Randomized Controlled Trial of Group Cognitive-Behavioral Therapy for ADHD Among College Students

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A dissertation

submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

University of Washington

2013

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Abstract

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OBJECTIVE: Attention-deficit/hyperactivity disorder (ADHD) affects between 2% and 8% of college students and is associated with broad and significant functional impairment. Effective interventions for ADHD among college students are urgently needed; however, very few studies and no randomized controlled trials have been published evaluating the efficacy of treatments for ADHD among college students. The present study is a pilot randomized controlled trial evaluating the efficacy, acceptability, and feasibility of a group-based dialectical behavior therapy (DBT) skills training intervention for college students with ADHD.

METHOD: Thirty-three undergraduate students with ADHD were randomized to receive either group skills training or self-guided skills handouts during an 8-week intervention phase. Participants were 42% female, 58% white, with an average age of 21.3 years (range 18-24).

ADHD symptoms, executive functioning, and several related outcomes were assessed via self-report and neuropsychological testing. Repeated-measures analysis of variance was used to analyze primary outcome measures at baseline, post-treatment, and 3-month follow-up. RESULTS: Participants receiving group skills training showed greater improvement in executive functioning and quality of life, with a trend toward greater improvement in ADHD symptoms and sustained attention. Treatment response rates were approximately 60% vs. 25% and clinical recovery rates were approximately 55% vs. 20% in the group skills training and handouts conditions, respectively. Acceptability and feasibility of group skills training were high. CONCLUSIONS: Group DBT skills training may be efficacious, acceptable, and feasible for treating ADHD among college students. A large-scale randomized trial is needed to further evaluate this intervention.

Keywords: ADHD, college, skills training, dialectical behavior therapy, mindfulness

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ACKNOWLEDGMENTS

I wish to express my sincere appreciation for the dedication of the students who participated in this research project. These individuals not only devoted their time and energy to engaging in the intervention, but also to sharing their experiences with us. Their feedback has been invaluable in guiding our efforts to improve treatment for ADHD among college students.

I would like to acknowledge my advisor, Bob McMahon, PhD, for his unwavering mentorship throughout my graduate career. I am especially grateful for his willingness to support an ambitious treatment development dissertation project, and to share his depth of experience in order to guide its success. I would like to thank Liliana Lengua, PhD, for her wise and steady guidance as my co-advisor throughout my graduate training. I am also very grateful for the support and expertise of the many faculty mentors who have contributed vitally this project, including Marsha Linehan, PhD, Julie Quamma, PhD, Nina Parker-Cohen, PhD, and Corey Fagan, PhD. And, I wish to acknowledge James Mazza, PhD, Mary Larimer, PhD, Chris Varley, MD, and Ron Smith, PhD, for serving on my dissertation committee. I was truly fortunate to have such a wonderful group of scientist mentors to work with throughout this journey.

I am grateful to Paige Peterson, Meagan Wong, Joseph Park, and Anthony Dreessen; without such a wonderful group of skilled and talented research assistants, this project would not have been possible. I truly appreciate the extraordinary contributions of Lyndsey Moran, MS, whose clinical skill, research savvy, and sense of humor were all invaluable as co-leader of the intervention groups. To my big sisters in the McMahon lab—Julia Hitch, PhD, Sarah Jensen, PhD, Jessica Vando, PhD, and Dana Rhule, PhD—thank you for everything.

Most importantly, I wish to thank my family and my partner, Merriss, for their love and support. You are at the heart of all of this.

DEDICATION

To my mother and father…

for inspiring me to pursue my dreams

and always being happy to see me when I return home.

CHAPTER 1

BACKGROUND AND RATIONALE

Introduction

Attention-deficit/hyperactivity disorder (ADHD)—once thought to be a disorder of childhood—persists into adulthood in up to 80% of individuals diagnosed as children (Barkley, Murphy, & Fischer, 2007). ADHD is characterized by developmentally atypical levels of inattentive behavior, hyperactive and impulsive behavior, or both. Between 2% and 8% of college students meet criteria for ADHD (DuPaul, Weyandt, O'Dell, & Varejao, 2009). College students with ADHD tend to have higher cognitive abilities and more effective compensatory skills than their peers diagnosed with ADHD who do not attend college (Frazier, Youngstrom, Glutting, & Watkins, 2007); however, they also experience an environment that presents a unique combination of stressors and challenges for individuals who struggle with sustained attention, organization, self-management, and pursuit of long-term rewards over short-term rewards (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999; Meaux, Green, & Broussard, 2009).

ADHD- and maturation-related deficits in behavioral self-regulation combine with an abrupt loss of external structure and support (e.g., parents, family) to produce significant adaptive impairment for many college students with ADHD. Compared to their undergraduate peers without ADHD, students with ADHD tend to have lower GPAs (e.g., Blase et al., 2009; Glutting, Monaghan, Adam, & Sheslow, 2002) and graduation rates (Heiligenstein et al., 1999; Wolf, 2001); higher rates of academic probation (Frazier et al., 2007; Heiligenstein et al., 1999), depressive symptoms (Blase et al., 2009; Heiligenstein & Keeling, 1995; Rabiner, Anastopoulos, Costello, Hoyle, & Swartzwelder, 2008), tobacco use and dangerous alcohol use (Rooney,

Chronis-Tuscano, & Yoon, 2012), and overall psychological distress (Richards, Rosen, & Ramirez, 1999; Weyandt, Rice, Linterman, Mitzlaff, & Emert, 1998); and lower social adjustment (Shaw-Zirt, Popali-Lehane, Chaplin, & Bergman, 2005) and self-reported quality of life (e.g., Blase et al., 2009). For many emerging adults (age 18-24) with ADHD, this trajectory of impaired functioning extends into adulthood, where ADHD is associated with greater rates of unemployment and underemployment, economic problems, depression and anxiety, relationship difficulties, and diminished life satisfaction (Biederman et al., 2006; Safren, Sprich, Cooper-Vince, Knouse, & Lerner, 2010). Given the significant and lifelong impairment associated with ADHD, effective intervention for ADHD among college students may have powerful benefits in both the short term and the long term.

Despite this clear treatment need, virtually no published research has evaluated the efficacy of psychosocial treatments for ADHD among college students. Although a small number of uncontrolled studies (Heiligenstein, Johnston, & Nielsen, 1996) and one recent placebo-controlled crossover study (DuPaul et al., 2012) have examined stimulant medication treatment or educational coaching (Allsopp, Minskoff, & Bolt, 2005; Zwart & Kallemeyn, 2001), there are no known randomized trials on treatment of any kind for ADHD in college students. A comprehensive review of ADHD symptomatology among college students highlighted the urgent need for treatment development research with this population. "Given the unique developmental needs and environmental challenges that college students with ADHD face, it is imperative that controlled investigations of pharmacotherapy, psychosocial, and educational interventions be conducted" (Weyandt & DuPaul, 2008, p. 316).

Existing Treatment Research for Adults & Adolescents with ADHD

Given the lack of intervention research on ADHD among college students, existing treatments designed for adults and adolescents with ADHD provide a useful framework for treatment development.

Stimulant medication is the most common treatment for ADHD among individuals of all ages. In randomized trials, stimulants have proven effective in reducing core symptoms of ADHD among young adults and adults (e.g., Wilens, Biederman, & Spencer, 1998) and improving health-related quality of life (Weiss et al., 2010). However, 20%-50% of adults in these trials were considered non-responders due to intolerable side effects or insufficient change in core symptoms. Additionally, most adults who respond to medication experience less than a 50% reduction in symptoms, and most responders still experience significant deficits in executive control and adaptive functioning (Wilens, Spencer, & Biederman, 2002). Among college students, a recent placebo-controlled crossover study of lisdexamphetamine (Vyvanse) showed similar results, with approximately 85% total treatment response rate in ADHD symptom reduction and approximately 70% total treatment response rate in executive functioning symptoms across three dosing conditions (DuPaul et al., 2012). Despite these strong response rates, subjects remained significantly impaired relative to a normative sample of nonclinical college students. Authors noted that these results "highlight the need to develop effective psychosocial treatment for the college ADHD population as an adjunct to pharmacotherapy" (DuPaul et al., 2012, p. 215).

One retrospective chart-review investigation found positive effects for stimulant medication treatment among college students with ADHD (Heiligenstein et al., 1996). Conversely, a large correlational study found no overall association between current stimulant medication use and academic performance among college students (Rabiner et al., 2008). In

addition, many college students choose not to regularly take prescribed stimulant medication because of side effects (e.g., feeling "zoned out" or less sociable, reduced appetite, difficulty sleeping) (Meaux, Hester, Smith, & Shoptaw, 2006). Rates of diversion and stimulant misuse are high, with up to 29% of students prescribed stimulants for ADHD reporting that they have given or sold their medication to peers (Upadhyaya et al., 2005).

Individual and group cognitive-behavioral therapy (CBT) interventions for adults with ADHD have shown efficacy in a small number of randomized trials (Knouse, Cooper-Vince, Sprich, & Safren, 2008). Most follow a similar treatment model of 8 to 16 weekly sessions (1-2 hours each) including components such as 1) psychoeducation, 2) enhancing motivation for change, 3) training and practice of skills/coping strategies, 4) cognitive restructuring of maladaptive thoughts, and 5) strategies for accessing/utilizing support.

Safren and colleagues (2005) randomly assigned 31 adults with ADHD who were stable on stimulant medication to receive either individual CBT plus continued medication or continued medication alone. Participants who received CBT showed lower independent-evaluator-rated symptoms of ADHD, depression, and anxiety, with very large effect sizes (d = 1.2-1.4). In a subsequent large-scale follow-up trial (Safren, Sprich, Mimiaga, et al., 2010), 86 adults with ADHD who were stable on stimulant medication were randomized to receive continued medication plus either individual CBT or relaxation and educational support. The CBT group showed roughly twice as many clinically significant responders as in the relaxation group (67% vs. 33%) and greater average improvement by the end of treatment (d = .53-.60). Treatment gains were maintained at 6-month and 12-month follow-up assessments.

Solanto and colleagues (2010) randomly assigned 88 adults with ADHD to receive either group CBT or supportive group therapy. Compared to the supportive control condition, group

CBT showed greater improvement in core ADHD symptoms (d = .67) and a higher clinically significant response rate (53% vs. 28%). Medication status was not associated with response to treatment. Higher baseline severity of ADHD symptoms was associated with greater improvement among subjects receiving group CBT. Similarly, Stevenson and colleagues (2002) found higher core symptom response rates among adults with ADHD who received a group CBT intervention (55%) than those in a waitlist control group (36%).

In addition to individual and group CBT, mindfulness training has shown preliminary evidence of efficacy as an intervention for ADHD. Mindfulness training has been shown to improve attention performance among college students (Tang et al., 2007), as well as broad-based psychological functioning (e.g., mood, stress, fatigue) among college students (Caldwell, Harrison, Adams, Quin, & Greeson, 2010) and adults in general (Carmody & Baer, 2008). Tang and colleagues randomly assigned 40 Chinese undergraduate students to either mindfulness training or relaxation training. After only 1 week of 20 minutes of daily practice, students in the meditation training group outperformed relaxation training subjects on the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002), a computerized test designed to assess conflict attention—a commonly impaired function among individuals with ADHD (Barkley, 2006). Zylowska and colleagues (Zylowska et al., 2008) conducted an open trial of a mindfulness training program adapted from Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1982) for 24 adults and 8 adolescents with ADHD. Significant pre- to post-treatment improvement was found in conflict attention and set-shifting, as well as symptoms of anxiety and depression.

Given the overlap between ADHD and borderline personality disorder (BPD) both in symptomatology (e.g., impulsivity, emotion dysregulation, and cognitive impairment) and co-

occurrence (Philipsen, 2006), Philipsen and colleagues (2007) combined dialectical behavior therapy (DBT; Linehan, 1993a) with standard CBT for ADHD in a group skills training format. This intervention included mindfulness training, behavioral analysis, and emotion regulation strategies along with more typical behavioral strategies (e.g., organization) in a group treatment delivered to 72 adults with ADHD. Pre- to post-treatment improvement effect sizes were moderate to large; although improvements cannot be attributed to specific components of the program, mindfulness and emotion regulation were ranked by participants as the second- and third-most helpful components (behavior analysis was rated as the most helpful component).

Psychosocial treatment for adolescents with ADHD has shown preliminary evidence of efficacy in a handful of studies. Behavioral family-based (Barkley, Anastopoulos, Guevremont, & Fletcher, 1992; Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001) and school-based interventions (e.g., Ervin, DuPaul, Kern, & Friman, 1998; Evans, Axelrod, & Langberg, 2004; Evans, Langberg, Raggi, Allen, & Buvinger, 2005) that emphasize management of external contingencies (e.g., daily report card, time out, point system) appear to be helpful. In contrast, one trial using a cognitive-oriented approach showed no evidence of efficacy (Morris, 1993).

