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# Evaluation of a Mindfulness-based Intervention for Adolescents with Learning Disabilities and Co-occurring ADHD and Anxiety

**Jillian Haydicky · Judith Wiener · Paul Badali ·
Karen Milligan · Joseph M. Ducharme**

**Abstract** The current study evaluated the impact of a 20-week mindfulness training program on executive function (EF), internalizing and externalizing behavior and social skills in a clinical sample of adolescent boys with learning disabilities (LD). Integra Mindfulness Martial Arts (MMA) is a manualized group treatment program incorporating elements of mindfulness meditation, cognitive behavioral therapy (CBT), behavior modification and mixed martial arts. Adolescents (ages 12–18; $n=60$) with LD were assigned to the MMA or wait list control group (WL). Adolescents and their parents completed standardized questionnaires before and after training. Subgroup analyses were conducted to investigate the impact of the intervention on youth with co-occurring attention deficit/hyperactivity disorder (ADHD) or anxiety. Compared to the WL group, MMA participants with co-occurring ADHD (14 MMA, 14 WL) improved on parent-rated externalizing behavior, oppositional defiant problems and conduct problems. Boys with elevated hyperactive/impulsive symptoms (12 MMA, 17 WL) improved on parent-rated social problems and monitoring skills. Boys with elevated inattentive symptoms (15 MMA, 18 WL) improved on parent-rated social problems. Boys with elevated anxiety (12 MMA, 17 WL) reported decreased anxiety. MMA shows promise as an alternative treatment option for youth with LD and co-occurring difficulties.

**Keywords** Mindfulness · MBCT · Learning disability · Attention · Anxiety · Adolescent

J. Haydicky (✉) · J. Wiener · J. M. Ducharme
Department of Human Development and Applied Psychology,
Ontario Institute for Studies in Education
of the University of Toronto,
252 Bloor Street West, 9th Floor,
Toronto, ON M5S 1V6, Canada
e-mail: jill.haydicky@utoronto.ca

P. Badali · K. Milligan
Integra Foundation,
Toronto, Ontario, Canada

## Introduction

The overall purpose of this study is to investigate the impact of a mindfulness intervention with youth with learning disabilities (LD) and co-occurring attention deficit/hyperactivity disorder (ADHD) or anxiety. Mindfulness is the nonevaluative, present-centered awareness that results from the deliberate focusing and refocusing of attention on sensations, thoughts and feelings as they arise on a moment-by-moment basis (Williams et al. 2007). Bishop, Lau, Shapiro, Carlson, Anderson, Carmody, et al. (2004) propose an operational definition of mindfulness consisting of two components: self-regulation of attention and a curious and accepting attitude towards experience. Mindfulness can be conceptualized as both an enduring disposition and a fluctuating state. State levels of mindfulness can be enhanced through a variety of informal and formal meditative practices such as sitting meditation (Miners 2008).

A growing body of evidence supports the use of mindfulness meditation as a complementary or alternative treatment for a variety of health and mental health issues. Mindfulness has been incorporated into several manualized treatment programs such as mindfulness-based cognitive therapy (MBCT; Ma and Teasdale 2004; Teasdale et al. 2000) for depression relapse prevention, Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn et al. 1992) for chronic pain and stress-related disorders, Dialectical Behavior Therapy (DBT; Koerner and Linehan 2000) for

borderline personality disorder and Acceptance and Commitment Therapy (ACT; Hayes et al 2006).

Baer's (2003) empirical review reported that mindfulness-based programs are moderately effective treatments for chronic pain, binge eating, anxiety and depression in adults, with an overall mean effect size of 0.59. Keng, Smoski and Robins' (2011) recent review of correlational and randomized control studies supports and extends Baer's findings. According to this review, correlational research with community and clinical samples found that mindfulness is positively associated with self-report measures of psychological health, cognitive processes related to psychological well-being and neurological indices of emotion regulation and negatively associated with psychopathology (Keng et al. 2011). Intervention research using randomized control designs suggest that mindfulness practice reduces depression, self-harming behaviors, anxiety, medical problems, substance use and general distress. Mindfulness-based interventions increase positive effect, emotion regulation, empathy, social functioning, satisfaction and quality of life (Keng et al. 2011).

Mindfulness is believed to enhance psychological well-being through the processes of decentering, acceptance, exposure and self-regulation (Allen et al. 2006; Baer 2003; Bishop et al. 2004; Brown et al. 2007; Chambers et al. 2008; Hayes and Feldman 2004; Hooker and Fodor 2008; Thompson and Gauntlett-Gilbert 2008). Detached observation of internal experience allows one to monitor the content of thoughts without judgment or self-censorship. Thoughts are viewed as passing mental events reflecting the impermanent nature of being. Thoughts and feelings are not labeled as "good" or "bad" nor are they actively sought or avoided. This attitude of acceptance and openness to experience allows previously suppressed thoughts to enter the field of awareness. It has been hypothesized that repeated exposure to stressful thoughts leads to desensitization and reduced emotional reactivity (Baer 2009). As a result, experiential avoidance, which may be associated with some forms of psychopathology (Chawla and Ostafin 2007), may be reduced. Constant monitoring and regulation of cognitive processes reduces the tendency to act on "auto-pilot." Automatic and maladaptive cognitive coping responses such as rumination are identified early (Heeren and Philippot 2011; Raes and Williams 2010) allowing one to select more adaptive cognitive coping responses such as positive reappraisal (Garland et al. 2011). Detached self-observation allows one to recognize problematic situations before they escalate and weigh potential coping strategies without reverting to habitual patterns of response. In this way, impulsivity is reduced (Hooker and Fodor 2008; Baer 2009) This self-regulation of attention, cognition, emotion and behavior is also known as metacognition or executive function (EF). As such, mindfulness-based interventions may be particularly beneficial for individuals with EF deficits such as youth with LD and ADHD.

## Spelling it Out: The Relationship Between LD, ADHD and EF

LD are neurobiological disorders affecting the ability to acquire, organize, retain, understand and use information (Learning Disabilities Association of Canada 2005). Although the impact of LD is primarily in the academic domain, youth with LD also experience social difficulties and psychological disturbance (e.g., Capozzi et al. 2008; Willcutt and Pennington 2000). ADHD, characterized by cognitive impairments and developmentally inappropriate or excessive behavior (Barkley 2006), frequently co-occurs with LD. Comorbidity estimates range from 20 to 60% (Maynard et al. 1999; Willcutt et al. 2007). Although it is generally accepted that LD and ADHD are distinct disorders, research suggests that a common deficit in EF explains the high degree of overlap (Seidman et al. 2001; Willcutt et al. 2005). EF refers to the set of cognitive processes that control goal-directed behavior. These processes include goal setting, organization of behavior, response inhibition, cognitive flexibility, working memory, attention, emotional control and progress monitoring (Denckla 2007; Fernandez-Duque et al. 2000). Students with LD and ADHD often exhibit impairment in one or more of these processes (e.g., Lazar and Frank 1998).

