Contemp School Psychol
DOI 10.1007/s40688-017-0140-3

The Effects of a Mindfulness and Biofeedback Program on the On- and Off-Task Behaviors of Students with Emotional Behavioral Disorders

Karena S. Rush[1] · **Maria E. Golden**[1] · **Bruce P. Mortenson**[2] · **Daniel Albohn**[3] · **Melissa Horger**[1]

Abstract Research suggests that mind-body techniques are useful for enhancing self-regulatory behaviors, including attention and emotional regulation. The majority of research in this area focuses on adult behavior. However, there has been a growing interest in using mindfulness techniques with children and more recently, in the school setting. Students identified as emotionally disturbed (ED) could potentially benefit from such interventions. In this study, a 12-week mind-body curriculum utilizing mindfulness and game-based biofeedback techniques was implemented in special education emotional support classrooms with elementary and middle school students. A quasi-experimental design was implemented to examine the effects of the mindfulness and biofeedback program on students' on-task and off-task behaviors in the classroom. Results indicated significant decreases in overall off-task behaviors and improvements that approached significance in on-task behaviors for the participants in the treatment group (n = 14) compared to the participants in the control group (n = 17). The potential benefits of using a mindfulness and biofeedback program with ED students are discussed as well as limitations of the study, implications for practice, and recommendations for future research.

Keywords Mindfulness · Biofeedback · Emotional disturbance (ED) · Emotional regulation · Off-task behavior · On-task behavior

✉ Karena S. Rush
Karena.rush@millersville.edu

Maria E. Golden
meh414@lehigh.edu

Bruce P. Mortenson
bmortenson@towson.edu

Daniel Albohn
d.albohn@gmail.com

Melissa Horger
Mhorger814@gmail.com

[1] Department of Psychology, Millersville University, 214C Luek Hall, Millersville, PA 17551, USA

[2] Department of Psychology, Towson University, 8000 York Road, Towson, MD 21252, USA

[3] 377 Farmview Drive, East Earl, PA 17519, USA

Introduction

Social and emotional competence is essential for a child's overall well-being (Diamond 2010). Behaviors related to appropriate social and emotional functioning include the ability to identify and understand one's own feelings, the ability to read and comprehend others' feelings and emotional states, and the ability to establish and maintain meaningful relationships with others (U.S. Department of Education 2002). These skills are critical for the healthy development of social relationships and self-regulation of emotions and behaviors. When children exhibit deficits in this area, their functioning in the school, home, and community is adversely affected. For example, students with difficulties in the areas of social-emotional and behavioral functioning often have more behavioral infractions in school and have lower academic achievement compared to their non-disabled peers (U.S. Department of Education 2002). In educational systems, when a student's academic performance and ability to access the curriculum is impeded by his or her difficulties with social-emotional and behavioral functioning, he or she is typically given the educational identification of Emotional Disturbance (IDEA 2004).

Published online: 21 July 2017

Emotional Disturbance

The Emotional Disturbance (ED) classification requires the prolonged presence of one more of the following characteristics to a marked degree thus adversely affecting the child's educational performance: "an inability to learn that cannot be explained by intellectual, sensory, or health factors; an inability to build or maintain satisfactory interpersonal relationships with peers and teachers; inappropriate types of behaviors or feelings under normal circumstances; a general pervasive mood of unhappiness or depression; and/or a tendency to develop physical symptoms or fears associated with personal or school problems" (IDEA 2004, p. 2). Mental health concerns are prevalent in the school setting with 17% of school-aged students requiring mental health services in school (NASP Resources 2004). Of the students receiving support under the Individuals with Disabilities Act (IDEA), 8.1% are identified as having an emotional and behavioral disturbance (U.S. Department of Education 2002).