Unique Developmental and Environmental Context of College

An effective intervention for ADHD in college must take into account both the existing intervention research on ADHD among adolescent and adults and the unique contextual factors that affect college students. Most undergraduates with ADHD face a “double-deficit” in behavioral self-regulation (e.g., organizing, planning, inhibiting impulses) due to the conjunction of ADHD-related impairment (Barkley, 1997) and still-maturing neural networks supporting behavioral inhibition and long-term planning (Giedd, 2004). At the same time, the transition to college typically brings an abrupt decrease in external support and a marked increase in

powerfully distracting environmental stimuli. Social context may exert a particularly powerful influence on college students' behavior, as emerging adults (age 18-24) tend to show impaired decision-making in situations with high socio-emotional arousal in a way that adults (age 25+) do not (Gardner & Steinberg, 2005). In short, the college context places high demands precisely on those areas where emerging adults (age 18-24) with ADHD tend to be most vulnerable.

Compared to interventions for ADHD in adults, it is likely that effective intervention for ADHD among college students must lean more heavily on moderating the self-regulation demands of the environment. This can be accomplished both by increasing external support structures (e.g., activating friends and instructors for support, creating external contingencies) and decreasing challenging contextual factors (e.g., reducing distractions, making decisions in states of low socio-emotional arousal). Additionally, because disruption in important daily life routines (e.g., sleeping, medication/substance use) is common among college students and linked to impaired functioning, regulation of these routines may also require more emphasis in treatment. College-specific skills such as test-taking and organizing work throughout the cyclical academic term should be addressed as well.

Beyond these differences, many elements of interventions for adults with ADHD will likely translate effectively to treatment of college students. Inattentive symptoms appear to be the primary driver of functional impairment among college students (e.g., Glutting et al., 2002; Rabiner et al., 2008) as well as adults (e.g., Stavro, Ettenhofer, & Nigg, 2007); thus, skills used to increase effective attention control and organization should be a key focus of treatment.

The specific goals in developing this intervention program were:

1) To develop a treatment that addresses key deficits associated with ADHD and that is appropriate to the unique developmental and environmental context of college, thereby aiming to provide effective immediate reduction in functional impairment.
2) To develop a program that trains practical behavioral skills that can be incorporated into daily life in a way that supports sustainable improvement in functioning and long-term maintenance of gains.
3) To develop a program that is acceptable to college students with ADHD and enhances motivation for change and engagement with treatment.
4) To develop a group-administered program that provides participants with the benefits of peer support and modeling and allows for feasible and cost-effective delivery of the intervention.

Purpose

Onken and colleagues (1997) described a three-stage model for the development of evidence-based behavioral treatments (Stage I: pilot testing and manual development; Stage II: manualized clinical trials; Stage III: effectiveness and dissemination research), which has been further expanded upon by Rounsaville and colleagues (2001). Preliminary Stage 1a therapy/manual development work for the present line of research was conducted during a 1-year period preceding the present study. This study represents a Stage Ib pilot randomized controlled trial (RCT) (i.e., an initial "strong test" of efficacy). In broad terms, the primary goal of a Stage 1b trial is to lay the foundation for a major Stage II randomized controlled trial. As described by Rounsaville and colleagues, the specific aims of a Stage Ib trial are to determine: 1) acceptability of the treatment, 2) ability to recruit the target population, 3) feasibility of the treatment delivery

method, 4) clinically significant patient improvement (e.g., evidence of efficacy), and 5) an estimate of the likely effect size in order to guide sample size selection for a Stage II trial.

Acceptability. Acceptability of the group-based intervention was assessed through client retention and attendance rates during treatment, and through a treatment satisfaction questionnaire administered at the end of the primary treatment phase. Clients were asked to report on how worthwhile they found the treatment to be, and on whether they would recommend the treatment to a friend in similar circumstances as themselves.

Recruitment. An essential component of the present study was establishing subject recruitment avenues for the target population sufficient to support not only this trial, but also a larger, Stage II trial. Recruitment success in the proposed trial would dictate the breadth of recruitment required for future trials, including determination of whether multiple sites may be necessary to meet Stage II recruitment goals.

Feasibility. The present study sought to demonstrate that the intervention can be delivered in the proposed manner (e.g., therapists, clients, treatment setting) and with fidelity to the treatment model. Feasibility was assessed through therapists' qualitative assessments of the treatment implementation, and through tracking of therapist intervention time and effort required to deliver the intervention. Fidelity was assessed through therapist self-report of intervention components included in each session.

Efficacy. Treatment outcomes from the present study will help to determine whether the proposed intervention leads to clinically significant improvement for clients. A broad range of primary outcomes (e.g., core ADHD behaviors, functional impairment due to ADHD behaviors, symptoms of anxiety and depression) and secondary outcomes (e.g., executive and neuropsychological functioning, study skills, mindfulness skills) was assessed. The present study

examined treatment outcomes both at the end of the intervention and after a 3-month follow-up period.

Effect size. An estimate of the effect size of contrasts between the intervention and control group in the present study will guide power analyses to determine the necessary sample size for a Stage II trial.

Intervention development. In addition to the previous five aims, the present study also provided valuable feedback to guide continued refinement of the treatment manual and procedures; a finalized treatment manual is a key precursor for a Stage II trial. At the conclusion of the treatment phase, both clients and therapists were asked to identify the intervention components that seemed most effective and those that seemed least effective, and to suggest ways to improve the intervention.

Training materials. Lastly, the present study provided useful materials for training future therapists involved in Stage II or Stage III trials. All sessions were video recorded, and clients were required to grant permission for use of these recordings for the purposes of research and training. (*Note:* Clients were <u>not</u> required to grant permission for broader use of these recordings.)

CHAPTER 2

METHOD

Design

Thirty-three undergraduate students who met a revised version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) criteria for ADHD in adulthood, as proposed by (Barkley, 2011a), and were actively seeking treatment were recruited from three universities (one public, two private) in the Seattle area. Participants were stratified by a median split on ADHD inattentive symptoms and randomly assigned to receive either group cognitive-behavioral skills training or self-guided skills training handouts. Participants were enrolled and randomly assigned in three cohorts at the beginning of three consecutive academic quarters. Participants were assessed before treatment, after treatment, and 3 months after treatment ended, corresponding to the beginning and end of the academic quarter in which treatment was received, and the end of the following academic quarter.

The study was approved by the University of Washington Institutional Review Board; all participants provided written consent to participate.

Participants

Recruitment. Prospective participants were recruited from public and private universities in the Seattle area via offices for student disability resources, academic support services, and behavioral health. Recruitment was conducted via email, bulletin board postings, and direct referral from providers. Prospective participants contacted the study in order to begin the screening process.

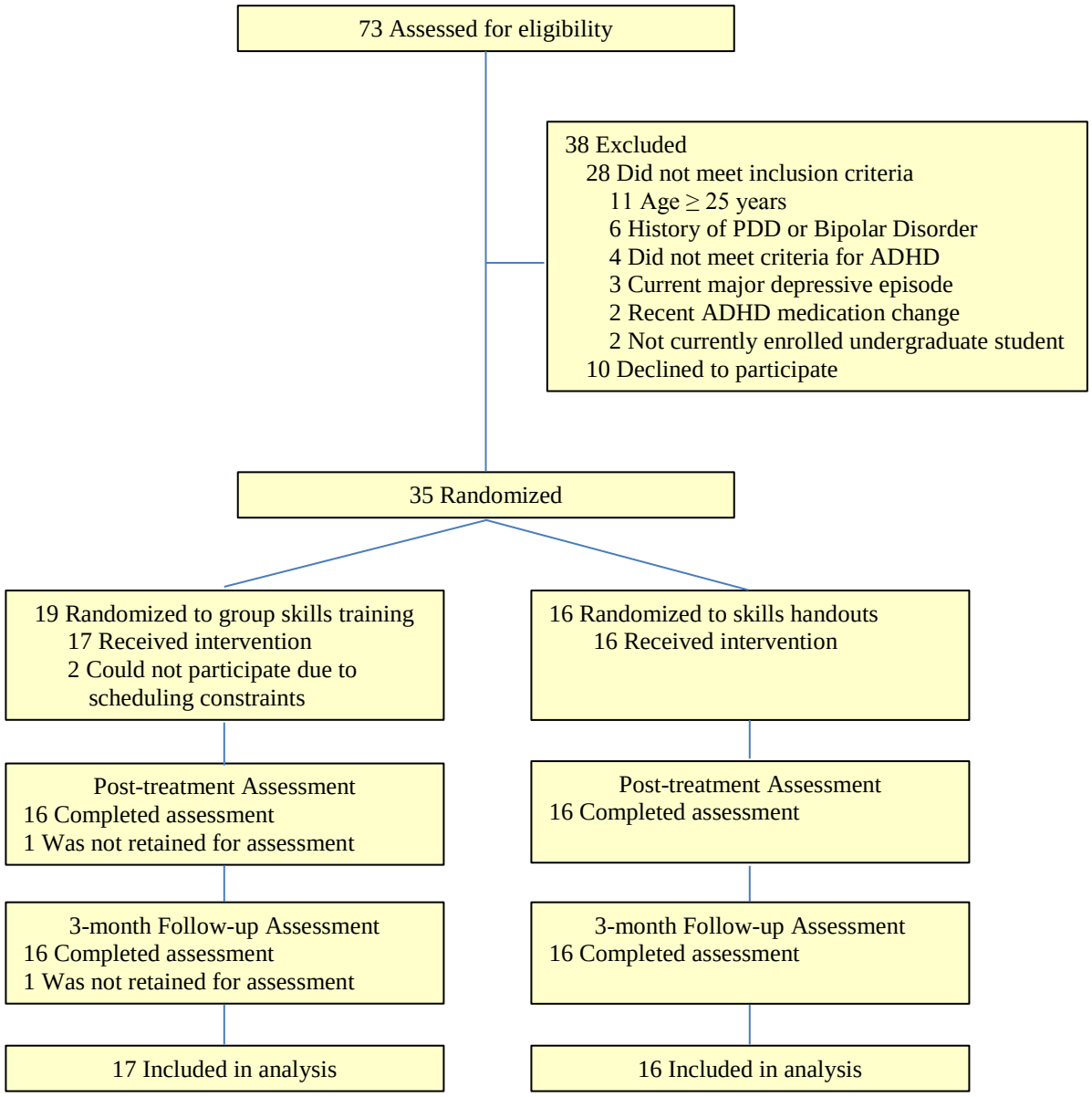
Eligibility. Participants were required to be currently enrolled undergraduate students between the ages of 18 and 24. Although a substantial minority of undergraduate students falls

outside this age range, the present study evaluated an intervention designed to treat ADHD in the unique developmental context faced by typical-aged college students (e.g., emerging adulthood). Because ADHD symptom counts often decline in adulthood while functional impairment remains (Barkley et al., 2007), participants were required to meet revised DSM-IV criteria for ADHD in adulthood (Barkley, 2011a), including 4 of 9 inattentive criteria and functional impairment in multiple domains. Inattentive symptoms appear to be the driver of functional impairment among college students; thus, per study protocol, individuals with clinical-level hyperactive/impulsive symptoms but low inattentive symptoms would have been excluded. However, no prospective participants fit this symptom presentation. Current DSM-IV-TR criteria for ADHD require symptom onset by age 7; however, research suggests that many adults diagnosed with ADHD did not experience symptom onset until as late as age 16 (Barkley et al., 2007). The present study required ADHD symptom onset by age 12 for eligibility. The presence of childhood symptoms was confirmed by either parent-report or self-report of four or more inattentive or hyperactive/impulsive symptoms by age 12.

Exclusion criteria were: active substance abuse or dependence, current active suicidality, current major depressive episode, and history of psychotic disorder, bipolar disorder or pervasive developmental disorder. Individuals receiving psychotropic medication for ADHD must have maintained a stable medication and dose for 1 month prior to enrollment, and were instructed to defer nonessential changes to their medication regimen until after the follow-up assessment. Prospective participants anticipating a medication trial or change were asked to do so prior to screening for the study. In order to ensure a high likelihood that a group treatment time could be scheduled to accommodate all participants assigned to that condition, participants were required to have scheduling flexibility on at least two afternoons per week.

Participant characteristics reflect a broad sampling of the college population at the universities targeted for recruitment. Demographics by sex, age, race, and class grade are shown in Table 1. Figure 1 summarizes the flow of participants through each phase of the study.