Students with LD and ADHD experience considerable functional impairment. Difficulties with social functioning and peer relations have been documented in both populations (Bagwell et al. 2001; Wiener et al. 1993; Wiener and Schneider 2002). Adolescents with LD and ADHD are more likely to experience mental health difficulties including anxiety, depression and substance abuse (Beitchman et al. 2001; Elia et al. 2008; Jarrett and Ollendick 2008; Treuting and Hinshaw 2001). Psychosocial or pharmacological treatments aimed at improving the problems associated with LD and ADHD are often viewed as stigmatizing for adolescents (Mishna and Muskat 2004). Interventions designed to teach social skills have limited efficacy in this population (Gresham and Horner 2001; Kavale and Forness 1996; Kavale and Mostert 2004). Medication is associated with negative side effects for some youth (Faraone et al. 2008; Graham and Coghill 2008; Schachter et al. 2001). Consequently, developing and evaluating alternative interventions for youth with LD and ADHD is a priority.

Mindfulness interventions, which target underlying EF deficits, may be helpful for addressing the behavioral and social difficulties experienced by youth with LD and ADHD. Mindfulness meditation improves self-observation, self-control and attention and has demonstrated clinical utility for a variety of populations (for reviews, see Baer 2003; Keng et al. 2011). It is important to note that research supporting the effects of mindfulness training on self-regulated attention has been mixed, particularly with regard to sustained attention

(Chiesa et al. 2011; Semple 2010). Examination of these studies suggests that methodical issues may partly obfuscate the results. Many of the performance tasks used to assess EF are designed to measure reactions to arbitrary external stimuli (e.g., random letters presented on a computer screen) and often require a verbal or motor response (e.g., press the spacebar following every letter except X). These tasks may not be representative of the internal monitoring of thoughts, feelings and bodily sensations that is fostered through mindfulness practice. The mismatch between the underlying constructs and the methods used to assess them may explain why support for mindfulness-based interventions's effects on EF has been mixed. For example, Josefsson and Broberg (2010) found no difference between experienced meditators and nonmeditators on computerized tasks requiring sustained attention to external stimuli. In their discussion, the authors acknowledged that performance on these tasks may not be reflective of a meditator's enhanced executive attention for internal processes. Further research is needed before definitive statements regarding the impact of mindfulness training on self-regulated attention can be made. Preliminary results suggest that mindfulness shows promise for improving attention-related processes in adults such as alerting and orienting (Jha et al. 2007), sustained attention to internal events (Chambers et al. 2008; Valentine and Sweet 1999) and conflict monitoring (Jha et al. 2007; Zylowska et al. 2008).

Mindfulness for Youth with EF Difficulties

Youth may benefit from mindfulness training in ways similar to adults. A preliminary review of existing literature indicates that mindfulness-based interventions are feasible and acceptable to youth, with no adverse side effects reported (Burke 2010). Mindfulness training appears to improve attention, executive control, psychological well-being and psychophysiological processes such as blood pressure and heart rate in samples of typically developing children and adolescents (Barnes et al. 2004; Black et al. 2009; Flook et al. 2010). In samples of clinic-referred children and adolescents with ADHD and externalizing disorders, mindfulness training is associated with reductions in parent-rated inattention, hyperactivity and impulsivity (van der Oord et al. 2011) as well as significant improvements in objective measures of EF including sustained attention (Bogels et al. 2008), conflict orienting and set shifting (Zylowska et al. 2008). Mindfulness-based programs also reduce internalizing and externalizing problems including anxiety (Bogels et al. 2008; Semple et al. 2005), aggression (Singh et al. 2007) and noncompliance (Singh et al. 2010). The results of these studies should be considered preliminary, as many of them did not include a comparison group and statistical analyses were conducted with small sample sizes.

Results of recent randomized control studies in school and clinic settings provide further support for mindfulness interventions. Elementary school students in Grades 1–3 enrolled in the Attention Academy Program, a school-based mindfulness intervention, showed greater improvements than the control group in overall attention, selective attention, social skills and test anxiety after 12 sessions (Napoli et al. 2005). A study evaluating the use of school-based mindfulness awareness practices (MAPs) with elementary school students in Grades 2–3 found that the students who displayed EF difficulties prior to the study made greater improvements in behavioral regulation, metacognition and global executive control, relative to the silent reading control condition (Flook et al. 2010). A study evaluating a modified MBCT program for 9- to 13-year-olds referred to a clinic-based remedial reading program reported significantly reduced attention problems as rated by parents after 12 weeks of training, relative to wait list controls (WL). Among the small subset of children displaying clinically elevated anxiety at pretest, 50% fell below the clinical cutoff after 12 weeks of intervention (Semple et al. 2010). Results of a RCT of MBSR with adolescents referred to an outpatient psychiatric clinic indicate that relative to the treatment-as-usual condition, MBSR participants experienced reductions in depression, anxiety and somatic complaints as well as improved sleep quality and self-esteem after 8 weeks of MBSR. MBSR participants demonstrated greater diagnostic improvement than the control group, as rated by clinicians blind to condition (Biegel et al. 2009). The promising results emerging from pilot studies, feasibility studies and randomized control trials with children and adolescents, combined with the well established and ever growing body of research with adults (Baer 2003; Keng et al. 2011) suggest that mindfulness-based therapies have the potential to improve EF and psychological well-being in clinical populations of all ages.

Aims of the Current Study

The aim of the current study was to investigate whether mindfulness meditation training is an effective intervention for adolescents with LD and co-occurring difficulties. A pretest, posttest and intervention WL design was used to determine whether 20 weeks of MBCT and martial arts training improves EF and decreases internalizing and externalizing problem behaviors and social problems in a mixed clinical sample of 12- to 18-year-old boys. Due to the heterogeneity of the sample, subgroup analyses were conducted to determine whether participants with co-occurring specific behavioral or emotional difficulties respond to mindfulness training differentially. It was hypothesized that improvements will be evident in the domains that were of clinical concern at pretest. Thus, it was hypothesized that participants with LD and ADHD enrolled in the Integra Mindfulness Martial Arts

(MMA) program will demonstrate significant improvements in executive functioning at posttest compared to the WL. Specifically, parent ratings will show enhanced behavioral regulation, characterized by inhibitory control, cognitive flexibility and emotional control. Behavioral and emotional regulation is negatively correlated with parent-reported behavioral problems (Eisenberg et al. 1997). As a result, the LD/ADHD MMA group was expected to exhibit a significantly greater reduction in externalizing problems than the WL group from pretest to posttest. Since early externalizing behavior is associated with later peer victimization (Schwartz, McFayden-Ketchum, Dodge, Pettit & Bates, 1999) and higher levels of regulation are predictive of greater social competence (Eisenberg et al. 1997), it was hypothesized that the LD/ADHD MMA group will report a greater reduction in social problems than the WL group from pretest to posttest. Previous research has established mindfulness as an effective treatment for anxiety and recurrent depression in adults and preliminary research indicates that mindfulness training reduces anxiety in children. As such, it was hypothesized that adolescents with LD and anxiety receiving MMA will exhibit a greater reduction in internalizing problems than the WL group from pre- to posttest.