It should be noted that the psychological diagnoses of Attention Deficit Hyperactivity Disorder (ADHD), Depression, Anxiety, Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD) do not automatically warrant an educational diagnosis of ED. A student can have both a psychological and educational diagnosis but in order to qualify as a student with ED, socio-emotional and behavioral functioning must impact educational and academic learning. However, many students with ED are diagnosed with psychiatric disorders thus resulting in complex academic, behavioral, and mental health issues (Forness et al. 1994; Landrum et al. 2003; Lane et al. 2001; Mattison and Felix 1997; Reddy et al. 2009; Reddy and Richardson 2006). Given the complexity of the multiple needs within the population, effective comprehensive interventions can be difficult to find. Many of the interventions for students with emotional disturbance are commonly perceived as difficult to implement, time consuming, or not appropriate for all educational settings (Niesyn 2009). Thus, finding effective interventions for this population is important.

Mindfulness

There has been a growing interest in the use of mindfulness and biofeedback techniques to improve social-emotional functioning. Mindfulness is defined as a nonjudgmental awareness that arises from consciously attending to the present moment (Kabat-Zinn 2015). Techniques such as meditation and breathing exercises are designed to teach individuals how to focus their attention to stimuli in their current environment and bring awareness to physiological responses such as heart rate (Burke 2010). The majority of the research examining the effectiveness of such techniques is with adult populations; only recently has there been a focus on using these techniques with children (Burke 2010; Flook et al. 2010; Schoenberg and David 2014). Even more recent is the use of these interventions in the school setting. However, the research that exists suggests that school-based mindfulness interventions hold promise (Felver et al. 2013; Zenner et al. 2014).

In recent years, many mindfulness programs and curriculums have been developed such as MindUP (Schonert-Reichl et al. 2015), Soles of our Feet (Bellack et al. 1997; Singh et al. 2011), Learning to BREATHE (Broderick and Frank 2014), Mindful Schools (Mindfulschools.org; Semple et al. 2016), and HeartSmarts (Childre 2013). Most of these curriculums involve mindfulness training and social-emotional psychoeducational components taught across multiple weeks (the programs above range from 6 to 18 sessions) (Harnett and Dawe 2012; Semple et al. 2016; Zenner et al. 2014). The most commonly taught social-emotional components are greater awareness of emotions; ability to identify maladaptive emotions, thoughts and behaviors; and promoting positive thoughts and behaviors. The mindfulness skills typically taught include awareness of breath, senses, thoughts, and emotions (Zenner et al. 2014). For example, MindUp is a mindfulness-based program that lists the following core components: mindfulness attention awareness practice; regulation of stress, well-being and prosocial behavior; and the practice of gratitude and acts of kindness. The skills taught include sustained attention on present experiences, perspective taking, and mindful breathing, smelling, and tasting (MindUP.org/thehawnfoundation; Schonert-Reichl et al. 2015). Research suggests that MindUP is effective as a prevention program for typically developing elementary students (Schonert-Reichl et al. 2015). In one randomized controlled trial study, 99 elementary students were randomly assigned to the MindUP group or a regular social responsibility program. The mindfulness curriculum was conducted across 12 sessions. Results suggested that the MindUP group showed significantly shorter response times and outperformed the control group on the flanker switch trials task suggesting a greater ability to selectively attend and inhibit distraction. Significant improvements from pre- to post-test scores were found in the areas of empathy, perspective taking, emotional control, optimism, self concept, and mindfulness and significant decreases in depressive symptoms (via child self-report) (Schonert-Reichl et al. 2015).

Such mindfulness programs have been implemented across a variety of settings and populations. For example, mindfulness techniques have been used in both prevention programs with typically developing children (Black and Fernando 2014; Mendelson et al. 2010; Schonert-Reichl et al. 2015; Thomas and Atkinson 2016) and as interventions with students who exhibit difficulty in the school setting (Bogels et al. 2008; van der Oord et al. 2012). Mindfulness interventions have been used with children and adolescents from urban, suburban, and rural school districts to decrease a variety of maladaptive behaviors such as anxiety, stress, and impulsivity as well as to increase adaptive behaviors such as sustained attention, relaxation, and emotional regulation (Black and Fernando 2014; Mendelson et al. 2010; Schonert-Reichl et al. 2015; Semple et al. 2010; Thomas and Atkinson 2016; van der Oord et al. 2012). Finally, mindfulness programs have been used with children diagnosed with psychological disorders including ADHD, ODD, CD, and Autism Spectrum Disorder (ASD) (Bogels et al. 2008; Carboni et al. 2013; van der Oord et al. 2012) with one study specifically targeting students identified with ED (Malow and Austin 2016). As these studies target a similar population as the current study, they will be described in further detail.

