. We also examined teacher ratings on the CPS. Analyses were conducted for average teacher ratings, as well as disaggregated teachers' ratings across the four core courses. No significant Condition × Time interactions emerged, nor did we find significant linear or quadratic differences between the treatment and control groups.

Grade analyses were conducted for language arts, math, science, and social studies. Six measurement occasions were analyzed, based on the times that grades were issued. For math and science classes, the linear and quadratic effects of time were not statistically significantly different for treatment and control (p > .05) and no significant Condition \times Time interactions were noted. In language arts classes, there was a significant quadratic trend (p = .04) for both groups because grades dropped from the start of the year to midyear and then increased slightly in the latter part of the school year. When mother's level of education was controlled, the differences between groups in language arts grades over time were

	Time 0: Intake		Time 1: Midyear			Time 2: End of Year				
Measure	М	SD	М	SD	d ^(0–1)	М	SD	<i>d</i> ^(0–2)	<i>d</i> ^(1–2)	% with CRI
DBD			1 Mar						1.	
Inattention										
Т	20.0	5.5	17.1	4.0	0.53	17.3	5.4	0.49	-0.05	42.9
С	19.0	5.7	16.8	5.8	0.39	17.8	5.3	0.21	-0.17	30.0
Hyperactivity-impulsivity										
T	12.0	6.3	10.4	5.7	0.25	10.6	5.4	0.22	-0.04	14.3
С	11.9	6.3	9.8	7.1	0.33	11.4	5.5	0.08	-0.26	10.0
IRS										
Relationship with peers										
Т	3.5	1.8	2.4	1.8	0.61	2.6	1.9	0.50	-0.11	30.4
С	2.4	2.1	2.3	2.4	0.05	1.8	1.7	0.29	0.21	20.0
Parent-child relationship										
Т	3.3	1.9	2.9	1.9	0.21	2.9	1.8	0.21	0	17.3
С	3.6	1.8	3.8	1.4	-0.11	3.1	1.8	0.28	0.50	10.0
Academic impairment										
Т	4.5	1.7	4.1	1.4	0.24	3.8	1.5	0.41	0.21	17.4
С	5.0	1.3	4.4	1.0	0.46	4.5	0.8	0.38	-0.10	0.0
Family impairment										
T	3.9	1.5	2.9	1.8	0.67	2.7	1.7	0.80	0.11	47.3
С	3.1	2.1	3.7	1.3	-0.29	2.9	1.6	0.10	0.62	30.0
Overall impairment										
Т	4.5	1.4	3.6	1.3	0.64	3.4	1.5	0.79	0.15	34.8
С	4.8	1.2	3.8	1.6	0.83	3.9	1.0	0.75	-0.06	20.0
CPS										
Academic performance										
Т	18.4	7.4	20.9	7.7	-0.34	20.5	6.8	-0.28	0.05	
С	22.6	7.6	23.7	8.7	-0.14	25.5	7.4	-0.38	-0.21	
Interpersonal performance										
T	8.4	3.3	9.5	4.3	-0.33	8.8	3.7	-0.12	0.16	
С	8.9	3.3	9.2	3.5	-0.09	10.2	4.2	-0.39	-0.29	
Grade point average				-						
T	2.6	0.8	2.2	0.9	-0.5	2.2	0.9	-0.5	0	
С	2.1	0.8	2.1	0.9	0	2.0	0.9	-0.13	-0.11	

			la	ble 2			
Descriptive	Statistics	for	Outcome	Variables	Over	Three	Measurement
			Occ	asions			

Note. Data are based on observed measurements and may differ from estimates in the hierarchical linear modeling analysis. Teacher data across the core courses were combined for grades and the CPS results, even though each class was also analyzed separately. Data were collected at six time points, but the table includes only the first, third, and sixth grading periods. The treatment group included 24 participants, and the control group included 12. The within-group Cohen's d is based on differences between intake and midyear (0-1), between intake and end of year (0-2), or between midyear and end of year (1-2). C = control group; CPS = Classroom Performance Survey (teacher ratings); CRI = Clinically Reliable Improvement; DBD = Disruptive Behavior Disorders Rating Scale (parent version); IRS = Impairment Rating Scale (parent version); T = treatment group.

statistically significant (t = -2.01, p = .046), with the treatment group outperforming the

control group in the early and middle part of the school year. By the end of the school year, language arts grades converged for the two conditions, but overall estimated grade point averages for treatment and control were 2.30 and 1.79, respectively.