## Method

### Participants

Adolescents who were clients of Integra, a children's mental health center serving youth with LD in Toronto, Canada, participated in the study. Eligible participants were boys between the ages of 12 and 18, had been previously diagnosed with LD and were enrolled in or were on the WL for the MMA program being offered at the agency.

Cognitive and academic testing was conducted to confirm the previous diagnosis of LD (see Table 1 for summary of scores). To be included in the current study, participants had to obtain an IQ estimate of at least 80 on the Wechsler Abbreviated Scale of Intelligence (WASI) and meet one of the following criteria: a) a standard score below 90 on at least one of the core reading, written language and mathematics subtests of the Woodcock–Johnson Tests of Achievement; or b) academic achievement at least one standard deviation below IQ. A total of 78 adolescents (39 MMA and 39 WL) were initially enrolled in the study. Six were excluded for having an IQ score below 80, nine did not meet the achievement criteria and three withdrew from the study, leaving a sample of 60 youth (28 MMA and 32 WL). The overall sample comprised 49 participants (21 MMA, 28 WL) who had at least one achievement standard score below 90 and 11 (7 MMA, 4 WL) classified on the basis of IQ/achievement discrepancy.

Approximately 47% of the overall sample ($n=28$; 14 MMA, 14 WL) reported a previous diagnosis of ADHD, 8% ($n=5$; 2 MMA, 3 WL) a previous diagnosis of anxiety disorder, 3% ($n=2$ MMA) a previous diagnosis of a mood disorder; 2% ($n=1$ MMA) a previous diagnosis of oppositional defiant disorder and 2% ($n=1$ MMA) a previous diagnosis of conduct disorder. Approximately 45% ($n=27$; 14 MMA, 13 WL) of participants reported taking psychostimulant medication for ADHD symptoms when they enrolled in the study. Of the WL participants, three attended a specialized summer camp for children with LD and one obtained brief counseling service at the agency. No other WL participants received treatment at the agency while participating in the study. A two-way contingency table analysis was conducted to evaluate whether the MMA and WL groups differed on demographic variables at Time 1 (pretest). The groups did not differ on ADHD diagnosis (Pearson $\chi^2=0.00$, $p=0.99$) or medication status (Pearson $\chi^2=0.42$, $p=0.52$). Significantly more participants in the WL group spoke a second language at home (1 MMA, 7 WL; Pearson $\chi^2=4.33$, $p=0.04$). Independent samples $t$-tests revealed no significant differences in age ($F(1,63)=2.41$, $p=0.19$), paternal education ($F(1,49)=0.007$, $p=0.17$) or maternal education ($F(1,59)=0.46$, $p=0.07$). Only three participants withdrew from the research prior to posttesting (1 MMA, 2 control), two of whom continued to participate in MMA, for an attrition rate of 4.6%.

The overall sample was further divided into subgroups to investigate the hypotheses of the current study. The LD/ADHD subgroup comprised participants with LD who also had a previous diagnosis of ADHD (14 MMA and 14 WL). To be included in the hyperactive/impulsive (H/I) subgroup, participants must have demonstrated clinically elevated levels of H/I symptoms as indicated by a $T$-score of 65 or greater on the DSM Hyperactive/Impulsive subscale of the Conners' Parent Rating Scale-Revised (CPRS). A total of 29 (12 MMA, 17 WL) participants met the criteria for inclusion in the H/I subgroup. To be included in the inattentive subgroup, participants must have demonstrated clinically elevated levels of inattentive symptoms as indicated by a $T$-score of 65 or greater on the DSM Inattentive subscale of the CPRS. A total of 33 participants (15 MMA, 18 WL) met criteria for inclusion in the inattentive subgroup. The anxiety subgroup consisted of participants demonstrating clinically elevated levels of anxiety symptoms as indicated by a $T$-score of 65 or greater on the anxious/shy subscale of the CPRS. A total of 29 participants (12 MMA, 17 WL) met inclusion criteria for the anxious subgroup.

### MMA Program Description

MMA is a manualized program (Badali 2007) designed to decrease problematic behavior and increase self-awareness, self-control, adaptability, social skills and self-defense skills

**Table 1** Cognitive ability and academic achievement scores of MMA and WL youth

| | MMA | | WL | | | |
|---|---|---|---|---|---|---|
| | M | (SD) | M | (SD) | t (df) | p |
| Participant age (in years) | 13.78 | (1.56) | 14.06 | (1.09) | 0.82 (58) | 0.42 |
| WASI IQ | 104.57 | (12.97) | 101.38 | (12.40) | −0.98 (58) | 0.33 |
| WJ-III subtest standard scores | | | | | | |
| Letter–word ID | 102 | (11.80) | 98.71 | (16.38) | −0.89 (57) | 0.38 |
| Calculation | 86.04 | (16.11) | 80.87 | (14.78) | −1.28 (57) | 0.20 |
| Spelling | 92.25 | (19.41) | 92.09 | (15.54) | −0.04 (58) | 0.97 |
| Passage comprehension | 94.29 | (12.84) | 91.71 | (13.20) | −0.76 (57) | 0.45 |
| Applied problems | 94.04 | (10.48) | 93.19 | (10.79) | −0.30 (57) | 0.76 |
| Writing samples | 91.39 | (17.99) | 90.94 | (12.97) | −0.11 (58) | 0.91 |
| Reading fluency | 96.78 | (14.41) | 98.56 | (12.98) | 0.39 (34) | 0.70 |
| Math fluency | 81.00 | (13.10) | 79.37 | (13.93) | −0.37 (35) | 0.72 |

in adolescents. The 20-week program consists of weekly 1.5-h sessions combining elements of mindfulness, cognitive behavioral therapy (CBT) and mixed martial arts. The core components of the program are conceptually linked by the overarching theme of Bushido or Way of the Warrior. Bushido, a Japanese tradition of meditation and combat arts, is based on the philosophy that fear is conquered through self-examination and self-knowledge (Cleary 2005). MMA participants are challenged to explore their inner world and accept their thoughts and feelings without judgment.