Bogels et al. (2008) implemented mindfulness training with adolescents previously diagnosed with a psychological disorder. The mindfulness program was an adaptation of Mindfulness-Based Cognitive Therapy (MBCT; Segal et al. 2002) and Mindfulness-Based Stress Reduction Training (MBSR; Kabat-Zinn 2003). Following the 8-week mindfulness program, an analysis of pre- and post-intervention scores on a sustained attention task (the D2 test of attention) and self-report measures (the Child Behavior Checklist, Youth Self Report, CBCL-YSR) revealed statistically significant increases in scores on the sustained attention task and a significant decrease in scores on the externalizing behaviors and inattention subscales of the CBCL-YSR. Van der Oord et al. (2012) found similar results with children with ADHD using the same 8-week program. Specifically, significant improvements in scores on attention and hyperactivity subscales were reported on parent rating scales (no significant findings were found for teacher rating scales). Another study used observational methods to evaluate the impact of a mindfulness intervention on four elementary students diagnosed with ADHD (Carboni et al. 2013). The intervention was developed using components of a MBSR (Saltzman and Goldin 2008) and mindfulness practices from Lantieri and Goleman's (2008) *Building Emotional Intelligence: Techniques to Cultivate Inner Strength in Children*. Using a multiple baseline design, improvements were found in on-task behavior for all four students following the implementation of the mindfulness program. Finally, Malow and Austin (2016) investigated a 6-week mindfulness program (Learning to BREATHE) with 15 adolescent students classified as ED under IDEA (2004) residing at a residential school. All 15 students participated in the mindfulness program and completed pre- and post-intervention self-report measures. A control group was not utilized. The program consisted of daily 5–10 min sessions of instructing and practicing mindfulness techniques such as mindful breathing, relaxation, and/or focused attention. The results suggested that the students perceived a significantly greater sense of personal mastery and a significant decrease in levels of emotional reactivity following the intervention. However, the results should be interpreted with caution given the limitations of the research design.

The studies described above utilized mindfulness as the sole treatment component for improving behavioral and social-emotional deficits. However, biofeedback can be used in conjunction with mindfulness to further target these behaviors by bringing greater awareness to the physiological changes that occur with changes in our emotional state (Lloyd et al. 2010).

Biofeedback

Biofeedback teaches individuals how to monitor and modify their physiological responses (Schoenberg and David 2014). Heart rate is a common physiological response that is targeted in biofeedback (Wheat and Larkin 2010). Through observing heart rate variability (HRV), an individual may monitor and regulate their physiological responses. HRV is the naturally occurring beat-to-beat variation in the heart rate and can be influenced by breathing patterns, thoughts, and emotions (Childre 2013; Lehrer and Gevirtz 2014; Lloyd et al. 2010; McCraty and Childre 2010). High HRV is considered to be optimal for health and is associated with emotional stability and more efficient functioning of physiological systems (Childre 2013; Lehrer and Gevirtz 2014; McCraty and Zayas 2014). Low HRV has been associated with negative emotional states such as stress, anger, and anxiety and has been found to be a predictor of future health problems (Lloyd et al. 2010; Thayer et al. 2011). Interestingly, immediate changes in HRV can be seen when mindfulness techniques such as slow, steady, rhythmic breathing are employed (Childre 2013; McCraty and Childre 2010; Sigafus 2011).

Some studies have found promising results with biofeedback interventions targeting HRV as a prevention program with typically developing students (Pop-Jordanova 2009), students exhibiting high anxiety (Knox et al. 2011) as well as with students diagnosed with an internalizing or externalizing disorder (Arns et al. 2009; Pop-Jordanova and Chakalarosa 2008). However, limitations in the research designs are frequently noted. Two studies implementing a randomized controlled trial (RCT) investigating game-based biofeedback programs are important to discuss as they present conflicting findings. One RCT study evaluated the effectiveness of biofeedback (using Dojo, a biofeedback-based video game) in decreasing anxiety in students who exhibited elevated rates of anxiety as evidenced by high scores on the Spence Children Anxiety Survey (Scholten et al. 2016). The control group played a non-biofeedback-based video game. Results indicated that equal improvements were seen in scores on the Spence survey for both the treatment and control group. Lloyd et al. (2010) used a mindfulness curriculum paired with game-based HRV biofeedback training with middle school students diagnosed with ADHD. This RCT study found significant improvements in cognitive functioning (as measured by the computer-based cognitive test, Cognitive Drug Research