For social studies, there was a quadratic Condition \times Time interaction (t = 2.63, p = .01). The grades of the treatment group were relatively stable throughout the year, decreasing slightly over time. The grades of the control group started out lower, improved in the middle of the year, and then dropped again. As a result of these differential trends, the control group appeared to slightly outperform the treatment group during the middle of the school year, but the treatment group had an overall grade point average that was slightly above that of the control group for the entire school year (2.42 versus 2.25).

Overall, the statistically significant results of the intent-to-treat analyses indicated little statistically significant benefit for the CHP coaching condition; however, the effect sizes differed between groups and varied over time (see Table 2). Although there were some significant results consistent with a beneficial treatment, given the number of analyses, the magnitude of the effects, and the number of significant findings, we cannot conclude that the CHP coaching is likely to be a beneficial treatment. The second set of analyses addressed the question of whether dosage is related to outcomes. If dosage is related to outcomes, then this may have contributed to our lack of findings in the intent-to-treat analyses.

Dosage and Outcomes Analyses

We examined dosage effects on parent ratings of symptoms and impairment using probit dose-response regression. The goodness-of-fit test (Pearson χ^2) suggested that the model fit the data in all instances (ps > .15) and in no instances did residuals exceed 1.5. We noted positive trends across all of these parent ratings, with reliable improvement (RC) more likely as dosage increased (see Figure 1), but no trends reached statistical significance. Although there were differences in the proportions of each group that improved on parent ratings of functioning indices (treatment group, 17.3%-47.3%, and control group, 0%-30%; see Table 2), we believe that the primary value of these scores is in relation to treatment dosage. For measures of ADHD symptoms, the estimated odds improve only slightly with increased dosage. For example, the probit response model predicts that only 11.5% of adolescents achieve RC on parent ratings of hyperactivity-impulsivity symptoms without coaching, and that proportion only increases to an estimated 13.6% when receiving 50 coaching sessions-the maximum dosage we measured. However, for measures of impairment, dosage appears more impactful. For example, on the family impairment item of the IRS, our probit response model predicts that 14.9% of adolescents will achieve RC without coaching, whereas an estimated 55.7% of adolescents will achieve RC at 50 coaching sessions. The most dramatic dosage-related improvement was estimated for the academic impairment item of the IRS. According to our model, no adolescents will achieve RC without coaching whereas an estimated 51.5% of adolescents who receive 50 sessions would achieve RC. Follow-up analysis examining the potential impacts of covariates on dosage, including student IQ and symptom severity (examining the impairment items only), suggested that these covariates do not significantly affect our model estimates (ps > .05).

Discussion

This study examined the efficacy of CHP coaching and parent training when compared with a treatment-as-usual control condition for high school students. Overall, when we evaluated outcomes for all participants without controlling for dosage, the statistically significant benefits associated with the CHP coaching condition appeared to be limited. Specifically, our results suggested that coaching significantly improved parents' perceptions of their child's inattentive symptoms and family relations relative to the comparison condition. As can be seen by the effect sizes, the improvement in symptoms of inattention occurred in the first semester, with both groups declining slightly during the second semester. In contrast, parent ratings of family impairment improved in the treatment group during the fall semester (medium to large effect), which is when the parent group met. During this same semester, parent ratings of family impairment for those in the control group deteriorated (small to medium effect). Both groups improved in the spring semester, but the control group improved to a much greater degree than the treatment group during the spring semester, resulting in minimal differences in ratings of family impairment between groups at the end of the year. It may be that family support is needed throughout the year to maintain the gains reported by parents in the treatment group.