The key mindfulness concepts emphasized in the MMA program are impermanence, nonjudgment, acceptance, letting go and focusing on the moment. Participants are guided through body scans, sitting meditation, walking meditation and mindful activities. The length of formal meditation is gradually increased each week. Early sessions use concentrative "one-pointed" meditations to improve self-regulation of attention. During these meditations, students use a mantra as a focal point, and they are instructed to return to the mantra whenever their mind wanders. Once students have mastered concentrative meditation, they are introduced to receptive meditation in which there is no specific object of attention. In this form of mindfulness meditation, the individual is open to all experiences that may arise during the meditation.

The CBT element of the program consists of learning to name thoughts, feelings and body sensations; interpreting thoughts and feelings in self and in others; using coping self-talk; recognizing self-defeating thinking; and understanding how thoughts and feelings affect interpersonal relationships. Adolescents select personal goals to work towards. Weekly practice logs and individual meetings with youth, parents and the therapist/instructor are strategies used to monitor progress. Progress towards goals, practice at home, effort, prosocial behavior during sessions and indications of improvement in any of the core components of the program are rewarded by points. When students reach

predetermined point levels, they are promoted to the next belt level.

The core mindfulness and CBT components of treatment focus on a specific concept each week and are embedded into mixed martial arts training. For example, the concept of *no lingering* introduced in Week 13 is related to mindfulness (observing thoughts as passing events), CBT (reducing rumination) and martial arts (responding quickly when sparring). Concepts and skills are introduced gradually through didactic teaching, modeling, role playing and scaffolding by the therapist/instructor. Instructors tailor the length, depth and style of instruction based on the needs of each group.

Both MMA instructors are child and family therapists at Integra with Master's degrees in social work/drama therapy. They hold advanced belts in martial arts and are experienced practitioners of mindfulness meditation. The program developer implemented MMA on his own until the fall of 2008, at which time a second therapist was trained to lead additional groups. The second therapist led one of the MMA groups in the current study.

Design

Due to ethical and practical considerations, a WL design was used instead of random assignment. Since most families wait at least a year to access treatment programs at Integra, it would be unethical to further delay entry into the program. Five phases of data were collected over a period of 2.5 years in order to garner a sufficient sample size. Each phase consisted of a MMA group of approximately eight participants and a WL group of approximately eight participants. Two MMA groups were offered during Phase 5 because an additional instructor was trained. Data were collected in three sessions: pretest (during Week 1 of the MMA program), posttest (during Week 20 of the MMA program) and a cognitive and academic assessment conducted any time between Weeks 1 and 20.

## Procedures

The research was approved by the University of Toronto's Research Ethics Board and Integra's internal ethical review. Prior to beginning the MMA program, adolescents and their parents attended an information session conducted by the program's developer and lead instructor. The goals, expectations and potential risks and benefits of the program were explained in detail. Control participants were recruited from the MMA WL. WL control participants were offered admission into the MMA program after completing all phases of the research.

## Measures

The demographics questionnaire contained questions pertaining to the child's health history, parental health history, parental education and employment status, and family composition. The WASI (Wechsler 1999) is a standardized abbreviated intelligence test which provides an estimate of general cognitive ability. The Vocabulary and Matrix Reasoning subtests were administered to all participants to obtain an IQ estimate. The IQ score derived from two subtests has an average reliability coefficient of 0.96. The Woodcock–Johnson Tests of Achievement–3 rd edition (WJ-III; Woodcock et al. 2001) is a standardized measure of academic achievement. The core reading, writing and mathematics subtests were administered. The WJ-III subtests demonstrate strong reliabilities (0.80 or higher).

The Conners' Scales (Conners 1997) are often used to screen for ADHD in children and adolescents. The CPRS assesses inattentive, hyperactive and impulsive symptoms and measures behaviors that are often observed in youth with ADHD such as social problems, anxiety, perfectionism, oppositionality and emotional lability. The CPRS demonstrates high internal consistency, with coefficient alphas ranging from 0.81 to 0.92 for males aged 13–17 years and excellent discriminant power for detecting ADHD (Conners et al. 1998). The CPRS was used to assess ADHD and anxiety symptoms in order define the samples for subgroup analysis.

The Behavior Rating Inventory of Executive Function—Parent Form (BRIEF; Gioia et al. 2000) is an 86-item questionnaire designed to assess executive functioning in youth ages 5–18. The scale consists of two broad indexes (behavioral regulation and metacognition) in addition to a global executive composite. The BRIEF demonstrates high internal consistency and moderate correlations between parent and teacher report. Construct validity and concurrent validity as reported in the manual have been supported by a number of studies with clinical populations (Strauss et al. 2006).

The Child Behavior Checklist (CBCL; Achenbach 2001) is a parent rating scale designed to assess child competencies and problematic behavior in 6- to 18-year olds. Parents were asked to rate the severity of their child's internalizing (e.g., anxious and depressed) and externalizing (e.g., non-compliant, hyperactive and aggressive) symptoms as well as social problems, somatic complaints and thought problems. The CBCL demonstrates very high test–retest reliability ($r=0.90$) and moderate to high internal consistency of scales (alpha=0.72–0.97). The Youth Self-Report (YSR; Achenbach 2001) is the self-report version of the CBCL. Adolescents were asked to rate their own competencies and problematic behavior in the last 6 months using a three-point scale (never true, sometimes true or often true). Internalizing, externalizing and total problem scores were generated, along with syndrome scales and DSM-oriented scales that parallel those of the CBCL. The YSR demonstrates moderate to high test–retest reliability ($r=0.79–0.88$) and moderate to high internal consistency of scales (0.55–0.95).

## Statistical Analyses

All analyses were conducted on the subscale *T*-scores of each measure. Pretest differences between groups on baseline scores were evaluated using independent samples *t*-tests. Differences in change on outcome variables after the intervention period were assessed using analysis of covariance (ANCOVA) when the underlying assumption of homogeneity of slopes was met. When the assumption was violated, a 2 (group: MMA vs. WL) by 2 (time: Time 1 vs. Time 2) repeated measures analysis of variance (ANOVA) was conducted. Although ANCOVA is a more powerful and precise test of differences in change than ANOVA (Rausch, Maxwell & Kelley, 2003), results are not interpretable if this assumption is violated. Selection of outcome variables for the analyses was based on the hypotheses articulated above. Consequently, only main effects supporting or refuting the hypotheses are reported below. Analyses pertaining to the total sample are reported elsewhere (Haydicky 2010).