Figure 1. Flow of Participants From Randomization Through Analysis



ADHD: Attention-deficit/hyperactivity disorder, PDD: Pervasive developmental disorder

Table 1. Demographic and Clinical Characteristics of Intent-to-treat Sample (*N*=33)

	Group CBT/DBT (*n* = 17)		Skills Handouts (*n* = 16)	
Characteristic	*N*	(%)	*N*	(%)
Sex				
Female	7	(41.2)	7	(43.8)
Male	10	(58.8)	9	(56.2)
Race				
White	11	(64.7)	8	(50.0)
Latino	3	(17.7)	2	(12.5)
Asian	1	(5.9)	1	(6.3)
Black	0	(0.0)	1	(6.3)
Multi-Racial/Other	2	(11.8)	4	(25.0)
University				
Public	12	(70.6)	12	(75.0)
Private	5	(29.4)	4	(25.0)
ADHD subtype				
Inattentive (revised)	5	(29.4)	5	(29.4)
Inattentive (standard DSM-IV-TR)	11	(64.7)	7	(43.8)
Combined (standard DSM-IV-TR)	1	(5.9)	4	(25.0)
Psychopharmacological medication				
Methylphenidate only	5	(29.4)	3	(18.8)
Amphetamine only	5	(29.4)	8	(50.0)
Methylphenidate and SSRI[a]	1	(5.9)	1	(5.9)
Amphetamine and SSRI[b]	0	(0.0	1	(5.9)
SSRI only[c]	1	(5.9)	0	(0.0
None	5	(29.4)	3	(18.8)
	M	(*SD*)	*M*	(*SD*)
Age (years)	21.20	(1.67)	21.50	(1.12)
KBIT-2 Verbal IQ	108.94	(10.96)	111.06	(16.83)
WAIS-IV Digit Span	10.06	(2.22)	10.31	(2.24)
WRAML-2 Finger Windows	8.24	(1.75)	7.94	(2.32)
Barkley Adult ADHD Rating Scale-4th Edition				
Inattentive subscale	26.59	(3.71)	26.25	(2.75)
Hyperactive subscale	11.24	(2.51)	11.50	(3.74)
Impulsive subscale	8.41	(2.53)	9.12	(2.45)
Brown ADD Scales	80.59	(19.24)	77.31	(17.43)
Barkley Functional Impairment Scale[d]	4.29	(1.51)	4.24	(1.56)
Beck Anxiety Inventory	14.18	(13.69)	15.25	(8.93)
Beck Depression Inventory-2nd Edition	10.65	(7.86)	13.56	(8.26)
Adult ADHD Quality of Life Questionnaire	55.98	(11.51)	51.35	(12.99)

[a] Citalopram (*n*=1); Sertraline (*n*=1).

[b] Fluoxetine (*n*=1).

[c] Sertraline (*n*=1).

[d] Average functional impairment score.

Note: SSRI: selective serotonin reuptake inhibitor, KBIT-2: Kaufman Brief Intelligence Test-2nd Edition.

Study Procedures

Screening

Prospective participants contacted the study and completed initial screening via phone or a combination of phone and internet-based questionnaires conducted by trained research assistants. Participants meeting all basic eligibility criteria were invited to complete an in-person assessment. Prior to this assessment, participants completed a personal history form and were asked to have a parent or other caregiver complete a report form for childhood ADHD symptoms. In-person evaluations were conducted by an advanced graduate student with extensive training in assessment for ADHD, supervised by a licensed neuropsychologist. Participants completed questionnaire measures and a clinical interview and diagnostic assessment for ADHD. Participants were also assessed for substance abuse/dependence and other exclusion criteria. Those meeting all eligibility criteria were invited to participate in the study.

Baseline assessment

Enrolled participants completed a 90-minute baseline assessment, including questionnaire measures and brief neuropychological tasks administered by trained undergraduate research assistants.

Randomization

Approximately 5 days prior to the start of each treatment phase, all enrolled participants were stratified based on a median split of ADHD inattentive symptoms and assigned to treatment condition using a table of randomly generated numbers. Randomization was blocked to ensure an approximately 1:1 ratio of participants between the two conditions in each cohort. Participants were immediately notified of their study assignment and arrangements were made to begin treatment.

Treatment phase

The treatment phase spanned 8 weeks, from the 3rd week through the 10th week of the academic quarter. All universities from which students were recruited operated on approximately the same academic calendar. At the start of the treatment phase, participants either began attending group sessions or received skills handouts by mail.

Post-treatment and follow-up assessments

Within 5 days following the end of the treatment phase (approximately the final week of instruction in the academic quarter), participants completed a 90-minute post-treatment assessment. A 90-minute follow-up assessment was completed during the final week of instruction in the following academic quarter.

Because it was expected that students' subjective experience of their ADHD symptoms and impairment might vary from the high-demand period at end-of-quarter to the low-demand period immediately thereafter, significant efforts were taken to ensure that assessments were conducted in close proximity to each other and prior to completion of the final examination period. Of 32 post-treatment assessments, 29 were conducted within the 3-day period preceding the last day of instruction; the remaining 3 were conducted on Monday of the final examination week. Of 32 follow-up assessments, 31 were conducted within the 9-day period preceding the last day of instruction; the remaining assessment was conducted 3 weeks after the last day of instruction due to difficulty contacting the participant. Follow-up assessments for 8 subjects were completed by phone and excluded neuropsychological measures.

Both post-treatment and follow-up assessments included interview measures of ADHD symptoms and functional impairment, self-report questionnaires, and brief neuropsychological tasks, as well as quantitative and qualitative measures of intervention acceptability.

Measures

ADHD symptoms

Barkley Adult ADHD Rating Scale-IV (BAARS-4; Barkley, 2011a). This 27-item self-report questionnaire assesses the 18 DSM-IV criteria for ADHD, as well as 9 symptoms of "sluggish cognitive tempo" (SCT)—a set of behaviors that may characterize an etiologically distinct phenotype of ADHD, or an entirely different disorder (Diamond, 2005). Questions about age of onset and current functional impairment are also included. The BAARS-4 yields raw scores and percentiles derived from an age-based normative sample for inattentive, hyperactive, impulsive, total ADHD, and SCT subscales. Normative data for the BAARS-4 also includes cutoff scores for treatment response and recovery. The measure shows adequate internal consistency and test-retest reliability, and strong construct validity and discriminant validity. BAARS-4 versions for self-report of current symptoms (BAARS-4 S:Cr) and childhood symptoms (BAARS-4 S:Ch), and other-report of childhood symptoms (BAARS-4 O:Ch) were used in the proposed study.

Executive Functioning

Brown ADD Rating Scales (BADDS; Brown, 1996). This is a 40-item self-report inventory that yields *T*-scores for five empirically derived clusters of executive functioning (EF) (i.e., organization and prioritization, focused and sustained attention, regulation of alertness and sustained effort, affect modulation, and working memory), as well as a composite (total) index. The measure has been shown to have good internal consistency, test-retest reliability, construct validity, and discriminant validity. Normative data for the BAARS-4 also includes cutoff scores for treatment response and recovery. The BADDS was selected over the Conners' Adult ADHD

Ratings Scales (Conners, Erhardt, & Sparrow, 1999) for the present study based upon preliminary evidence of greater discriminant validity (Kooij et al., 2008).

Functional Impairment

Barkley Functional Impairment Scale—Long Form (BFIS-LF; Barkley, 2011b). This 15-item self-report questionnaire assesses functional impairment in 15 domains, including family life, occupation, and educational activities. The measure yields percentiles derived from age-based norms for each domain of impairment. The FIS-LF shows high internal consistency and adequate test-retest reliability, and good convergent validity with other measures of functional impairment.

Quality of Life

ADHD Quality of Life Questionnaire (AAQoL; Brod, Johnston, Able, & Swindle, 2006). This is a 29-item self-report inventory that assesses functioning and quality of life in four domains often affected by ADHD symptoms in adults: life productivity, psychological health, relationships and life outlook. Subscale and overall scores are calculated on a 0-100 scale. The measure shows good internal consistency and construct validity.

Comorbid Symptoms

Beck Depression Inventory—2nd edition (BDI-2; Beck, Steer, & Brown, 1996) and *Beck Anxiety Inventory* (BAI; Beck, Epstein, Brown, & Steer, 1988). These 21-item measures are widely used in clinical research and have strong reliability and validity. Both yield summed total scores that may be categorized by level of impairment. On the BAI, raw scores from 10-18 are classified as mild-to-moderate anxiety; on the BDI-2, raw scores from 14-19 are indicative of mild depression.

Academic Performance

Grade Point Average (GPA). Undergraduate GPA was be used as a measure of academic performance. GPA during the academic quarter prior to enrollment in the study (excluding summer quarter) was used as the baseline GPA score, with GPA from the subsequent two quarters serving as the post-treatment and follow-up values (e.g., for participants receiving treatment during winter quarter, GPA from fall, winter, and spring quarters were used as the three assessment time points).

Mindfulness Skills

Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). This is a 39-item self-report inventory that was derived based on a factor-analytic study of five independently developed mindfulness questionnaires. It assesses five related clusters of behaviors representing a general tendency to be mindful in daily life: observing, describing, acting with awareness, nonreactivity to inner experience, and nonjudging of inner experience. The five factors show adequate-to-good internal consistency and strong construct validity. Research indicates that these factors improve with mindfulness training, partially mediate the relation between meditation practice and psychological well-being, and account for 39% of the variance in well-being (Baum et al., 2010; Carmody & Baer, 2008).

Neuropsychological Performance

Kaufman Brief Intelligence Test—2nd Edition, verbal scale (KBIT-2; Kaufman & Kaufman, 2004). This brief, interviewer-administered IQ screener provides an estimate of verbal intelligence based upon Verbal knowledge and Riddles questions. This scale measures word knowledge, verbal reasoning, and fund of knowledge, and yields raw scores and age-normed standard scores with $M = 100$ and $SD = 15$. The KBIT-2 verbal scale shows good reliability and

validity, and correlates highly with comprehensive measures of verbal IQ, such as the Wechsler Adult Intelligence Scale—3rd edition (WAIS-3; Wechsler, 1997).

Wide Range Assessment of Memory and Learning—2nd Edition, finger windows test (WRAML-2; Sheslow & Adams, 2003). The finger windows test assesses both nonverbal (visuospatial) working memory and freedom from distraction. The interviewer points to a sequence of holes on a card at a rate of one per second, and the subject is then asked to repeat the sequence by pointing at the appropriate holes. Sequences increase incrementally in length; two trials are given at each length. The test concludes when the subject fails to correctly repeat both sequences of a given length. The raw scores from the two subtests are combined to form a total raw score and age-normed scaled scores with $M = 10$ and $SD = 3$.

Wechsler Adult Intelligence Scale—4th Edition, digit span test (WAIS-4; Wechsler, 2008). The digit span test assesses both auditory working memory and freedom from distraction. The test includes two subtests in which an interviewer reads strings of digits at a rate of one per second, and the subject is then asked to repeat these strings either forward or backward. Digit strings increase incrementally in length; two trials are given at each string length. The test concludes when the subject fails to correctly repeat both strings of a given length. The raw scores from the two subtests are combined to form a total raw score and age-normed scaled scores with $M = 10$ and $SD = 3$.

Conners' Continuous Performance Test—2nd edition (CPT-2; Conners, 2000). This standardized computer-administered test presents single letters on a screen at varying rates (one every 1 second, 2 seconds, or 4 seconds) for a total of 15 minutes. Participants are instructed to press a button in response to every letter except the target letter ("X"). The CPT-2 provides total scores, *T*-scores, and percentile ranks for omission errors, commission errors, reaction time

variability, as well as other measures. As a group, individuals with ADHD tend to show more commission errors than those without ADHD (d = .63) (Hervey, Epstein, & Curry, 2004). Although insufficient to diagnose ADHD, CPT-2 scores appear to be a useful supplement to behavioral reports, and may be particularly helpful in identifying cases of ADHD in which executive dysfunction plays a significant role (e.g., Nigg, Willcutt, Doyle, & Sonuga-Barke, 2005). As in several previous studies (e.g., Murphy, Barkley, & Bush, 2001; Nigg et al., 2005), omission errors, commission errors, and reaction time standard error were used to assess response sustained attention, inhibition, and response variability, respectively.

Demographics

Socioeconomic status (SES). Current household income was used as a proxy for socioeconomic status. Individuals who receive substantial financial assistance from parents or other family members were asked to include this family income in their report of household income.

Intervention Acceptability

Participants in both conditions provided quantitative and qualitative reports of treatment acceptability. Questions included overall ratings of treatment match, utility, and effectiveness, likelihood of referring a friend for the same treatment, as well as ratings of treatment length, format, and content. All quantitative acceptability ratings were made on a visual analog scale with anchor points at 0 (Strongly disagree), 5 (Neutral), and 10 (Strongly agree).

Primary and Secondary Outcome Measures

It was hypothesized a priori that individuals receiving group skills training would show greater improvement than those receiving skills handouts at post-treatment and at follow-up on these primary outcome measures: BAARS-4 S:Cr inattentive symptoms total score, BADDS

total score, AAQoL total score, FIS-LF total score, BAI total score, and BDI-2 total score, and grade point average (GPA).

In order to generate hypotheses regarding the mechanisms of treatment effect in the present study, exploratory analyses were planned for the following secondary measures: BAARS-4 S:Cr hyperactive, impulsive, total ADHD, and sluggish cognitive tempo scores, BADDS subscales: 1) organizing and prioritizing, 2) managing attention, 3) regulating alertness and sustaining effort, 4) regulating emotion, and 5) utilizing working memory, FFMQ subscales: 1) observing, 2) describing, 3) acting with awareness, 4) nonreactivity, and 5) nonjudging, AAQoL subscales: 1) life productivity, 2) psychological health, 3) relationships, and 4) life outlook, Conners' CPT-2: omission errors, Conners' CPT-2: commission errors, Conners' CPT-2: reaction time standard error, WAIS-4 digit span test, and WRAML-2 finger windows test.