System, CDR) and behavioral functioning (as measured by self-report and teacher rating scales). Specifically, there were significant increases in memory and processing skills scores on the CDR from the pre-test to the post-test. In addition, there was a significant decrease in scores on the Strengths and Difficulties Questionnaire-Difficulties subscale (but not for the Strengths subscale). One difference between these two studies is that Lloyd et al. (2010) implemented a biofeedback component as well as a mindfulness curriculum. The program used was the HeartSmarts Program with emWave technology.

The HeartSmarts program with emWave technology is also the program utilized in the current study. It is a multi-session mindfulness and biofeedback program that is divided into five modules. Each module has four or five core learning experiences paired with activities designed to teach students mindfulness techniques and social-emotional awareness. The curriculum begins with psychoeducational activities that foster a greater awareness of emotions and how emotions affect the student's body, school work, and other people. Students are then taught mindfulness techniques such as mindful breathing as well as focused awareness on current emotional states and how to shift from a focus on undesired emotions to beneficial emotions using techniques such as positive self-talk. To help provide concrete feedback for students on their breathing, a biofeedback component is introduced during the third module of HeartSmarts (the emWave technology). The emWave is a biofeedback monitor that provides students with real-time physiological information about their breathing, heart rate, and heart rate variability (with the use of a finger or ear sensor). This program allows for students to observe on a computer screen changes in their heart rate and heart rate variability as they change their rate of breathing. The program includes activities to help the student better control their breathing. First, students are taught how they can alter their HRV through changing their breathing pattern. In one activity, students are instructed to breathe at the same rate as a ball that moves up ("breathe in") and down ("breathe out") on the screen to further reinforce this concept. Once students' have mastered the focused breathing technique, computerized games are introduced to allow for further practice. To date, the Lloyd et al. (2010) study described above is the only published research on the HeartSmarts and emWave technology curriculum. Some research exists in which components of the curriculum were used such as the mindfulness curriculum modified for use with preschoolers (Bradley et al. 2012) or the use of the emWave component with adolescents (Pop-Jordanova 2009), thus more research is needed to determine the effectiveness of this program.

The Current Study

Research on the ED population shows there is a need for effective interventions targeting behaviors that influence social-emotional functioning as deficits in this area can lead to deficits in behaviors that facilitate optimal learning. Biofeedback and mindfulness programs have empirical support and, when combined, could provide a comprehensive program that targets the complex deficits found in this population. To date, the majority of the research that has been conducted with children using mindfulness interventions has been conducted with a normative general education population using questionnaires as the dependent outcome measure (Felver et al. 2016; Waters et al. 2015; Zenner et al. 2014). This is not surprising given the time and cost-effective benefits of rating scales. It has been recommended that future research include students with identified disabilities using outcome measures other than self-report and rating scales (Felver et al. 2016). Thus, the purpose of this study was to evaluate the effectiveness of the HeartSmarts curriculum on the on-task and off-task behavior of students identified as ED in special education emotional support classrooms. Pre- and post-intervention observation data collected using the *Behavioral Observation of Students in School* served as the outcome measure. It was hypothesized that the intervention would lead to a significant increase in on-task behavior and decrease in off-task behavior for participating students.

Method

Research Design and Participants Selection

A quasi-experimental non-equivalent groups design was utilized in this study. First, the school districts of the participating school psychologists were informed of the study and invited to participate. Five of the seven school districts agreed to participate. Thus, all students in the special education Emotional Support classrooms served by the participating school psychologists from these school districts were invited to participate in the study. Four of the participating school psychologists were formally trained in the intervention program. One of the psychologist's worked in a classroom for which school board approval was not obtained thus the classrooms of the three remaining trained psychologists were identified as the treatment group. Three additional classrooms were chosen as the control group because they were similar in age to the treatment group, the associated school psychologist was a member of the research team, and all necessary consents were obtained.