## Results

### Subgroup: CoMorbid LD/ADHD Diagnosis

Independent samples *t*-tests found no significant differences between the MMA and WL groups on any of the outcome variables at Time 1 (pretest). ANCOVA results are reported in Table 2. ANCOVA results revealed significant main effects for CBCL conduct problems. The strength of the relationship between the independent and dependent variables was indicated by partial $\eta^2=0.26$, with MMA status accounting for approximately 26% of the variance of conduct

**Table 2** Means, standard deviations and results of ANCOVAs for ADHD/LD subgroup

| Outcome variables | Group | Pretest M(SD) | Posttest M(SD) | Group effect/ANOVA Group×Time effect |
|---|---|---|---|---|
| BRIEF $df(1, 18)$ | | | | |
| Behavior regulation | MMA | 72.92 (9.94) | 69.10 (7.99) | $F=0.09$, $p=0.76$, $\eta^2=0.01$ |
| | WL | 66.14 (13.93) | 60.64 (16.19) | |
| Monitor | MMA | 74.30 (7.12) | 65.50 (11.78) | $F=2.53$, $p=0.13$, $\eta^2=0.18$[a] |
| | WL | 68.00 (9.62) | 64.55 (9.46) | |
| CBCL $df(1,17)$ | | | | |
| Externalizing | MMA | 63.92 (6.91) | 60.11 (6.85) | $F=3.83$, $p=0.067$, $\eta^2=0.18$ |
| | WL | 58.36 (10.43) | 54.36 (10.35) | |
| Social problems | MMA | 64.15 (7.70) | 59.33 (5.87) | $F=1.40$, $p=0.25$, $\eta^2=0.076$ |
| | WL | 66.43 (8.34) | 63.00 (8.30) | |
| Rule breaking | MMA | 61.69 (5.72) | 58.22 (5.61) | $F=3.69$, $p=0.072$, $\eta^2=0.18$ |
| | WL | 56.29 (6.29) | 55.55 (6.15) | |
| ADHD problems | MMA | 66.00 (6.12) | 64.67 (7.62) | $F=0.00$, $p=0.10$, $\eta^2=0.00$ |
| | WL | 66.07 (8.04) | 61.82 (10.64) | |
| Oppositional defiant | MMA | 67.33 (9.25) | 60.56 (6.43) | $F=6.025$, $p=0.03$, $\eta^2=.25$[a] |
| | WL | 57.55 (7.71) | 57.45 (7.31) | |
| Conduct problems | MMA | 63.00 (6.56) | 58.56 (6.84) | $F=5.889$, $p=0.027$, $\eta^2=0.26$ |
| | WL | 58.64 (7.66) | 56.82 (7.36) | |
| YSR $df(1,21)$ | | | | |
| Externalizing | MMA | 55.00 (12.22) | 55.38 (11.28) | $F=0.2.60$, $p=0.12$, $\eta^2=0.11$ |
| | WL | 56.36 (11.85) | 50.00 (13.12) | |
| Social problems | MMA | 58.38 (10.64) | 55.54 (6.65) | $F=0.30$, $p=0.59$, $\eta^2=0.01$ |
| | WL | 61.36 (12.21) | 55.55 (7.06) | |
| ADHD problems | MMA | 61.92 (7.83) | 59.00 (7.00) | $F=0.02$, $p=0.89$, $\eta^2=0.01$ |
| | WL | 59.93 (9.34) | 58.09 (8.85) | |
| Oppositional defiant | MMA | 58.46 (7.77) | 56.92 (5.72) | $F=1.40$, $p=0.25$, $\eta^2=0.06$ |
| | WL | 58.57 (8.57) | 55.00 (5.93) | |
| Conduct problems | MMA | 59.08 (8.68) | 58.23 (9.24) | $F=0.15$, $p=0.70$, $\eta^2=0.01$ |
| | WL | 58.79 (10.03) | 55.55 (7.63) | |

Effect sizes reported are partial eta squared

[a] Results from repeated measures ANOVA are reported because ANCOVA could not be conducted

problems, holding constant the level of conduct problems at Time 1. Effects of externalizing problems and rule breaking approached significance ($p=0.067$ and $p=0.072$). No significant effects were found on any of the YSR or BRIEF subscales.

ANCOVA could not be conducted for CBCL oppositional defiant problems or BRIEF monitoring as the homogeneity of slope assumption was violated in both cases. Repeated measures ANOVA (also reported in Table 2) revealed a significant main effect of Time and significant Group× Time interaction effect for CBCL oppositional defiant problems, with MMA youth showing greater reductions in oppositional defiant behavior than WL youth. The main effect of Time was $F=6.35$, $p=0.02$, $\eta^2=0.26$, and the interaction effect was $F=6.01$, $p=0.03$, $\eta^2=0.25$. The main effect of Group approached significance at $F=4.08$, $p=0.058$, $\eta^2=0.185$. A significant main effect of Time was found for monitoring on the BRIEF ($F=13.27$, $p=0.00$, $\eta^2=0.41$). The main effect for Group and Time×Group interaction were nonsignificant ($F=0.88$, $p=0.36$, $\eta^2=0.04$ and $F=2.53$, $p=0.13$, $\eta^2=0.12$, respectively).

Subgroup: Hyperactive/Impulsive Symptoms

At Time 1, youth in the WL group reported significantly higher levels of externalizing problems ($M=61.47$, SD= 11.07), $t(27)=-2.30$, $p<0.05$, and DSM conduct problems ($M=63.06$, SD=9.61), $t(27)=-2.56$, $p<0.05$, on the CPRS than did youth in the MMA group ($M=51.92$, SD=10.99 and $M=55.67$, SD=5.93, respectively). No other significant differences were found on levels of H/I symptoms or outcome variables at Time 1.

The ANCOVA for CBCL social problems was significant. The strength of the relationship between the independent and dependent variables was indicated by partial $\eta^2=0.39$, with MMA status accounting for approximately 39% of the variance of social problems, holding constant the level of social problems at Time 1. No significant ANCOVA results were found on any other CBCL, BRIEF or YSR subscales (Table 3).

It was not possible to run ANCOVA for BRIEF monitoring problems, as the homogeneity of slope assumption was violated. Repeated measures ANOVA revealed significant