Group Skills Training

Intervention design

The group skills training intervention was designed by adapting empirically supported intervention techniques and principles from individual- or group-based treatment for ADHD among adults (e.g., Philipsen et al., 2007; Safren, Sprich, Mimiaga, et al., 2010; Solanto et al., 2010; Zylowska et al., 2008) to address the unique developmental context and symptomatology of ADHD among college students (DuPaul et al., 2009; Fleming & McMahon, 2012). Skills training was delivered following the DBT group skills training format (Linehan, 1993b) and included the following content/skills: 1) psychoeducation about ADHD and executive functioning, 2) mindfulness practice, 3) organization and planning, 4) structuring environment, 5) managing daily life rhythms, and 6) emotion regulation. Figure 2 displays intervention content by treatment session.

Figure 2. Group Skills Training Intervention Content by Session

Session 1	Group orientation and goal-setting Psychoeducation; Mindfulness
Session 2	Daily planner use Chunking tasks and prioritization
Session 3	Structuring environment Using social support
Session 4	Managing sleep, eating, and exercise
Session 5	Generalizing and troubleshooting skills use
Session 6	Emotion regulation (e.g., opposite action)
Session 7	Generalizing and troubleshooting skills use
Session 8	Review of skills Plan for high-demand period
Session 9*	Review of skills Plan for maintaining skills use

*Booster session delivered in Week 1 of the following academic quarter.

Intervention components

The group skill training intervention included one 15-minute individual meeting prior to the first group, eight weekly 90-minute group sessions, and seven weekly 10- to 15-minute individual coaching phone calls. The treatment phase ran from the 3rd to the 10th week of the academic quarter in fall and spring quarters. Inclement weather delayed the start of the treatment phase by one week during the winter quarter; the omitted group session was rescheduled for later in the quarter. A 90-minute booster group session was held during the first week of the follow-up quarter. Thus, the maximum total intervention time was 13.5 hours of contact in group and 2 hours of individual contact. Because many participants in the spring treatment cohort planned to be out of town for the summer quarter, content from the booster session was included in the final session during the spring quarter treatment phase. Participants who missed four group sessions (with a "missed session" defined as missing at least half of that session) were considered to have dropped out of the group and not completed the treatment.

Pre-group meeting. Participants met with either the group leader or co-leader for a 15-minute individual session prior to the first group. This session focused on describing the format of the group intervention, identifying key goals and concerns for the group, enhancing

motivation for change, strengthening commitment to treatment, and troubleshooting potential difficulties in participating in the group throughout the quarter.

Group sessions. Treatment sessions were conducted in an outpatient clinic setting. Four treatment groups were conducted, ranging from three to six participants in size (weighted M = 4.76). Group sessions followed a regular structure based upon the typical protocol for standard DBT skills training groups (Linehan, 1993b), including: 1) introductory mindfulness exercise, 2) brief review of previous skills teaching, 3) review of each participant's daily skills practice, 4) midpoint mindfulness exercise, 5) instruction and practice of new skills, 6) assignment of daily practice, and 7) closing mindfulness exercise. Participants tracked skills practice and relevant behavior (e.g., sleep, exercise) on daily diary cards; daily tracking was emphasized as an essential component of the intervention and barriers to regular tracking were addressed in group sessions and phone calls.

Coaching phone calls. Weekly 10- to 15-minute individual coaching phone calls were administered by the group leader or co-leader. Phone calls were designed to support treatment engagement and facilitate generalization of skills use into daily life. Phone calls included: 1) 1-minute mindfulness practice, 2) review of skills used and positive reinforcement for practice, 3) troubleshooting problems with skills use and planning additional practice, and 4) assessing/enhancing motivation for treatment and addressing barriers to participation in treatment

Therapists

Group sessions were administered by a group leader (AF) and co-leader, sixth-year and third-year graduate students in child clinical psychology, respectively. Both therapists had received intensive training in DBT and were current members of a DBT consultation team led by

Dr. Marsha Linehan. Intervention was supervised by a licensed psychologist with experience in assessment and treatment of college students with ADHD. As prescribed in full-model DBT treatment (Linehan, 1993a), the DBT consultation team supported the two therapists in implementing DBT-consistent treatment strategies throughout the intervention. Both therapists maintained a regular personal mindfulness practice.

Skills Handouts

Participants in this treatment condition were mailed a 34-page bound packet of skills handouts; receipt of the handouts was confirmed by phone or email. Handouts were drawn from a manual for cognitive-behavioral treatment of ADHD in adults (Tuckman, 2007) and were selected to provide brief, practical, and accessible behavioral strategies in the primary areas of skills deficit for college students with ADHD. Topics included the following domains: 1) psychoeducation about ADHD and executive functioning, 2) organization, 3) planning, 4) time management, 5) structuring environment, 6) emotion regulation and stress management. Each handout included a brief description of a common area of difficulty associated with ADHD and of the utility of skills in that area, followed by a list of specific behavioral skills to practice.

Data Analytic Plan

The two treatment groups were compared on demographic and baseline clinical characteristics using independent samples *t* tests for continuous data and chi-square tests for categorical data.

Univariate repeated-measures analysis of variance (RM ANOVA; Winer, 1971) was used to compare overall relative changes in outcome variables between two treatment conditions across the treatment and follow-up periods. RM ANOVA was selected over alternative methods (e.g., multivariate RM ANOVA, mixed-effects models) in order to maximize power and validity

given the small sample size (Gueorguieva & Krystal, 2004); the Greenhouse-Geisser correction (Greenhouse & Geisser, 1959) was used on all analyses to correct for violations of the sphericity assumption. When the overall RM ANOVA *F* test indicated a time × condition interaction effect, planned linear contrasts were used to evaluate the relative efficacy of the two conditions at post-treatment and at follow-up. As is common in small-sample pilot efficacy trials, alpha levels were not adjusted across the seven primary outcome comparisons in order to avoid excess risk of Type II error (e.g., false negatives). Results from secondary outcome analyses are interpreted as exploratory rather than confirmatory findings due to the large number of comparisons. Data were analyzed using SPSS Version 19 (SPSS Inc, 2010).

Mean change effect sizes (Cohen's *d*) at post-treatment and follow-up were calculated using pooled standard deviations and were interpreted as follows: 0.2 = small, 0.5 = medium, 0.8 = large. Effect sizes for the RM ANOVA time × condition interaction were calculated using partial eta-squared and interpreted as follows: 0.01 = small, 0.06 = medium, and 0.14 = large.

Responder analyses were conducted using chi-square tests to determine whether participants showed clinically meaningful change in response to treatment. Positive response on the BAARS-IV and BADDS was defined using the Reliable Change Index (RCI; Jacobson & Truax, 1991), which determines a threshold of change that would be expected to occur by chance alone (e.g., measurement error) less than 5% of the time. Based on this metric, a reduction of 8 or more points in ADHD inattentive symptoms raw score and 12 or more points in total ADHD symptoms raw score was be considered indicative of positive response (Barkley, 2011a). Positive response on the BADDS required a reduction of 10 to 16 points in total raw score, with higher baseline scores requiring a larger change in order to be considered reliable, as described by Brown (1996).

Similarly, recovery analyses were conducted using chi-square tests to determine whether participants had improved to within the normal range in response to treatment. Recovery (also described in previous studies as "normalization") was defined conservatively as both reliable change (i.e., response), as defined above, and reduction of symptoms below the 93rd percentile (1.5 SD) on the BAARS-IV (Barkley, 2011a) and below the 96th percentile (1.7 SD) on the BADDS (Brown, 1996). Based upon this approach, raw scores at or below 20 points on ADHD inattentive symptoms, 38 points on total ADHD symptoms, and 59 points on BADDS total score were indicative of recovery.

Given the exploratory nature of this pilot randomized trial, change over time within each of the two treatment groups was evaluated regardless of the outcome of the between-groups comparisons. When the within-groups RM ANOVA *F* test indicated a main effect of time, planned contrasts were conducted to assess for change from baseline at post-treatment and at follow-up.

Linear regressions were conducted in order to explore potential baseline predictors of change in key primary outcome variables. Baseline demographic and clinical variables were entered as predictors of pre- to post-treatment change in ADHD inattentive symptoms and executive functioning, while controlling for initial levels of the outcome variable and the effect of treatment condition.

CHAPTER 3

RESULTS

Sample Characteristics

Intent-to-treat sample

Of 96 individuals who began the study screening process, 35 met full criteria and were randomly assigned: 19 to group skills training and 16 to skills handouts; 2 individuals were unable to participate in group treatment due to disparate schedules of the group members. Thus, the intent-to-treat sample included 17 and 16 participants in group skills training and skills handouts, respectively.

Attrition & Medication Change

One participant dropped out of group skills training after four sessions and did not complete the post-treatment or follow-up assessments; all other participants completed treatment and the three study assessments. For intent-to-treat analyses, missing data from one participant were imputed using the last observation carried forward (LOCF) method (Fayers, Curran, & Machin, 1998). Given the pattern of missing data in this sample, LOCF represents a conservative approach more likely to underestimate rather than overestimate the actual treatment effect. As expected, relative to results from the intent-to-treat sample, analyses conducted on the treatment completers sample consistently showed greater treatment effect sizes favoring group skills training; however, given the importance of including treatment dropout when evaluating overall clinical outcome, all results reported are from the intent-to-treat sample.

Two participants receiving group skills training and one receiving skills handouts had substantial ADHD medication changes during the study (either >25% change in dose or change

in medication type). All analyses were conducted with and without medication changers. The pattern of results did not differ; thus, results from the full intent-to-treat sample are reported.

Baseline comparisons

Treatment groups were compared on all demographic and clinical variables at baseline using independent samples *t* tests for continuous variables and chi-square tests for dichotomous variables. No differences were found between the two groups on any variable at baseline (all *p*s > .10). Baseline demographic and primary clinical variables are displayed in Table 1.

Primary Treatment Outcomes

The primary outcomes measures were ADHD inattentive symptoms (BAARS-IV), executive functioning (BADDS), quality of life (AAQoL), functional impairment (BFIS), anxiety symptoms (BAI), depressive symptoms (BDI-2), and grade-point average (GPA). Primary outcome data from the three assessments (pre-treatment, post-treatment, and follow-up) and results from the RM ANOVAs comparing change from baseline between the two treatment groups are summarized in Table 2, along with within- and between-groups mean change scores and effect sizes of mean change scores. Treatment response and recovery rates by condition are displayed in Table 3.

ADHD Inattentive Symptoms

In intent-to-treat analyses (N = 33), participants who received group skills training showed an overall trend toward lower ADHD inattentive symptoms ($F(2, 62) = 3.13$, $p = .056$, partial $\eta^2 = .092$) when compared with those receiving skills handouts; the main effect of time was also significant ($F(2, 62) = 63.31$, $p < .001$). Based on planned contrasts, group skills training did not significantly outperform skills handouts at post-treatment ($F(1, 31) = 2.29$, p =

Table 2. Results of primary outcome measures: Means, standard deviations, confidence intervals and mean change effect sizes (Cohen's *d*) by treatment group.

						Pre- vs. Post-Treatment					
		Pre-Treatment		Post-Treatment		Mean Differences[a]		Effect Sizes[a, b]			
Outcome Measure	Group	Mean	(*SD*)	Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]
BAARS	CBT	26.59	(3.71)	18.94	(4.94)	7.65	2.33	1.75	***	0.55	
Inatt.	Hndt	26.25	(2.74)	20.94	(5.08)	5.31		1.30	***		
BADDS	CBT	80.59	(19.24)	60.29	(23.17)	20.29	18.54	0.95	***	0.94	**
Total	Hndt	77.31	(17.43)	75.56	(18.46)	1.75		0.10			
AAQoL	CBT	54.56	(12.58)	67.09	(11.24)	12.53	11.07	1.05	**	0.90	*
Total	Hndt	51.35	(12.99)	52.80	(12.60)	1.45		0.11			
BFIS	CBT	4.29	(1.51)	2.95	(1.58)	1.34	0.56	0.86	***	0.37	
Average	Hndt	4.24	(1.56)	3.47	(1.46)	0.77		0.51	*		
BAI	CBT	14.18	(13.69)	9.82	(9.25)	4.35	4.85	0.37		0.44	
Total	Hndt	15.25	(8.93)	15.75	(11.07)	-0.50		-0.05			
BDI-2	CBT	10.65	(7.86)	7.47	(5.94)	3.18	0.80	0.46	*	0.10	
Total	Hndt	13.56	(8.26)	11.19	(10.27)	2.38		0.25			
GPA	CBT	3.04	(0.65)	3.02	(0.47)	-0.02	0.07	-0.04		0.04	
	Hndt	3.19	(0.47)	3.10	(0.58)	-0.09		-0.17			

[a] Mean differences and effect sizes calculated such that positive values represent improvement on all variables.

[b] Effect sizes calculated with pooled standard deviation from pre-treatment and post-treatment.

[c] Effect sizes calculated with pooled standard deviation from pre-treatment and follow-up.