Participants

Participants (29 boys and 4 girls) were students from four suburban elementary and middle schools who ranged in age from 8 to 13 years old. Two students from the treatment group had changes in school placement during the study thus 27 boys and 4 girls completed the study. Three classrooms were designated as the treatment group (n = 14, mean age = 10.10, SD = 2.01) and three classrooms were designated as the control group (n = 17, mean age = 10.79, SD = 2.59). Participants in both groups possessed a preexisting diagnosis of ED under IDEA (2004). Additional diagnoses included the following: ADHD (41% of control group, 50% of treatment group), ODD (35 and 29%, respectively), Mood disorder (29 and 14%, respectively), and Anxiety disorder (12 and 7%, respectively).

Materials

Behavior Observation of Students in Schools The Behavioral Observation of Students in Schools (BOSS) is an observational system designed to measure on-task and off-task behaviors in the classroom setting (Shapiro 2011).

Students in this study were observed for two 30-min periods (one pre-treatment and one post- treatment) using the BOSS with each observation divided into 120, 15-s intervals. On-task behaviors were divided into two categories: active engaged time (AET) and passive engaged time (PET) which were measured using a momentary time sampling procedure in which the behaviors were coded as occurrence/nonoccurrence at the beginning of each 15-s interval (Shapiro 2011). A student was coded as actively engaged when he or she was actively participating in a lesson demonstrating behaviors such as raising a hand to contribute to a discussion, writing or taking notes, reading aloud, etc. (Shapiro 2011). PET was defined as the time a student was passively engaged in academic work, such as reading silently, looking at the board, or listening to the teacher. Off-task behaviors were measured using a partial interval recording procedure in which behaviors could be coded as occurring or not occurring at any point during the 15-s interval (Shapiro 2011). Off-task behaviors were categorized as off-task motor (OTM), off-task verbal (OTV), and off-task passive (OTP). OTM was recorded when a student was engaging in motor movements that were off-task such as tapping a pencil, turning around in one's chair, or fidgeting in one's seat. Students were coded as engaged in OTV behavior when they were speaking or making sounds not related to the assigned academic task (e.g., humming), or speaking about unrelated topics. Lastly, OTP behaviors were defined as time when a student was passively not attending to the academic task, such as looking out the window, looking around the room, or listening to other students about unrelated topics (Shapiro 2011).

HeartSmarts Curriculum The HeartSmarts curriculum is a program designed to promote greater emotional awareness and self-regulation of emotions through the knowledge and skills taught in the curriculum (Heartmath science and research 2013). The curriculum has five modules that include psychoeducational and mindfulness components involving awareness and regulation of social-emotional behaviors and teaching specific mindfulness techniques (see Table 1). The curriculum comes with an instructor manual that includes scripts and visual aids to assist in program implementation. The goal of the program is to help students learn about the heart-mind-body connection and ultimately learn skills to be more aware of their emotional states and skills for altering their own physiological responses in the context of emotional experiences. For example, Module 1: Exploring Emotions introduces students to becoming more aware of the emotions they are experiencing at the present moment and how to calm themselves when experiencing a negative emotion. Various emotional states are defined and discussed. Visual cues are used to further reinforce the concepts such as viewing emotions through a "weather report" (i.e., the child is asked "How is your inner-weather today?" while presented with pictures of "stormy, sunny, cloudy, calm" weather examples). The mindfulness tool taught for this Module is "HeartShift," which teaches children how to calm themselves when feeling upset using breathing techniques as well as learning to shift emotions and thoughts from negative to positive (such as focusing on things in their lives that make them happy or grateful).