**Table 3** Means, standard deviations and results of ANCOVAs for hyperactive/impulsive subgroup

| Outcome variables | Group | Pretest M(SD) | Posttest M(SD) | Group effect/ANOVA Group×Time effect |
|---|---|---|---|---|
| **BRIEF** $df(1,22)$ | | | | |
| Behavior regulation | MMA | 74.36 (9.78) | 67.73 (8.25) | $F=2.16, p=0.16, \eta^2=0.10$ |
| | WL | 72.31 (9.15) | 71.85 (12.71) | |
| Monitor | MMA | 75.55 (5.87) | 68.55 (7.63) | $F=6.90, p=0.02, \eta^2=0.24$[a] |
| | WL | 71.23 (9.85) | 71.31 (10.15) | |
| **CBCL** $df(1,22)$ | | | | |
| Externalizing | MMA | 63.36 (8.05) | 59.64 (8.03) | $F=2.33, p=0.14, \eta^2=0.11$ |
| | WL | 60.77 (7.12) | 60.23 (8.35) | |
| Social problems | MMA | 70.45 (7.05) | 62.36 (5.56) | $F(1,20)=12.86, p=0.002, \eta^2=0.39$ |
| | WL | 68.62 (9.65) | 67.92 (7.47) | |
| ADHD problems | MMA | 68.27 (2.94) | 64.64 (7.59) | $F=2.64, p=0.12, \eta^2=0.12$ |
| | WL | 66.85 (6.48) | 67.08 (9.04) | |
| Conduct problems | MMA | 62.82 (5.96) | 59.27 (6.20) | $F=2.12, p=0.16, \eta^2=0.10$ |
| | WL | 59.54 (6.19) | 59.46 (7.45) | |
| **YSR** $df(1,23)$ | | | | |
| Externalizing | MMA | 51.92 (10.98) | 54.00 (9.44) | $F=1.45, p=0.24, \eta^2=0.06$ |
| | WL | 61.00 (12.08) | 57.38 (10.07) | |
| Social problems | MMA | 59.58 (9.02) | 55.58 (6.19) | $F=0.71, p=0.41, \eta^2=0.03$ |
| | WL | 61.92 (10.36) | 57.31 (7.45) | |
| ADHD problems | MMA | 61.33 (8.00) | 59.17 (6.93) | $F=0.35, p=0.56, \eta^2=0.02$ |
| | WL | 64.54 (8.56) | 62.77 (7.73) | |
| Oppositional defiant | MMA | 55.17 (6.03) | 53.83 (4.12) | $F=3.29, p=0.08, \eta^2=0.13$ |
| | WL | 60.38 (8.06) | 56.62 (4.96) | |
| Conduct problems | MMA | 55.67 (5.93) | 58.33 (7.99) | $F=0.01, p=0.92, \eta^2=0.00$ |
| | WL | 62.08 (10.38) | 59.31 (8.40) | |

Effect sizes reported are partial eta squared

[a]Results from repeated measures ANOVA are reported because ANCOVA could not be conducted

Time and Group×Time interaction effects for monitoring problems on the BRIEF, with MMA youth showing more improvement in monitoring than WL youth (Table 3). The main effect of Time was $F=6.61, p=0.02, \eta^2=0.23$, and the interaction effect was $F=6.90, p=0.02, \eta^2=0.24$. The main effect of Group was nonsignificant at $F=0.06, p=0.82, \eta^2=0.00$.

Subgroup: Inattentive Symptoms

Independent samples $t$-tests were conducted to explore group differences on baseline scores at Time 1. There were no differences between the MMA and WL groups on baseline levels of inattention, EF or parent- and self-reported behavior problems. ANCOVA results for the inattentive subgroup are reported in Table 4. The ANCOVA results for CBCL social problems were significant. The strength of the relationship between the independent and dependent variables was indicated by partial $\eta^2=0.18$, with MMA status accounting for approximately 18% of the variance of social problems, holding constant the level of social problems at Time 1. No significant ANCOVA results were found on any other CBCL, BRIEF or YSR subscales.

It was not possible to run ANCOVA for BRIEF monitoring problems, as the homogeneity of slopes assumption was violated. Repeated measures ANOVA revealed significant Time effects only ($F=10.99, p=0.00, \eta^2=0.31$). There were no significant main effects of Group ($F=.02, p=0.89, \eta^2=0.00$) or Group×Time interaction ($F=0.62, p=0.44, \eta^2=0.03$).

Subgroup: Anxiety Symptoms

Independent $t$-tests conducted to explore group differences on baseline scores at Time 1 showed no significant differences in baseline levels of the CPRS anxious/shy scale. Parent ratings on the CBCL Syndrome Scale: Anxious/Depressed were significantly higher for the WL group ($M=69.53$, SD=8.48) than the MMA group ($M=62.55$, SD=7.08) at Time 1, $t(26)=2.27$, $p<0.05$. Parent ratings on the CBCL DSM Scale: Anxiety Problems approached significance, with the WL group trending toward higher scores than the MMA group, $t(26)=1.99$, $p=0.057$. No other significant differences were found on the parent or self-report measures at Time 1.

ANCOVA results for the anxious subgroup are reported in Table 5. The ANCOVA for DSM anxiety problems on the YSR was significant. The strength of the relationship between the independent and dependent variables was indicated by partial $\eta^2=0.23$, with MMA status accounting for approximately 23%

**Table 4** Means, standard deviations and results of ANCOVAs for inattentive subgroup

| Outcome variables | Group | Pretest M(SD) | Posttest M(SD) | Group effect/ANOVA Group×Time effect |
|---|---|---|---|---|
| **BRIEF** $df(1,23)$ | | | | |
| Behavior regulation | MMA | 73.25 (9.50) | 65.58 (12.57) | $F=1.06$, $p=0.31$, $\eta^2=0.04$ |
| | WL | 66.07 (15.16) | 64.00 (16.00) | |
| Monitor | MMA | 73.42 (7.54) | 67.17 (11.61) | $F=0.62$, $p=0.44$, $\eta^2=0.03$[a] |
| | WL | 71.71 (8.40) | 67.86 (10.45) | |
| **CBCL** $df(1,23)$ | | | | |
| Externalizing | MMA | 60.93 (10.0) | 55.83 (8.85) | $F=2.36$, $p=0.14$, $\eta^2=0.09$ |
| | WL | 57.89 (10.82) | 55.07 (10.42) | |
| Social problems | MMA | 66.21 (8.60) | 59.50 (6.67) | $F=4.99$, $p=0.04$, $\eta^2=0.18$ |
| | WL | 65.83 (10.57) | 63.36 (9.23) | |
| ADHD problems | MMA | 66.57 (5.88) | 62.33 (8.60) | $F=2.63$, $p=0.12$, $\eta^2=0.10$ |
| | WL | 65.33 (7.47) | 63.93 (9.92) | |
| Oppositional defiants | MMA | 62.36 (10.51) | 56.92 (5.90) | $F=1.96$, $p=0.18$, $\eta^2=0.08$ |
| | WL | 60.50 (9.85) | 57.50 (7.26) | |
| Conduct problems | MMA | 61.71 (7.09) | 56.50 (5.80) | $F=1.68$, $p=0.21$, $\eta^2=0.07$ |
| | WL | 59.06 (7.14) | 56.36 (7.38) | |
| **YSR** $df(1,25)$ | | | | |
| Externalizing | MMA | 53.00 (10.81) | 53.21 (11.01) | $F=2.20$, $p=0.15$, $\eta^2=0.08$ |
| | WL | 58.06 (10.94) | 52.00 (11.52) | |
| Social problems | MMA | 58.57 (8.71) | 55.07 (5.27) | $F=0.07$, $p=0.80$, $\eta^2=0.00$ |
| | WL | 62.39 (11.14) | 56.21 (6.89) | |
| ADHD problems | MMA | 62.79 (8.09) | 59.07 (6.40) | $F=0.13$, $p=0.73$, $\eta^2=0.01$ |
| | WL | 61.67 (8.51) | 59.86 (8.68) | |
| Oppositional defiant | MMA | 55.71 (6.29) | 54.29 (5.03) | $F=.02$, $p=0.88$, $\eta^2=0.00$ |
| | WL | 57.50 (8.05) | 54.64 (4.81) | |
| Conduct problems | MMA | 57.00 (6.67) | 57.43 (7.86) | $F=1.20$, $p=.28$, $\eta^2=0.05$ |
| | WL | 60.39 (9.40) | 55.79 (7.08) | |