[d] Significance value for T2 vs. T1 or T3 vs. T1 planned contrasts in within-groups RM ANOVA.

[e] Significance value for CBT vs. Control planned contrast in between-groups RM ANOVA.

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

Note: CBT: group cognitive-behavioral skills training, Hndt: self-guided skills handouts. BAARS Inatt.: Barkley Adult ADHD Rating Scale-4th Edition, Inattentive symptoms, BADDS: Brown ADD Rating Scales, AAQoL: Adult ADHD Quality of Life Questionnaire, BFIS: Barkley Functional Impairment Scale, BAI: Beck Anxiety Inventory, BDI-2: Beck Depression Inventory-2nd Edition, GPA: Grade Point Average (college), RM ANOVA: Repeated Measures Analysis of Variance

Pre-Treatment vs. Follow-up										
Follow-up		Mean Differences[a]		Effect Sizes[a, c]				Between-Groups RM ANOVA		
Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]	*F*	η^2	*p*
18.06	(4.92)	8.53	3.34	1.96	***	0.84	*	3.130	0.092	0.056
21.06	(4.12)	5.19		1.48	***					
59.06	(24.86)	21.53	15.97	0.97	***	0.81	**	5.457	0.150	0.007
71.75	(15.85)	5.56		0.33						
61.71	(15.26)	7.15	3.00	0.51	*	0.21		3.469	0.101	0.038
55.50	(15.19)	4.15		0.29						
3.02	(1.47)	1.27	0.73	0.85	***	0.49		1.932	0.059	0.160
3.70	(1.43)	0.54		0.36						
10.06	(10.63)	4.12	3.74	0.34	*	0.35		1.588	0.049	0.213
14.87	(8.72)	0.38		0.04						
10.76	(9.12)	-0.12	-2.93	-0.01		-0.34		1.375	0.042	0.260
10.75	(9.14)	2.81		0.32						
2.97	(0.63)	-0.07	-0.07	-0.10		-0.07		0.240	0.008	0.765
3.19	(0.44)	0.00		0.00						

.14, $d = 0.55$) but showed significantly greater improvement at follow-up ($F(1, 31) = 5.82$, $p = .02$, $d = 0.81$).

In within-groups analyses, participants in both the group skills condition ($F(2, 32) = 38.55$, $p < .001$) and the skills handouts condition ($F(2, 30) = 24.90$, $p < .001$) showed improvement over time on the BAARS-IV inattentive scores, with lower symptoms at post-treatment (Group: $F(1, 16) = 48.81$, $p < .001$; Handouts: $F(1, 15) = 23.90$, $p < .001$) and at follow-up (Group: $F(1, 16) = 58.50$, $p < .001$; Handouts: $F(1, 15) = 42.37$, $p < .001$) relative to baseline. Within-group mean change effect sizes (Cohen's *d*) at post-treatment and follow-up, respectively, were 1.75 and 1.96 for those receiving group treatment and 1.30 and 1.48 for those receiving skills handouts.

On BAARS-IV inattentive scores, 11 out of 17 (65%) intent-to-treat participants receiving group skills training showed positive response at post-treatment, compared to 6 out of 16 (38%) receiving skills handouts ($\chi^2(1) = 2.44$, $p = .12$). Among those responding to treatment, 10 (59%) showed recovery (i.e., normalization) after group skills training, while 5 (31%) showed recovery after skills handouts ($\chi^2(1) = 2.53$, $p = .11$).

At follow-up, 11 (65%) participants in the group skills condition showed positive response, compared to 4 (25%) receiving skills handouts ($\chi^2(1) = 5.24$, $p = .02$). Among treatment responders at follow-up, 9 (53%) showed recovery after group skills training, while 4 (25%) showed recovery after skills handouts ($\chi^2(1) = 2.70$, $p = .10$).

Executive Functioning (EF)

Participants who received group skills training showed greater EF improvement when compared with those receiving skills handouts ($F(2, 62) = 5.46$, $p = .007$, partial $\eta^2 = .150$); the

Table 3. Treatment response and recovery rates by treatment group.

		Post-Treatment						Follow-up					
		Response[a]			Recovery[b]			Response[a]			Recovery[b]		
Outcome Measure	Group	*N*	(%)	Sig.[c]	*N*	(%)	Sig.[c]	*N*	(%)	Sig.[c]	*N*	(%)	Sig.[c]
BAARS-IV	CBT	11	(64.7)		10	(58.8)		11	(64.7)	*	9	(52.9)	
Inattentive	Control	6	(37.5)		5	(31.3)		4	(25.0)		4	(25.0)	
BAARS-IV	CBT	10	(58.8)	*	10	(58.8)	**	9	(52.9)	*	8	(47.1)	**
Total score	Control	4	(25.0)		2	(12.5)		3	(18.8)		1	(6.3)	
BADDS	CBT	11	(64.7)	**	9	(52.9)	**	10	(58.8)	*	8	(47.1)	*
Total score	Control	3	(18.8)		1	(6.3)		4	(25.0)		2	(12.5)	

[a] Response indicated by symptom reduction greater than Reliable Change Index (RCI):
BAARS-IV Inattentive and Total: 95% confidence of symptom reduction
BADDS Total: 90% confidence of symptom reduction

[b] Recovery indicated by reliable change and reduction of symptoms to within normal range:
BAARS-IV Inattentive and Total: below 93rd percentile (1.5 *SD*)
BADDS Total: below clinical cutoff score of 60 (97th percentile, 1.7 *SD*)

[c] Significance value for CBT vs. Control chi-square test. *** $p < .001$, ** $p < .01$, * $p < .05$.
Note: BAARS-IV: Barkley Adult ADHD Rating Scale-4th Edition, BADDS: Brown ADD Rating Scales

main effect of time was also significant ($F(2, 62) = 11.23$, $p < .001$). Based on planned contrasts, group skills training outperformed skills handouts both at post-treatment ($F(1, 31) = 9.85$, $p = .004$, $d = .94$) and at follow-up ($F(1, 31) = 7.61$, $p = .01$, $d = .81$).

In within-groups analyses, individuals receiving group skills training showed overall improvement over time in EF on the BADDS ($F(2, 32) = 11.67$, $p < .001$), with lower EF impairment at post-treatment ($F(1, 16) = 16.92$, $p < .001$) and at follow-up ($F(1, 16) = 25.72$, $p < .001$); participants receiving skills handouts did not show significant EF improvement over time ($F(2, 30) = 1.47$, $p = .25$). Within-group mean change effect sizes at post-treatment and follow-up were 0.95 and 0.97 for those receiving group treatment and 0.10 and 0.33 for those receiving skills handouts.

Eleven of 17 (65%) participants receiving group skills training showed positive response in executive functioning at post-treatment, compared to 3 of 16 (19%) receiving skills handouts ($\chi^2(1) = 7.13$, $p = .008$). Among those responding to treatment, 9 (53%) showed recovery after group skills training, while 1 (6%) showed recovery after skills handouts ($\chi^2(1) = 8.51$, $p = .004$).

At follow-up, 10 (59%) participants in the group skills condition showed positive response at post-treatment, compared to 4 (25.0%) receiving skills handouts ($\chi^2(1) = 3.86$, $p = .049$). Among treatment responders at follow-up, 8 (47%) showed recovery after group skills training, while 2 (13%) showed recovery after skills handouts ($\chi^2(1) = 3.66$, $p = .03$).

Quality of Life

Participants who received group skills training experienced greater QOL improvement ($F(2, 62) = 3.47$, $p = .038$, partial $\eta^2 = .101$) when compared to those receiving skills handouts; the main effect of time was also significant ($F(2, 62) = 5.83$, $p = .005$). Based on planned contrasts, group skills training significantly outperformed skills handouts at post-treatment ($F(1, 31) = 6.69$, $p = .015$, $d = .90$) but not at follow-up ($F(1, 31) = .423$, $p = .52$, $d = .21$).

In within-groups analyses, individuals receiving group skills training showed an overall improvement over time in quality of life (QOL) on the AAQoL ($F(2, 32) = 8.01$, $p = .002$), with higher QOL at post-treatment ($F(1, 16) = 12.86$, $p = .002$) and at follow-up ($F(1, 16) = 5.98$, $p = .026$); participants receiving skills handouts did not show significant QOL improvement over time ($F(2, 30) = .991$, $p = .37$). Within-group mean change effect sizes at post-treatment and follow-up were 1.05 and 0.51 for the group treatment condition and 0.11 and 0.29 for the skills handouts condition.

Functional Impairment

Participants who received group skills training did not show significantly greater improvement in functional impairment ($F(2, 62) = 1.93$, $p = .16$, partial $\eta^2 = .059$) when compared to those receiving skills handouts; the main effect of time was significant ($F(2, 62) = 17.23$, $p < .001$).

In within-groups analyses, individuals receiving group skills training showed lower functional impairment (FI) over time on the BFIS ($F(2, 32) = 8.01$, $p = .002$), with lower FI at post-treatment ($F(1, 16) = 12.86$, $p = .002$) and at follow-up ($F(1, 16) = 5.98$, $p = .026$). Participants receiving skills handouts also showed decreased FI over time ($F(2, 30) = 4.41$, $p = .034$); this within-groups effect was significant at post-treatment ($F(1, 15) = 7.79$, $p = .014$) but not at follow-up ($F(1, 15) = 2.80$, $p = .12$). Within-group mean change effect sizes at post-treatment and follow-up were 0.86 and 0.85 for the group treatment condition and 0.51 and 0.54 for the skills handouts condition.

Anxiety Symptoms

Participants who received group skills training did not show significantly lower anxiety symptoms ($F(2, 62) = 1.59$, $p = .21$, partial $\eta^2 = .049$) when compared to those receiving skills handouts; the main effect of time was also not significant ($F(2, 62) = 1.45$, $p = .24$).

In within-groups analyses, individuals in the group skills condition exhibited a trend toward decreased anxiety symptoms over time on the BAI ($F(2, 32) = 3.34$, $p = .055$), with lower anxiety at follow-up ($F(1, 16) = 4.51$, $p = .050$) and a trend toward lower anxiety at post-treatment ($F(1, 16) = 4.10$, $p = .060$). Participants receiving skills handouts did not show significant reduction in anxiety symptoms over time ($F(2, 30) = .084$, $p = .91$). Within-group mean change effect sizes at post-treatment and follow-up were 0.37 and 0.34 for the group treatment condition and -0.05 and 0.04 for the skills handouts condition.

Depressive Symptoms

Participants who received group skills training did not show significantly lower depressive symptoms ($F(2, 62) = 1.38$, $p = .26$, partial $\eta^2 = .042$) when compared to those receiving skills handouts; the main effect of time was also not significant ($F(2, 62) = 2.75$, $p = .074$).

In within-groups analyses, skills training group members showed a trend toward decreased depressive symptoms over time on the BDI-2 ($F(2, 32) = 3.04$, $p = .067$), with lower depressive symptoms at post-treatment ($F(1, 16) = 5.25$, $p = .036$) but no significant difference at follow-up ($F(1, 16) = .005$, $p = .95$). Participants receiving skills handouts did not show a significant reduction in depressive symptoms over time ($F(2, 30) = .084$, $p = .91$). Within-group mean change effect sizes at post-treatment and follow-up were 0.46 and -0.01 for the group treatment condition and 0.25 and 0.32 for the skills handouts condition.

Grade Point Average (GPA)

Participants who received group skills training did not show greater improvement in GPA ($F(2, 56) = .24$, $p = .77$, partial $\eta^2 = .008$) when compared to those receiving skills handouts.

In within-groups analyses, neither treatment group showed significant change over time in GPA (all ps > .10). Within-group mean change effect sizes at post-treatment and follow-up were -0.04 and -0.10 for those receiving group treatment and -0.17 and 0.00 for those receiving skills handouts.

Predictors of Treatment Response

Initial severity of ADHD inattentive symptoms, initial severity of executive functioning impairment, estimated verbal IQ, ADHD diagnostic subtype, full DSM-IV-TR vs. revised diagnostic criteria status, ADHD medication status, participant sex, and university of enrollment

did not predict change in either inattentive symptoms or executive functioning. Study cohort was associated with change in executive functioning at follow-up, but this relation was not significant after controlling for baseline executive functioning ($p > .10$). Lower participant age predicted greater improvement in executive functioning at post-treatment after controlling for baseline executive functioning and the effect of treatment condition ($F(1, 29) = 5.197$, $p = .030$, $\beta = -.33$); however, when age was entered as a covariate in RM ANOVAs, no time × age or time × age × condition interactions were significant (all *p*s > .10) and the pattern of results were unchanged. Raw correlations among predictor variables and change in outcome variables are displayed in Table 4.

Table 4. Correlations Among Predictor Variables and Change in ADHD Inattentive and Executive Functioning Symptoms.