Though not statistically significant in the HLM analyses, a review of the effect sizes related to teacher ratings of academic func-

tioning indicated a pattern of responding that changes from the first to the second semester. During the first semester, teacher reports indicated that participants in both groups deteriorated in academic and interpersonal functioning. Teacher ratings at the end of the second semester showed group differences because their ratings of academic and interpersonal performance on the CPS indicated no change or a small improvement for the treatment group and a continuation of the decline in academic and interpersonal functioning for participants in the control condition. We have found a pattern of steady decline over the course of an academic year for adolescents with ADHD not receiving CHP services (Evans et al., 2011) and attributed a protective effect to the CHP interventions by reducing or preventing that decline for students receiving these services (Schultz, Evans, & Serpell,



Figure 1. Estimated probability of achieving clinically reliable improvement by dosage. Inattentive and hyperactive symptoms were measured using the relevant subscales of the Disorders Rating Scale; family impairment, peer relationships, parent-child relationships, academic impairment, and overall impairment were measured using the relevant items of the Impairment Rating Scale. Reliable change was calculated using the formula of Jacobson and Truax (1991).

2009). Although the pattern of teacher ratings is consistent with this description, further research with larger samples is needed to confirm these descriptions.

Our findings related to dosage offer a potential explanation for the few statistically significant findings in our intent-to-treat analyses. Some treatment participants met with the coaches and staff fewer than 10 times, whereas others received 40 or more sessions. The results of our probit response model indicate that parent ratings of many students improved to a degree consistent with RC. The probit response estimates suggest that benefits associated with parent ratings of symptoms of ADHD were only minimally associated with dosage; however, parent ratings of impairment yielded promising effects of dosage (see Figure 1). Given the small sample of this pilot study, we are interpreting the findings based on the magnitude of the effects instead of statistical significance. On the basis of our model, the predicted proportion of participants likely to achieve RC in any area of impairment without any sessions does not exceed 18%; however, the percent of participants likely to reach RC after 50 sessions ranges from about 40% to 56% (excluding ratings of parentchild relationship, which peaks at 23%). Most compelling is the relationship between dosage and academic impairment that indicates a 0% chance for RC without any sessions of CHP coaching and a greater than 50% chance of RC with 50 sessions. We have not analyzed dosage effects to this degree in any of the studies of CHP in middle schools, so we cannot make direct comparisons. Nevertheless, as reported above, we have found that the higher-dosage after-school version of the program has resulted in greater benefits to students than the lower-dosage consulting version (Evans, van der Oord et al., 2013). These findings suggest that even small differences in dosage may meaningfully affect the likelihood of a clinically significant improvement.

It is important to put the percentages of responding at a level consistent with the RC index into context. The RC is a conservative index of change, and as a result, many investigators do not report it (Evans, Owens et al., 2013). For example, the investigators from the Multimodal Treatment Study of Children With Attention-Deficit Hyperactivity Disorder (MTA) chose to not report the percent of respondents meeting RC criteria in any of the articles we could find; however, the percent achieving RC on parent ratings for participants in any of the three active treatment groups can be calculated from analyses of MTA data reported by Karpenko, Owens, Evangelista, and Dodds (2009). On the basis of their report of parent ratings of participants in the medication-only, behavior therapy-only, and combined groups (active treatment groups), at the 14-month evaluation, 36% of participants met RC on the Columbia Impairment Scale, 48% on the Home Situation Questionnaire, 54% on the Homework Checklist, and 60% on the Social Skills Rating Scale. These percentages are based on results from well-established treatments with children between the ages of 7 and 9 years. When one considers relatively new treatments for adolescents, the percentages are often much lower than those (e.g., depression prevention, 28.7%; Spence, Sheffield, & Donovan, 2003; treatment for oppositional behavior, range = 32%-48%; Nelson-Gray et al., 2006). In the only study that we found of treatment of adolescents with ADHD that reported RC, Barkley, Edwards, Laneri, Fletcher, and Metevia (2001) reported that between 0% and 24% of participants showed RC on parent ratings of a variety of functioning domains related to parent-child interactions. The results of our study indicate that the percent of respondents in the treatment condition meeting RC on parent ratings of functioning ranged from 17.3%-47.3% (see Table 2), which substantially overlaps with the RC results of the MTA and is as good as or better than the other studies noted above with adolescents. When one considers the predicted responses based on the dose-response analysis, 40%-60% of adolescents can achieve benefits from CHP coaching on parent ratings of functioning in a variety of domains by meeting an average of 1.4 times per week during the school year. Given the literature reviewed above, the degree of improvement in this study is equivalent to or greater than the degree of responding in many other studies of psychosocial treatments. As a result, the range of respondents achieving with RC and the relationship between dosage and outcomes generally support the efficacy of the interventions.