Effect sizes reported are partial eta squared

[a] Results from repeated measures ANOVA are reported because ANCOVA could not be conducted

of the variance of anxiety problems, holding constant the level of anxiety at pretest. The ANCOVA for the anxious/depressed syndrome scale of the YSR approached significance. The strength of the relationship between the independent and dependent variables was indicated by partial $\eta^2=0.14$, with the MMA status accounting for approximately 14% of the variance of anxious/depressed symptoms, holding constant the level of symptoms at pretest. ANCOVA was also conducted for the following CBCL subscales which met the homogeneity of slopes assumption: internalizing problems, total problems, anxious/depressed syndrome scale, affective problems and DSM anxiety. No significant results were found on any of the CBCL subscales.

## Discussion

The objective of the current study was to evaluate the impact of the Integra MMA program on EF, internalizing and externalizing symptoms, and social skills in a mixed clinical sample of adolescent boys with LD. When the total sample was analyzed, significant time effects were found for all measures, but there appeared to be no improvements attributable to the MMA program itself. During the 4-month interval between pre- and post-testing, participants in both groups and their parents reported significant change. This is not surprising given the rapid cognitive, academic and social development associated with adolescence. As such, it was

**Table 5** Means, standard deviations and significant effects of ANCOVAs for anxious subgroup

| Outcome variables | Group | Pretest M(SD) | Posttest M(SD) | Group effect |
|---|---|---|---|---|
| **YSR** $df(1,58)$ | | | | |
| Anxious/depressed | MMA | 60.18 (8.93) | 53.36 (4.25) | $F=0.3.7$, $p=.067$, $\eta^2=0.14$ |
| | WL | 60.59 (10.3) | 56.40 (7.08) | |
| DSM anxiety | MMA | 61.00 (5.95) | 54.27 (4.43) | $F=6.75$, $p=0.016$, $\eta^2=0.23$ |
| | WL | 57.73 (8.54) | 56.53 (6.48) | |

Effect sizes reported are partial eta squared

critical to include a control group to differentiate typical growth from treatment effects. Results of the analyses of the total sample are reported elsewhere (Haydicky 2010). In the current study, subgroup analyses were conducted to determine whether participants with co-occurring specific behavioral or emotional difficulties respond to mindfulness training differentially. It was hypothesized that youth with ADHD would respond to the intervention differently than youth with anxiety, that is, youth were expected to demonstrate improvements in the areas that were of clinical concern at pretest. The hypotheses were partially supported.

It was hypothesized that participants with LD and ADHD would demonstrate significant improvements in executive functioning, reductions in externalizing problems and reductions in social problems at posttest compared to the WL group. Approximately 47% of the sample was formally diagnosed with ADHD. Among this subgroup, those who completed the MMA program exhibited significant improvements in parent-rated oppositional defiant problems and conduct problems compared to boys on the WL. A trend towards significance was also found for parent-rated externalizing problems and rule-breaking behavior. It is possible that this trend would reach significance in a larger sample. It is interesting to note that the improvements for this subgroup were limited to the domain of behavioral problems. No significant improvements were found on executive functioning or social skills. It is possible that the youth who received diagnoses of ADHD demonstrated behavioral problems that were disruptive enough to warrant formal investigation and subsequent diagnoses. As such, youth with externalizing problems may be overrepresented in this subgroup. Many of the adolescents enrolled in MMA demonstrated clinically significant symptoms of ADHD, irrespective of diagnostic status. For this reason, it was possible to conduct further analyses on youth presenting with elevated hyperactive/impulsive symptoms and elevated inattentive symptoms, in order to determine the differential impact of MMA on youth with various attention profiles.

Boys with clinically elevated hyperactive/impulsive symptoms at Time 1 showed improvement in parent-rated social problems and monitoring skills (a component of EF) after completing the MMA program. Self-monitoring is a metacognitive function that involves evaluating one's own performance. Detached self-observation is a central component of mindfulness practice. Nonjudgmental monitoring of thoughts, feelings and impulses reduces the tendency to react impulsively or revert to habitual patterns of response ("auto-pilot"). Results of this subgroup analysis are interpreted in light of the increase in monitoring skills as reported on the BRIEF. The BRIEF assesses task monitoring (reviewing one's performance on a task to assess accuracy and progress towards goals) and interpersonal monitoring (awareness of the impact of one's behavior on others). It is

possible that the significant reduction in social problems observed in the H/I subgroup is a result of improved interpersonal monitoring.

Adolescents with clinically elevated inattentive symptoms demonstrated significant reductions in social problems, as rated by their parents. MMA status accounted for approximately 39% of the variance of social problems, holding constant the level of social problems at Time 1. This subgroup did not exhibit improved EF or reductions in behavior problems resulting from the intervention.

These results support and expand upon previous research on mindfulness training for individuals with ADHD. We found reductions in externalizing behavior and social problems similar to those reported by Bogels et al.'s (2008) study investigating the impact of a mindfulness intervention on adolescents with externalizing disorders. Although the WL design used by Bogels et al. was strong, the small sample size and mixed diagnoses made interpretation of the results difficult. Whereas only four participants in the former study had a diagnosis of ADHD and 11 had a diagnosis of oppositional defiant or conduct disorder, 28 participants (14 MMA and 14 WL) in the current study reported a diagnosis of ADHD and only two had a diagnosis of oppositional defiant or conduct disorder. Zylowska et al.'s (2008) feasibility study reported a positive impact of mindfulness training for individuals with ADHD, but there was no control group and two-thirds of the sample were adults. As such, the current findings provide stronger support for the clinical applications of mindfulness for adolescents with ADHD than previous studies. Further, the current study is the first to explore the differential impact of mindfulness training for adolescents exhibiting clinical levels of hyperactive/impulsive and inattentive symptoms.