			Change in Outcome Variables				Predictor Variables									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Change in Outcome Variables	1	T1-T2 Δ Att.	---													
	2	T1-T3 Δ Att.	.72 ***	---												
	3	T1-T2 Δ EF	.59 ***	.38 *	---											
	4	T1-T3 Δ EF	.48 **	.71 ***	.51 **	---										
Predictor Variables	5	T1 Att.	.19	.23	.04	.10	---									
	6	T1 EF	- .06	.04	.30	.29	.51 **	---								
	7	Verbal IQ	.28	- .09	.07	.00	.24	- .15	---							
	8	ADHD type	- .07	.09	- .15	- .06	.34	.24	- .01	---						
	9	Full/Rev. Dx	.15	.22	- .10	.05	.71 ***	.28	- .04	.28	---					
	10	Med. Status	.10	- .09	.09	- .04	.04	.20	.21	.07	- .26	---				
	11	Cohort	.30	.27	.39 *	.28	.34	.35 *	.04	.24	.28	- .10	---			
	12	Sex	.14	.02	- .13	- .12	- .13	- .11	.17	- .02	- .10	.11	- .18	---		
	13	University	.09	.04	.08	.12	.09	.01	- .05	.08	.26	.23	.33	.09	---	
	14	Age	- .26	- .11	- .37 *	- .04	.05	.00	- .03	.09	.01	- .08	- .08	- .35 *	- .13	---

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

Note: T1: Baseline, T2: Post-treatment, T3: Follow-up, Δ Att.: Change in ADHD Inattentive Symptoms, Δ EF: Change in Executive Functioning Symptoms, Full/Rev. Dx: Full DSM-IV-TR ADHD criteria vs. Revised Criteria, Med. Status: ADHD Medication Status.

Treatment Acceptability

Participants in the group skills training condition showed high treatment attendance (88% of scheduled sessions attended) and low treatment dropout (6% of participants). Participants gave significantly more favorable scores to the group skills training as compared to the skills handouts on four ratings of overall treatment acceptability: "The treatment matched my needs" (8.50 vs. 5.25, $t(30) = 4.91$, $p < .001$); "The skills and information that I gained from the treatment were useful" (9.31 vs. 6.19, $t(30) = 4.15$, $p < .001$); "The treatment improved my ability to manage difficulties related to ADHD" (8.75 vs. 4.94, $t(30) = 5.44$, $p < .001$); and "I would recommend the treatment that I received to a friend who has ADHD" (9.44 vs. 5.50, $t(30) = 5.31$, $p < .001$). Due to high intercorrelation among these four items (rs between .74 and .90), scores were averaged to create a total acceptability score. Participants gave higher total acceptability scores to group skills training over skills training handouts (9.00 vs. 5.47, $t(30) = 5.59$, $p < .001$) with a very large effect size ($d = 2.00$).

Participants receiving group skills training gave favorable ratings for the helpfulness of the skills training leaders ($M = 9.80$, $SD = .56$), group-based format ($M = 9.19$, $SD = 1.38$), and coaching phone calls ($M = 8.06$, $SD = 2.11$). One-sample t tests comparing to a test value of 5.0 (Neutral) suggest that the 90-minute session length was appropriate ($M = 5.06$, $SD = 1.39$, $t(15) = .18$, $p = .86$) and reflect a trend toward rating the 9-session treatment length as too short ($M = 4.19$, $SD = 1.60$, $t(15) = -2.03$, $p = .06$).

Participants receiving the skills training handouts gave an approximately neutral rating to the helpfulness of the handouts ($M = 5.50$, $SD = 2.97$). One-sample t tests comparing to a test value of 5.0 (Neutral) suggest that the length of individual skills handouts ($M = 4.63$, $SD = 1.63$,

t(15) = -.92, *p* = .37) and of the overall skills handout packet (*M* = 4.69, *SD* = 2.21, *t*(15) = -.57, *p* = .58) were appropriate.

Participants who received group skills training provided the following ratings of the utility of each treatment component, in order from highest to lowest rating: mindfulness (mindfulness practice, non-judgmentalness, etc.) (*M* = 9.25, *SD* = 1.13), structuring the environment (study context, using support, etc.) (*M* = 8.69, *SD* = 1.99), planning (chunking, prioritizing, listing tasks, etc.) (*M* = 8.69, *SD* = 1.85), organization (planner, notepad, etc.) (*M* = 8.13, *SD* = 2.42), emotion regulation (functions of emotions, check the facts, opposite action) (*M* = 7.75, *SD* = 3.40), managing daily life rhythms (sleep, eating, exercise, etc.) (*M* = 7.56, *SD* = 2.87), pros and cons (making decisions in advance) (*M* = 7.31, *SD* = 2.12), information about ADHD (causes, common experiences, etc.) (*M* = 6.69, *SD* = 2.27).

Secondary Treatment Outcomes

Secondary outcomes measures were ADHD hyperactive, impulsive, and total symptoms; five BADDS subscales (organizing/activating, managing attention, sustaining effort, regulating emotion, and using working memory); four quality of life (AAQoL) subscales (life productivity, psychological health, relationships, and life outlook); five mindfulness (FFMQ) subscales (observing, describing, acting with awareness, nonreactivity, and nonjudgmentalness); auditory working memory (WAIS-IV Digit Span), visuo-spatial working memory (WRAML-2 Finger Windows); and three CPT-2 subscales (omission errors, commission errors, and reaction time standard error). Data from the three assessments (pre-treatment, post-treatment, and follow-up) and results from the RM ANOVAs comparing change from baseline between the two treatment groups are summarized in Tables 5 and 6, including within- and between-groups mean change scores and effect sizes of mean change scores.

Table 5. Results of secondary outcome measures: Means, standard deviations, confidence intervals and mean change effect sizes (Cohen's *d*) by treatment group.

						Pre- vs. Post-Treatment					
		Pre-Treatment		Post-Treatment		Mean Differences[a]		Effect Sizes[a, b]			
Outcome Measure	Group	Mean	(*SD*)	Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]
BAARS											
Impulsive	CBT	8.41	(2.53)	6.53	(2.37)	1.88	0.76	0.77	***	0.30	
	Hndt	9.13	(2.45)	8.00	(2.71)	1.13		0.44	**		
Hyperact.	CBT	11.24	(2.51)	9.35	(3.02)	1.88	0.57	0.68	*	0.17	
	Hndt	11.50	(3.74)	10.19	(3.85)	1.31		0.35	*		
ADHD	CBT	46.24	(6.31)	34.82	(8.83)	11.41	3.66	1.49	***	0.47	
Total	Hndt	46.88	(6.72)	39.13	(8.71)	7.75		1.00	***		
SCT	CBT	25.24	(4.58)	19.65	(4.54)	5.59	1.71	1.23	***	0.36	
	Hndt	24.44	(5.32)	20.56	(4.79)	3.88		0.77	**		
BADDS											
Organize	CBT	81.00	(9.61)	69.71	(13.65)	11.29	13.67	0.96	**	1.17	***
	Hndt	75.56	(11.78)	77.94	(11.49)	-2.38		-0.20			
Attention	CBT	81.59	(7.37)	70.71	(13.93)	10.88	7.32	0.98	**	0.78	*
	Hndt	80.13	(6.02)	76.56	(7.62)	3.56		0.52			
Effort	CBT	78.06	(13.71)	66.88	(12.59)	11.18	12.55	0.85	**	1.01	**
	Hndt	76.94	(11.26)	78.31	(11.67)	-1.38		-0.12			
Affect	CBT	61.88	(12.88)	57.47	(8.89)	4.41	2.41	0.40		0.20	
	Hndt	64.19	(14.29)	62.19	(12.81)	2.00		0.15			
Memory	CBT	77.06	(13.49)	64.76	(13.42)	12.29	10.11	0.91	***	0.79	*
	Hndt	74.81	(11.37)	72.63	(12.58)	2.19		0.18			
AAQoL											
Productivity	CBT	46.26	(17.25)	63.10	(14.85)	16.84	16.70	1.05	**	1.12	**
	Hndt	45.45	(12.69)	45.60	(14.10)	0.15		0.01			
Psy Health	CBT	52.70	(19.87)	63.48	(14.09)	10.78	7.66	0.63	*	0.41	
	Hndt	48.96	(19.09)	52.08	(20.81)	3.12		0.16			
Relationships	CBT	66.47	(18.77)	76.47	(11.96)	10.00	4.69	0.64		0.26	
	Hndt	58.13	(20.65)	63.44	(20.23)	5.31		0.26			
Life Outlook	CBT	60.71	(10.94)	69.75	(15.73)	9.04	9.70	0.67	**	0.68	*
	Hndt	57.81	(15.61)	57.14	(14.46)	-0.67		-0.04			

[a] Mean differences and effect sizes calculated such that positive values represent improvement on all variables.

[b] Effect sizes calculated with pooled standard deviation from pre-treatment and post-treatment.

[c] Effect sizes calculated with pooled standard deviation from pre-treatment and follow-up.

[d] Significance value for T2 vs. T1 or T3 vs. T1 planned contrasts in within-groups RM ANOVA.

[e] Significance value for CBT vs. Control planned contrast in between-groups RM ANOVA.

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

Note: CBT: group cognitive-behavioral skills training, Hndt: self-guided skills handouts. BAARS Inatt.: Barkley Adult ADHD Rating Scale-4th Edition, Inattentive symptoms, SCT: Sluggish Cognitive Tempo, BADDS: Brown ADD Rating Scales, AAQoL: Adult ADHD Quality of Life Questionnaire, RM ANOVA: Repeated Measures Analysis of Variance

Pre-Treatment vs. Follow-up										
Follow-up		Mean Differences[a]		Effect Sizes[a, c]				Between-Groups RM ANOVA		
Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]	F	η^2	*p*
6.35	(2.34)	2.06	1.06	0.84	***	0.43		1.896	0.058	0.160
8.13	(2.42)	1.00		0.41	**					
9.47	(2.70)	1.76	0.76	0.68	**	0.24		0.485	0.015	0.604
10.50	(3.52)	1.00		0.28						
33.88	(8.13)	12.35	5.17	1.70	***	0.71	*	3.179	0.093	0.053
39.69	(7.59)	7.19		1.00	***					
21.12	(4.46)	4.12	1.06	0.91	**	0.22		0.569	0.018	0.542
21.38	(5.27)	3.06		0.58	*					
68.06	14.57)	12.94	13.32	1.05	***	1.18	***	9.616	0.237	<0.001
75.94	(7.84)	-0.38		-0.04						
68.94	(13.07)	12.65	7.77	1.19	***	0.80	*	2.864	0.085	0.068
75.25	(10.78)	4.88		0.56						
67.59	(13.63)	10.47	7.47	0.77	**	0.59		4.704	0.132	0.016
73.94	(11.65)	3.00		0.26						
56.53	(10.24)	5.35	0.17	0.46		0.01		0.297	0.009	0.718
59.00	(12.25)	5.19		0.39						
65.94	(15.52)	11.12	9.43	0.76	**	0.72		3.582	0.104	0.038
73.13	(11.09)	1.69		0.15						
55.61	(20.17)	9.35	5.24	0.50	*	0.31		4.488	0.126	0.016
49.57	(17.51)	4.12		0.27						
61.03	(19.93)	8.33	2.60	0.42		0.13		0.730	0.023	0.481
54.69	(21.29)	5.73		0.28						
74.71	(14.19)	8.24	5.42	0.49		0.29		0.501	0.016	0.598
60.94	(19.93)	2.81		0.14						
62.61	(18.52)	1.90	-1.90	0.12		-0.13		3.128	0.092	0.062
61.61	(13.77)	3.80		0.26						

ADHD Hyperactive and Impulsive, Sluggish Cognitive Tempo, and Total ADHD Symptoms

Participants who received group skills training showed a trend toward greater improvement in total ADHD symptoms ($F(2, 62) = 3.18$, $p = .053$, partial $\eta^2 = .093$) when compared to those receiving skills handouts; the main effect of time was also significant ($F(2, 62) = 56.23$, $p < .001$). Based on planned contrasts, group skills training outperformed skills handouts at follow-up ($F(1, 31) = 6.09$, $p = .019$, $d = .71$) but not at post-treatment ($F(1, 31) = 2.41$, $p = .13$, $d = .47$). Group skills training did not significantly outperform skills handouts on ADHD hyperactive ($F(2, 62) = .49$, $p = .60$, partial $\eta^2 = .015$) or impulsive ($F(2, 62) = 1.90$, $p = .16$, partial $\eta^2 = .058$) symptoms, or sluggish cognitive tempo symptoms ($F(2, 62) = .57$, $p = .54$, partial $\eta^2 = .018$). Main effects of time were significant for all four variables (all ps $< .001$).

In within-groups analyses, both treatment groups showed significant improvement over time in ADHD impulsive (Group: $F(2, 32) = 16.45$, $p < .001$; Handouts: $F(2, 32) = 4.91$, $p = .023$) and total ADHD (Group: $F(2, 32) = 34.34$, $p < .001$; Handouts: $F(2, 32) = 23.23$, $p < .001$) symptoms, as well as sluggish cognitive tempo symptoms (Group: $F(2, 32) = 9.97$, $p < .001$; Handouts: $F(2, 32) = 9.34$, $p = .002$). Individuals who received skills training also showed significant improvement over time in ADHD hyperactive symptoms ($F(2, 32) = 5.66$, $p = .011$), while those in the skills handouts condition showed a trend toward improvement over time ($F(2, 32) = 3.78$, $p = .053$). Within-group mean change effect sizes at post-treatment ranged from 0.68 to 1.49 (group skills) and from 0.35 to 1.00 (handouts), and at follow-up from 0.68 to 1.70 (group skills) and from 0.28 to 1.00 (handouts).