Although 50 sessions is more than what is typical for clinic-based interventions, it is feasible for school-based interventions and may be necessary to achieve gains in adolescents with ADHD. For example, other schoolbased interventions such as Check and Connect (Christenson et al., 2008) and the DRCs are often provided for 30 sessions or more, and the middle school-based version of the CHP has been provided for over 50 sessions within an academic year. The more integrated an intervention is into the routine of the school, the greater the feasibility for providing intensive and consistent services over an extended period. This approach to a chronic condition such as ADHD has been repeatedly recommended and is unlikely to add burden beyond the costs already incurred to educate these students (Robb et al., 2011).

Although there are many remaining questions, the procedures were implemented without problems in the high schools and only two students discontinued early. Furthermore, parent and student attendance at evening meetings held at the high schools was commensurate with many parent training studies with parents of young children. Given that dosage was associated with improvement, this study suggests that the interventions appear to be targeting the aspects of impairment that are problematic for this population. Furthermore, the evidence from this study adds to a growing body of evidence suggesting that training interventions, as opposed to behavior management alone, may be the path to pursue with interventions targeting adolescents with ADHD (see Evans, Owens et al., 2013).

Limitations

This study should be interpreted cautiously for several reasons. First, our sample was relatively small and homogeneous, thereby making generalization to diverse populations of high school students imprudent. Moreover, with only two paraprofessionals, we are unable to analyze coaching factors that might help to explain the variability among participant outcomes. Second, there are limitations based on the measures used in this study. For example, comprehensive measures of social functioning and family relations would have improved our confidence in these findings. These results are primarily based on parent ratings that have limitations. Parents were aware of the treatment condition and the parent meetings during the fall semester; however, they were unaware of how often the coach met with their child. Furthermore, teacher ratings in secondary schools are difficult to interpret because there is considerable disagreement among teachers, and teachers only see each student for a short period each day and in a controlled setting (Evans, Allen, Moore, & Strauss, 2005). Identifying methods for improving the interpretation of teacher ratings to take into account differences between classrooms would improve our ability to use these ratings in analyses. In addition, grades as an outcome measure have serious psychometric limitations, even though they are highly valued outcomes by many parents and educators. Finally, although we did control for IQ and symptom severity in our probit response analyses, there are other possible confounds and interpretations that should be evaluated in future studies such as medication use, sex, and participant motivation and engagement. The obstacles to all students receiving between 40 and 50 sessions during the study were mostly logistical. Teachers' flexibility in allowing students to miss class, availability of students during study hall, student attendance, and other factors contributed to the variability. There may have been common characteristics of students who received large or small dosages. For example, students who were most eager to meet with the coaches may have had more meetings than those who were not. For these reasons and others, it is important to not assume causality based on the results of the probit regression. Finally, although we controlled for medication effects at a global level, there may have been subtle differences in

medication use that may have influenced our outcomes.

Future Directions

This study offers preliminary evidence that CHP coaching may offer some promise as a high school-based treatment for adolescents with ADHD. Specific findings related to the needed number of sessions, preventive effect on academic functioning, and implications for maintaining parent involvement over the academic year provide guidance for future refinements of the procedures. In addition, it is important to determine whether these services can be even more integrated into the school day to increase the ability to provide adequate dosages of the interventions to all students who need them (e.g., as part of study hall). Moreover, it will be important to measure the differential impact for families of low income and limited parent education by targeting a diverse sample of families, thereby examining the potential benefits for families with multiple risk factors.

Footnotes

¹Two students elected to drop from the study after five or fewer meetings with the ADHD coach. When these cases are removed from the dataset, the average number of sessions between students and coaches is 28.6 (SD = 4.9, range = 17–41), which is roughly equivalent to one CHP coaching session every six school days.

²Parents attended parent training when adolescents attended ISG. We chose to consider the parents' and adolescents' attendance as one session because they occurred concurrently.

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