Approximately 40% of the overall sample demonstrated high levels of parent-reported anxiety at Time 1. It was hypothesized that adolescents with anxiety in the current study would exhibit a greater reduction in internalizing problems than the WL group from pre- to posttest. Analyses conducted on the subset of youth with clinically elevated anxiety symptoms revealed significant improvements in self-reported anxiety following the MMA program. ANCOVA results indicated that MMA status accounted for approximately 23% of the variance of anxiety problems at posttest, holding constant the level of anxiety at pretest. Parent report of internalizing problems did not reveal significant change. Youth are considered the most reliable raters of their own internalizing problems, as parents are often unaware of their children's thoughts and feelings, and behavioral markers of anxiety or depression may be absent or difficult to detect. These results support preliminary research suggesting that mindfulness may be an effective intervention for anxious children (e.g., Semple et al. 2010; Semple et al. 2005) and is in keeping with evidence that

mindfulness effectively reduces anxiety in adults (Baer 2003; Grossman et al. 2004).

Overall, results of subgroup analyses partially supported the hypotheses. Adolescents with LD with different clinical profiles appeared to benefit from the intervention in unique ways. Youth with ADHD diagnoses receiving MMA demonstrated significant reductions in oppositional defiant problems and conduct problems compared to the WL group, but no change in EF or social problems. Further exploratory analyses revealed that MMA youth with clinically elevated hyperactive/impulsive symptoms (regardless of diagnostic status) showed improvement in parent-rated monitoring skills and reductions in social problems compared to WL. Youth with elevated inattentive symptoms demonstrated significant reductions in social problems compared to WL. They did not demonstrate changes in EF. Finally, the subgroup of youth with elevated anxiety at pretest reported reductions in anxiety compared to WL. These results suggest that MBCT combined with martial arts training is an effective intervention for youth with ADHD symptomotology as well as youth with anxiety.

Limitations and Future Research Directions

Conducting a program evaluation in a clinical setting presented several challenges. Ethical and practical constraints prevented random assignment of participants to conditions or controlling for participant characteristics such as type of LD or co-occurring disorders. Although attempts were made to document treatment received while on the WL, families were not prevented from seeking treatment outside of Integra. These methodological issues make interpretation of the results somewhat difficult. Attempts to artificially control the sample, however, would have reduced ecological validity and diminished the utility of the results for clinicians.

The current study meets most of Gersten et al.'s (2005) quality indicators for quasiexperimental program evaluation studies including adequate sample size; ample description of participants, interventionists and the program itself; appropriate, valid and varied measures; pre-, post- and follow-up assessments; documentation of attrition; and appropriate data analytic techniques. Treatment fidelity, however, was not measured; four of the five MMA groups were led by the developer of the program, and fidelity to the manual was assumed. The fifth and largest MMA group was led by a new therapist/instructor, which may have impacted outcomes in this group. It will be particularly important for future evaluations of MMA to include an assessment of treatment fidelity because new interventionists are currently being trained to deliver the program on a wider scale.

Although self-reports of behavior change can give valuable information about the subjective experience of participants, there are some disadvantages to using self-report

measures for adolescents with LD and ADHD. These adolescents often overestimate their competencies and underestimate the severity of their difficulties to a greater extent than their peers, a tendency known as the positive illusory bias (Heath and Glen 2005; Owens et al. 2007). It is possible that baseline ratings of behavior in the current study did not accurately reflect the problems experienced by the participants. As such, treatment effects may not have been captured. Although parent reports were obtained, they may have been biased by expectancy effects. Reports from teachers blind to the treatment condition of students or direct observation of behavior may have been more reliable indicators of change. Given the possibility that MMA improves problem recognition in youth with hyperactive/impulsive behavior, the potential impact of mindfulness training on the positive illusory bias should be investigated.

The hypothesis that mindfulness training would improve EF was only partially supported. Although changes in monitoring were observed in hyperactive/impulsive boys, there were no changes in inhibition, cognitive flexibility or emotional control. It is possible that the parent report questionnaire used to measure EF was not sensitive enough to detect changes. Future evaluations of the MMA program should include behavioral and neurological measures of EF to obtain more precise and reliable indicators of change. Psychological mechanisms of mindfulness should also be explored to determine the processes involved in behavior change.

In order to parse out the relative impact of each of the three components of MMA, future studies should include comparison groups exposed to mindfulness alone, CBT alone and martial arts alone. It is possible that behavioral improvements, particularly improved social skills, are due to regular contact with age- and gender-matched peers under the guidance of an adult model. MMA should be compared to other group programs such as social skills training and sports teams to determine whether mindfulness training is of additional benefit. Future studies should also include a qualitative component to explore the acceptability, feasibility and perceived benefits of the program. Follow-up measures to determine whether gains are maintained after the intervention period should also be included. Although we attempted to collect data from MMA participants 3 months after completion of the program, high attrition rates at follow-up prevented us from obtaining a sample large enough for meaningful statistical analyses.

Implications for Practice

While statistical significance is often regarded as the benchmark of a successful study, program evaluation research must also take into account the clinical significance of the results. Effect size estimates are one way to determine the impact of an intervention. The current study obtained partial

eta squared values for significant interaction effects ranging from 0.24 to 0.34, which are large by social scientific research standards. These values represent the proportion of variation in behavior change attributable to the intervention excluding other factors, suggesting that MMA had a substantial impact on the behavior of participants. Since many researchers erroneously report partial eta as classical eta (Pierce et al. 2004), causing overestimation of effects, direct comparisons between the current study and other intervention studies are not made.

In spite of the length of treatment, the group format of MMA is cost-effective for agencies with large client loads and extensive waiting lists. The therapist to client ratio (approximately 1:8) allows more children to access services sooner. As results of the current study suggest that MMA differentially impacts clients with different clinical profiles, MMA should be targeted to participants who would derive the most benefit from it. Children on the WL should be screened for attention problems and anxiety prior to enrolment in MMA so agencies can offer their clients interventions with the most potential for impact and allocate limited resources more effectively. It is possible that youth with other difficulties such as depression would also benefit, but there was an insufficient number of participants with these difficulties in the sample to determine whether this was the case.

The expansion and widespread implementation of MMA is restricted by the extensive training required to deliver the program. In addition to training in psychotherapy, therapist instructors need a background in mindfulness and martial arts. Following completion of the present study, Integra allowed the groups to grow to 10 to 12 students by adding a volunteer with expertise in martial arts or having advanced students of MMA assist instructors. This adds a peer modeling component to MMA and provides advanced students with an opportunity to develop leadership skills.

The high rate of retention in the program is noteworthy given that previous mindfulness research reported high dropout rates. Since it was piloted in 2002, only four participants have dropped out of MMA and none before the 13th session. Anecdotal reports suggest that adolescents find the program enjoyable and beneficial, but further research is needed to determine what factors enhance motivation to complete the program. Results of the current study suggest that MMA is an acceptable alternative intervention for youth with LD and co-occurring disorders. Mindfulness training shows promise for the management of behavioral, emotional and social difficulties experienced by youth with LD.

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