Executive Functioning Subscales

Among the five executive functioning subscales of the BADDS, participants who received group skills training showed greater EF improvement relative to those receiving skills

handouts in organizing/activating ($F(2, 62) = 9.62$, $p < .001$, partial $\eta^2 = .237$), sustaining effort ($F(2, 62) = 4.70$, $p = .016$, partial $\eta^2 = .132$), and using working memory ($F(2, 62) = 3.58$, $p = .038$, partial $\eta^2 = .104$), with a trend toward greater improvement in managing attention ($F(2, 62) = 2.86$, $p = .068$, partial $\eta^2 = .085$). No significant difference between groups was observed in regulating emotion ($F(2, 62) = .30$, $p = .718$, partial $\eta^2 = .009$).

In within-groups analyses, participants who received group skills training improved over time in organizing/activating ($F(2, 32) = 11.67$, $p < .001$), managing attention ($F(2, 32) = 12.10$, $p < .001$), sustaining effort ($F(2, 32) = 6.77$, $p = .006$), and using working memory ($F(2, 32) = 9.92$, $p < .001$); within-groups effect sizes on these four subscales ranged from 0.85 to 0.98 at post-treatment and 0.76 to 1.19 at follow-up. Improvement over time in regulating emotion was not significant ($F(2, 32) = 2.42$, $p = .126$). Those receiving skills handouts did not show significant improvement on any BADDS subscale (all ps > .10), with effect sizes ranging from -0.20 to 0.52 at post-treatment and -0.04 to 0.56 at follow-up.

Quality of Life Subscales

Among the four quality of life subscales of the AAQoL, participants who received group skills training showed greater improvement in life productivity ($F(2, 62) = 4.49$, $p = .016$, partial $\eta^2 = .126$) and a trend toward greater improvement in life outlook ($F(2, 62) = 3.13$, $p = .062$, partial $\eta^2 = .092$) when compared to those receiving skills handouts; no significant differences in psychological health ($F(2, 62) = .72$, $p = .48$, partial $\eta^2 = .023$) or relationships ($F(2, 62) = .50$, $p = .60$, partial $\eta^2 = .016$).

In within-groups analyses, participants who received group skills training improved over time in life productivity ($F(2, 32) = 7.67$, $p = .003$) and life outlook ($F(2, 32) = 3.70$, $p = .041$), with a trend toward improvement in psychological health ($F(2, 32) = 2.95$, $p = .070$). Within-

Table 6. Results of secondary outcome measures: Means, standard deviations, confidence intervals and mean change effect sizes (Cohen's *d*) by treatment group.

						Pre- vs. Post-Treatment					
		Pre-Treatment		Post-Treatment		Mean Differences[a]		Effect Sizes[a, b]			
Outcome Measure	Group	Mean	(*SD*)	Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]
FFMQ											
Observing	CBT	28.53	(5.73)	28.29	(5.39)	-0.24	1.26	-0.04		0.25	
	Hndt	29.38	(4.51)	27.88	(4.16)	-1.50		-0.35			
Describing	CBT	24.29	(7.54)	27.35	(6.21)	3.06	0.81	0.44		0.14	
	Hndt	22.25	(5.42)	24.50	(3.92)	2.25		0.48			
Act Aware	CBT	18.35	(4.23)	22.53	(5.48)	4.18	1.80	0.85	**	0.41	
	Hndt	18.44	(3.58)	20.81	(3.89)	2.38		0.64			
Non-judg.	CBT	24.00	(6.13)	28.53	(7.50)	4.53	4.03	0.66	*	0.54	
	Hndt	23.31	(6.90)	23.81	(9.25)	0.50		0.06			
Non-react.	CBT	20.82	(5.39)	23.12	(3.76)	2.29	2.86	0.49	*	0.61	*
	Hndt	22.38	(4.77)	21.81	(4.71)	-0.56		-0.12			
Total	CBT	116.00	(16.65)	129.82	(14.29)	13.82	10.76	0.89	**	0.72	*
	Hndt	115.75	(13.36)	118.81	(15.51)	3.06		0.21			
Working Memory											
Digit Span	CBT	10.06	(2.22)	10.41	(2.69)	0.35	-0.08	0.14		-0.04	
	Hndt	10.31	(2.24)	10.75	(2.21)	0.44		0.20			
Finger	CBT	8.24	(1.75)	8.53	(2.38)	0.29	0.86	0.14		0.40	
Windows	Hndt	7.94	(2.32)	7.38	(2.09)	-0.56		-0.25			
CPT-2											
Omission	CBT	48.64	(8.56)	46.26	(6.95)	2.37	8.52	0.30		0.74	
Errors	Hndt	45.90	(4.47)	52.04	(19.95)	-6.14		-0.42			
Commission	CBT	51.17	(9.95)	46.07	(9.15)	5.11	4.50	0.53		0.44	
Errors	Hndt	51.97	(10.03)	51.35	(11.80)	0.61		0.06			
Reaction Time	CBT	49.02	(12.96)	46.91	(13.51)	2.12	2.22	0.16		0.16	
Std Error	Hndt	47.65	(13.53)	47.75	(14.06)	-0.10		-0.01			

[a] Mean differences and effect sizes calculated such that positive values represent improvement on all variables.

[b] Effect sizes calculated with pooled standard deviation from pre-treatment and post-treatment.

[c] Effect sizes calculated with pooled standard deviation from pre-treatment and follow-up.

[d] Significance value for T2 vs. T1 or T3 vs. T1 planned contrasts in within-groups RM ANOVA.

[e] Significance value for CBT vs. Control planned contrast in between-groups RM ANOVA.

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

Note: CBT: group cognitive-behavioral skills training, Hndt: self-guided skills handouts, Non-judg.: Non-judgmentalness, Non-react: Non-reactivity, CPT-2: Conners' Continuous Performance Test-2nd Edition, FFMQ: Five Facet Mindfulness Questionnaire, RM ANOVA: Repeated Measures Analysis of Variance

Pre-Treatment vs. Follow-up										
Follow-up		Mean Differences[a]		Effect Sizes[a, c]				Between-Groups RM ANOVA		
Mean	(*SD*)	Within Group	vs. Control	Within Group	Sig.[d]	vs. Control	Sig.[e]	F	η^2	*p*
27.29	(4.92)	-1.24	0.39	-0.23		0.08		0.576	0.018	0.559
27.75	(5.08)	-1.63		-0.34						
26.94	(6.38)	2.65	1.65	0.38		0.25		0.356	0.011	0.679
23.25	(6.27)	1.00		0.17						
22.06	(4.84)	3.71	2.64	0.82	**	0.64		1.563	0.048	0.219
19.50	(3.79)	1.06		0.29						
28.18	(6.50)	4.18	3.30	0.66	*	0.47		2.022	0.061	0.150
24.19	(8.69)	0.88		0.11						
24.65	(2.94)	3.82	3.32	0.88	**	0.71	*	3.527	0.102	0.037
22.88	(5.35)	0.50		0.10						
129.12	(14.81)	13.12	11.31	0.83	***	0.75	*	4.149	0.118	0.031
117.56	(15.00)	1.81		0.13						
11.12	(2.60)	1.06	0.56	0.44		0.24		0.460	0.015	0.630
10.81	(2.43)	0.50		0.21						
8.82	(2.13)	0.59	1.34	0.30		0.64		1.794	0.055	0.176
7.19	(2.14)	-0.75		-0.34						
46.31	(7.34)	2.33	7.42	0.29		0.81	*	3.088	0.093	0.066
50.99	(13.96)	-5.09		-0.49						
46.75	(10.38)	4.43	4.94	0.44		0.47		1.432	0.046	0.247
52.48	(11.64)	-0.51		-0.05						
45.91	(11.90)	3.11	5.93	0.25		0.46		1.455	0.046	0.243
50.46	(13.06)	-2.81		-0.21						

groups effect sizes on these three subscales ranged from 0.63 to 1.05 at post-treatment and 0.12 to 0.50 at follow-up. Improvement over time in relationships ($F(2, 32) = 2.48$, $p = .105$) was not significant. Those receiving skills handouts did not show significant improvement on any AAQoL subscale (all ps > .10), with effect sizes ranging from -0.04 to 0.16 at post-treatment and 0.14 to 0.28 at follow-up.

Mindfulness Total

Participants who received group skills training showed greater improvement in overall mindfulness on the FFMQ ($F(2, 62) = 4.15$, $p = .031$, partial $\eta^2 = .118$) when compared to those receiving skills handouts; the main effect of time was also significant ($F(2, 62) = 8.71$, $p = .001$). Based on planned contrasts, group skills training outperformed skills handouts both at post-treatment ($F(1, 31) = 4.28$, $p = .047$, $d = .72$) and at follow-up ($F(1, 31) = 5.70$, $p = .023$, $d = .75$).

In within-groups analyses, individuals receiving group skills training showed overall improvement over time in mindfulness ($F(2, 32) = 11.59$, $p = .002$), with greater mindfulness at post-treatment ($F(1, 16) = 10.63$, $p = .005$) and at follow-up ($F(1, 16) = 17.41$, $p < .001$); participants receiving skills handouts did not show significant mindfulness improvement over time ($F(2, 30) = .526$, $p = .57$). Within-group mean change effect sizes at post-treatment and follow-up were 0.95 and 0.97 for those receiving group treatment and 0.10 and 0.33 for those receiving skills handouts.

Mindfulness Subscales

Among the five subscales of the FFMQ, participants who received group skills training showed improvement in mindfulness relative to those receiving skills handouts in non-reactivity ($F(2, 62) = 3.53$, $p = .037$, partial $\eta^2 = .102$), but no significant differences in observing ($F(2, 62)$

= .58, p = .56, partial η^2 = .018), describing (F(2, 62) = .36, p = .68, partial η^2 = .011), acting with awareness (F(2, 62) = 1.56, p = .22, partial η^2 = .048), and non-judging (F(2, 62) = 2.02, p = .15, partial η^2 = .061).

In within-groups analyses, participants who received group skills training improved over time in acting with awareness (F(2, 32) = 9.05, p = .001), non-judging (F(2, 32) = 5.88, p = .020), and non-reactivity (F(2, 32) = 8.76, p = .002), with at trend toward improvement in describing (F(2, 32) = 2.71, p = .099); within-groups effect sizes on these four subscales ranged from 0.44 to 0.89 at post-treatment and 0.38 to 0.88 at follow-up. Improvement over time in observing (F(2, 32) = 1.30, p = .29) was not significant. Those receiving skills handouts did not show significant improvement on any FFMQ subscale (all ps > .10), with effect sizes ranging from -0.35 to 0.64 at post-treatment and -0.34 to 0.29 at follow-up.

Working Memory

Participants who received group skills training did not show greater improvement in either auditory working memory (F(2, 62) = .46, p = .63, partial η^2 = .015) or visuo-spatial working memory (F(2, 62) = 1.79, p = .18, partial η^2 = .055) when compared to those receiving skills handouts.

In within-groups analyses, neither treatment group showed significant improvement over time on measures of auditory or visuo-spatial working memory performance (all ps > .10). Within-group mean change effect sizes at post-treatment ranged from 0.141 to 0.143 (group skills) and from -0.25 to 0.20 (handouts), and at follow-up from 0.30 to 0.44 (group skills) and from -0.34 to 0.21 (handouts).

Inattention, Impulsivity, and Response Variability

Participants who received group skills training showed a trend toward greater improvement in CPT-2 omission errors ($F(2, 60) = 3.09$, $p = .066$, partial $\eta^2 = .093$) when compared to those receiving skills handouts; the main effect of time was not significant ($F(2, 60) = .55$, $p = .54$). Based on planned contrasts, group skills training outperformed skills handouts both at follow-up ($F(1, 30) = 4.50$, $p = .042$, $d = .81$) and showed a trend toward greater improvement at post-treatment ($F(1, 30) = 3.50$, $p = .071$, $d = .74$). Group skills training did not significantly outperform skills handouts on CPT-2 commission errors ($F(2, 60) = 1.43$, $p = .25$, partial $\eta^2 = .046$) or response time standard error ($F(2, 60) = 1.46$, $p = .24$, partial $\eta^2 = .046$); main effects of time were also not significant (ps > .05).

In within-groups analyses, neither treatment group showed significant improvement over time on CPT-2 omission errors, commission errors, or response time standard error (all ps > .10). Within-group mean change effect sizes at post-treatment ranged from 0.16 to 0.53 (group skills) and from -0.42 to 0.06 (handouts), and at follow-up from 0.25 to 0.44 (group skills) and from -0.49 to 0.05 (handouts).

CHAPTER 4

DISCUSSION

Primary Aims

The present study was designed to evaluate the efficacy, acceptability, and feasibility of a group skills training intervention for college students with ADHD. This intervention combined elements of dialectical behavior therapy (DBT; Linehan, 1993a)—including mindfulness and emotion regulation skills—and cognitive-behavioral therapy (CBT) for ADHD (e.g., Safren, Sprich, Mimiaga, et al., 2010; Solanto et al., 2010)—including organization and planning skills—in a DBT skills training format (Linehan, 1993b). Participants were randomly assigned to receive either weekly group skills training or self-guided skills training handouts. Participants were assessed before and after an eight-week treatment phase, and three months following the end of treatment.

Within-group analyses showed that group skills training was associated with improvement over time in inattentive and total ADHD symptoms, executive functioning, quality of life, and functional impairment, both immediately after treatment ended and at a 3-month follow-up. Pre-treatment vs. post-treatment effect sizes on these four outcomes ranged from large to very large (d = 0.86-1.75). Improvements were maintained 3 months after treatment, with pre-treatment vs. follow-up effect sizes ranging from moderate to very large (d = 0.51-1.96). Group skills training was also associated with a trend toward lower anxiety and depressive symptoms over time, with lower anxiety at follow-up (d = 0.34) and lower depressive symptoms at post-treatment (d = 0.46).

When compared to self-guided skills handouts, group skills training appears to be efficacious in improving several key markers of ADHD impairment. Based on intent-to-treat

analyses, individuals receiving group skills training showed greater improvement in executive functioning and quality of life, with trends toward greater improvement in inattentive and total symptoms of ADHD. Pre-treatment vs. post-treatment mean change effect sizes comparing group skills training to skills handouts on these four measures ranged from moderate to large (*d* = 0.47-0.94). On all of these measures with the exception of quality of life, group skills training continued to outperform skills training handouts three months after treatment, with pre-treatment vs. follow-up effect sizes ranging from moderate to large (*d* = 0.71-0.84). Although a large within-group effect size was observed on functional impairment at both post-treatment and follow-up, group skills training did not significantly outperform skills handouts on this measure. Similarly, group skills training did not outperform skills handouts in improving anxiety, depressive symptoms, or GPA. Group skills training produced a greater proportion of participants with clinical meaningful response to treatment based on total ADHD symptoms (post-treatment: 59% vs. 25%; follow-up: 53% vs. 19%) and on executive functioning symptoms (post-treatment: 65% vs. 19%; follow-up: 59% vs. 25%). Likewise, group skills training also led to a greater percentage of participants with recovery into the normal range based on total ADHD symptoms (post-treatment: 59% vs. 13%; follow-up: 47% vs. 6%) and on executive functioning symptoms (post-treatment: 53% vs. 6%; follow-up: 47% vs. 13%). On ADHD inattentive symptoms, treatment response (post-treatment: 65% vs. 38%; follow-up: 65% vs. 25%) and recovery (post-treatment: 59% vs. 31%; follow-up: 53% vs. 25%) rates were significantly higher among individuals receiving group skills training only when comparing response rates at follow-up.

Overall response rates for both group skills training (53-65%) and the skills handout control condition (19-38%) are comparable to those observed in previous randomized trials of

individual- (Safren, Sprich, Mimiaga, et al., 2010) and group-based (Solanto et al., 2010) CBT skills training interventions for adults with ADHD (53-67% vs. 23-33% and 53% vs. 28%, respectively).

Participants in group skills training showed only modest improvements in depressive symptoms at post-treatment and in anxiety symptoms at follow-up. Neither of these outcome measures showed significant differences between group skills training and skill handouts. These findings parallel those of previous trials of CBT skills training for ADHD (Safren et al., 2005; Solanto et al., 2010) showing small-to-moderate effect sizes on measures of comorbid symptoms. These results may reflect floor effects on these measures given the fact that participants' baseline anxiety and depressive symptoms generally fell below the clinical range, due at least in part to the exclusion of individuals with a current major depressive episode.

Exploratory analyses suggest the possibility that relatively younger college students may experience greater improvement in executive functioning from group-based skills training; however, this association did not appear at follow-up or on other outcome measures. While no conclusion can be drawn from these findings, future studies may examine the effect of participant age using pre-planned contrasts.

Analyses of secondary outcomes suggest that groups skills training outperforms skills handouts on four of five executive functioning subscales of the BADDS: organizing/activating, managing attention, sustaining effort, and using working memory; effect sizes ranged from 0.78 to 1.17 at post-treatment and 0.59 to 1.18 at follow-up. Neither condition showed significant improvement over time in regulating emotion. Although both interventions included skills aimed at improving emotion regulation, baseline mean scores on this subscale were in the normal range, suggesting a possible floor effect. Group skills training appeared to outperform skills handouts

on two of four quality of life subscales of the AAQoL: life productivity and life outlook; effect sizes ranged from 0.68 to 1.12 at post-treatment, but differences were not significant at follow-up. No significant differences were observed between the two conditions on the psychological health or relationships subscales. On neuropsychological measures, groups skills training showed a trend toward greater improvement in CPT-2 omission errors, commonly interpreted as a marker of inattention; effect sizes were moderate-to-large at post-treatment and follow-up (d = 0.74 and d = 0.81, respectively). No significant between-group differences in treatment outcome were found on measures of impulsivity (CPT-2 commission errors), vigilance (CPT-2 reaction time standard error), auditory working memory (digit span), or visuo-spatial working memory (finger windows).

Mindfulness training is a key component of the group skills intervention; thus, secondary analyses of mindfulness scores on the FFMQ are of particular note. Results suggest that group skills training outperformed skills handouts in improving overall mindfulness, with relative improvement maintained three months after treatment; effect sizes at post-treatment and follow-up were moderate-to-large (d = 0.72 and d = 0.75, respectively). Analyses of mindfulness subscales suggest that the skills training intervention is associated with improvement over time in acting with awareness, nonjudgmentalness, and, non-reactivity, and greater improvement in non-reactivity when compared to the skills handouts intervention. Given the particularly large deficits in acting with awareness (d = 1.35) and non-judgmentalness (d = 0.62) that appear to be associated with ADHD (Smalley et al., 2009; n.b., the non-reactivity subscale was not reported) when compared with non-ADHD controls, these results highlight the value of future research on mindfulness-based treatments for ADHD, including prospective evaluation of the association between improvement in mindfulness and improvement in ADHD symptoms and impairment.

Participants gave strongly positive acceptability ratings to the group skills training intervention as a whole (9.0 on a 0 to 10 scale); these ratings were substantially higher (d = 2.00) than acceptability ratings of the skills handouts (5.47 out of 10), which were approximately neutral ("Neutral" = 5.0). The group leaders, group intervention format, and individual coaching calls were given strongly positive ratings as well. Dropout from group skills treatment was very low (6%) and treatment attendance was high (88% of scheduled sessions attended).

Despite lower efficacy and acceptability relative to group skills training, the skills handouts intervention may be an active treatment with potential utility. Approximately one-third of participants gave the handouts an overall acceptability score of 7.0 or above. Treatment response rates of approximately 25% on ADHD and executive function symptoms are comparable to those of relaxation training or supportive psychotherapy control conditions reported in previous studies of treatment for adults with ADHD. Given the very low cost of this intervention, skills training handouts may be worthy of further study as an alternative treatment for use when more efficacious interventions are not feasible.

The majority of psychosocial interventions with empirical support for treating ADHD in adults use CBT skills training alone (e.g., Safren, Sprich, Mimiaga, et al., 2010; Solanto et al., 2010; Virta et al., 2010); one program uses mindfulness training alone (Zylowska et al., 2008), while another program combines CBT and DBT skills (including mindfulness) training in a format similar to the present study (Philipsen et al., 2007). The present study design precludes any formal analysis of treatment components; however, acceptability ratings and exploratory analyses offer suggestions regarding the utility of the primary intervention components. Among the content areas included in the group skills training, participants gave the highest ratings of utility to mindfulness training and to skills for structuring the environment, planning, and

organization. Correspondingly, participants receiving group skills training showed large improvements in overall mindfulness, and on executive functioning subscales for organization/activation, managing attention, sustaining effort, and using working memory. Thus, a very tentative conclusion can be drawn that both mindfulness training and CBT skills training are acceptable to college students with ADHD and may provide independent contributions to treatment efficacy; further study is needed to formally evaluate these treatment components.

Internal validity of the study is supported by the fact that treatment groups did not differ significantly on any demographic or baseline clinical variable, suggesting that random assignment successfully produced equitable comparison groups. Moreover, all primary and secondary analyses controlled for baseline levels of each outcome variable. All assessments were conducted by an interviewer who was blind to participant condition. The low attrition rate and conservative approach to missing data further support internal validity.

Several aspects of the present study support generalizability of the findings. First, the sample reflects diversity in racial background, socioeconomic status, and age (within the required 18-24 range for traditional college students), with a male:female ratio that roughly approximates the population of college students with ADHD. Students were recruited from both public and private universities. As is typical among undergraduate students seeking psychosocial treatment for ADHD, the study sample included students currently receiving ADHD medication yet showing substantial residual symptoms as well as students not currently receiving ADHD medication, either due to personal preference, intolerable side effects, or lack of previous services.

To further promote generalizability to the typical collegiate academic setting, cohorts were enrolled and randomized at the beginning of three successive academic terms; thus, each

treatment phase occurred within a single term. With only one exception, post-treatment and follow-up assessments were conducted during the final 10 days of the academic term but prior to the conclusion of final exams, thereby minimizing any potential confounding effect that may have occurred if some participants had been assessed late in the quarter while others were assessed during the post-quarter break.

Limitations

The small sample size of this pilot randomized trial underscores the need for a larger-scale replication of these results with statistical power to detect moderate effect sizes and to more reliably estimate the magnitude of effects on measures showing positive results. The current findings suggest that the group skills training intervention is more helpful than self-guided skills handouts. This study cannot rule out the possibility that the observed treatment effects are attributable to nonspecific factors of group psychotherapy or to therapist effects rather than to factors specific to the CBT/DBT intervention; however, this concern is somewhat mitigated by the fact that treatment response rates in the skills handouts condition approximate those of supportive group psychotherapy or individual relaxation plus educational support treatments used as control conditions in previous trials for adults with ADHD. While this study evaluates the efficacy of a novel combination of treatment elements from CBT and DBT, it cannot be determined from this study if (and to what degree) any particular treatment component is helpful for college students with ADHD. In addition, although exploratory analyses of neuropsychological measures offer some corroborating evidence of treatment efficacy, this study relies primarily upon self-report measures of outcome, increasing the likelihood that observed improvements are somewhat due to biases inherent in self-reporting (e.g., expectancy effects, desire to please the investigator). The inclusion of 10 participants (5 in each treatment group)

meeting revised rather than full DSM-IV-TR criteria for ADHD may be viewed as a limitation; however, neither initial severity of ADHD symptoms nor initial ADHD diagnostic status predicted change on primary outcome variables. Given that many adults with ADHD show lower ADHD symptom counts despite significant functional impairment, and given that many partial responders to medication require further psychosocial treatment, it is likely that many college students meeting these revised DSM-IV-TR criteria will require and seek treatment. It is noteworthy that the present intervention appears to be effective across a range of ADHD symptom presentations.

Conclusions and Future Directions

The present study represents the first known randomized controlled trial of any intervention for ADHD among college students. Overall, results suggest that this group skills training intervention improves college students' ADHD symptoms, executive functioning, and quality of life to a greater degree than does skills training via self-guided handouts. Treatment efficacy appears comparable to previously studied individual and group CBT treatments for adults with ADHD, with large effect sizes and response rates of approximately 60%. Treatment gains were maintained 3 months following the intervention. Participant acceptability of the treatment is high, and the group-based implementation offers greater feasibility than interventions delivered individually, especially given the limited supply of academic support resources at many colleges and universities.

In the future, a larger-scale randomized trial is needed in order to provide further evidence of primary treatment efficacy, evaluate potential moderate-sized treatment effects on clinically relevant treatment outcomes (e.g., functional impairment, anxiety, and depressive symptoms), and control for nonspecific factors of group psychotherapy. Addition of a semi-

structured interview with clinician global rating, an external report of symptoms, and a measure of college-specific academic skills would be useful as broader indicators of treatment outcome. Because all treatment groups in the present study were conducted by the same leader and co-leader, it will be important for future investigations to rule out therapist effects and to demonstrate the feasibility of training new group leaders and co-leaders. Given that no evidence was found that treatment efficacy decreases as group size increases up to six participants, it would be worthwhile to evaluate group sizes of 7 to 10 participants to further augment feasibility of implementation. Feasibility may also be improved by evaluating the use of an individual "support person" to deliver coaching calls and reinforce skills use between sessions, rather than the therapists themselves. Further, efficiency of the treatment may be improved by a component analysis of the primary treatment elements (i.e., mindfulness practice, organizational skills training, coaching phone calls). Finally, considering the strong empirical support for stimulant medication treatment of ADHD among children and adults, and the initial evidence of its efficacy among college students, it will be important for future studies to evaluate the relative efficacy and acceptability of psychopharmacological and psychosocial interventions, both independently and in conjunction, for the treatment of ADHD among college students.

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