emWave Desktop Biofeedback Computer Program The emWave program was introduced as a tool in Module 3 of the HeartSmarts curriculum and is designed to give students real-time physiological feedback using a noninvasive pulse sensor attached to participants' earlobe or finger (Heartmath science and research 2013). The emWave program provides participants with immediate visual feedback of their heart and breath rates, as well as a coherence ratio in the form of graphs. The coherence ratio is the amount of time in a coherent state (defined as a predictable consistent variability in heart rate) compared to the amount of time out of a coherence state during a session. Initially students are taught slow and steady breathing through the use of a computer activity where the student is instructed to pace their breath with the pace of a ball on the computer screen. They are provided immediate feedback on their breathing, heart rate, and coherence ratio. Concurrently, students are taught how thoughts and emotions influence their physiological responses in the HeartSmarts program. Once students have been trained in the use of the emWave program, there are computer games and activities with which the student can engage to further reinforce the mindfulness skills being taught in HeartSmarts. For example, in a racing game, a student's car speeds up if the student remains calm (i.e., a steady rhythmic breath rate), but slows down if they become frustrated (i.e., faster irregular breathing, faster pulse). Another emWave computer activity presents the student with a black and white picture. When the student regulates their breathing, different parts of the picture slowly start to appear in color and additional details of the picture are

Table 1 HeartSmarts curriculum modules

Module	Lessons and tools
Exploring Emotions	Identification and awareness of emotions
	Tool: The HeartShift
Getting in Sync for Learning	How emotions affect your body
	Shifting negative self-talk to positive talk
	Tool: Getting in Sync
Listening with Your Heart	What does listening look, sound, and feel like?
	Tools: Heart Listening
	Introduction to emWave® technology
Becoming Your Best Self	Discovering strengths and exploring the future
	Improving personal best: Creating an action plan
	Tools—Shift & Shine
	emWave®
Sharing what you know	Making better choices; generalization of skills
	Tools: Role playing in every day dilemmas
	emWave®

revealed. Throughout the games, students receive visual feedback on their physiological responses. Students were allowed to choose which games they would play during each emWave session.

Procedure

Prior to the implementation of the study, approval was obtained from the Institutional Review Board (at the participating University) and School Board approval for the participating elementary and middle schools. Parent consent and student assent were also obtained. In addition, four masters-level school psychologists were formally trained and certified in the biofeedback emWave technology and HeartSmarts curriculum. Formal training and certification is not required for implementing the HeartSmarts curriculum; however, this was done to ensure each psychologist had the skills and knowledge necessary to implement the program with high integrity. Research meetings were conducted each week during the study to review the previous week's sessions and to discuss if any compromises to the treatment integrity occurred. One psychologist reported modifications to the treatment protocol on two occasions (both related to falling short of the 20–30 session minute length) and two psychologists reported a delayed implementation of a treatment component on one occasion (students were not able to engage in the emWave computer programs on the day intended and thus completed this component on a subsequent day). Thus, based on psychologist report, the treatment was implemented accurately and completely for 89% of sessions.

Five School Psychology graduate students served as data collectors and were trained on the BOSS using practice videos until they reached inter-observer agreement of 80% or higher. One 30-min pre-treatment BOSS observation was conducted on each child during the morning academic instruction period within 2 weeks prior to the initiation of the intervention. Data collectors were blind to the study conditions of the participants. Each data collector observed one student at a time with no more than two data collectors in a classroom at the same time, each observing a different student. Up to four students were observed each day during the morning academic period. Post-treatment observations were conducted during the 2 weeks following the termination of the intervention in a similar fashion. That is, the observations took place during the morning academic instruction period with the same teacher to minimize effects of environmental differences. After each observation, teachers were asked if the behavior observed during the observation was typical for that student. Teachers reported that the behaviors observed were typical during 100% of the observations suggesting minimal student reactivity. After each observation, the percentage of time engaged in on-task (AET, PET) and off-task behaviors (OTM, OTV, OTP) were calculated for each participant using the following equation: total number of intervals coded as on-task (or off-task) ÷ the total number of intervals observed × 100. While concurrent inter-observer agreement was not obtained during the observations, reliability probes were conducted for 22% of participants in which a second rater collected data on the same student but on a different day. Data from the first and second raters were analyzed to determine if the same trends were observed across both observations for each on- and off-task behavior (for example, if a decrease from pre-treatment passive off-task behavior was observed for student 1 during rater 1's observation, and a decrease was also seen in rater 2's observation of student 1, it was scored as "agreement"). Overall percent agreement for the reliability probes was 82%.

Prior to the start of the study, all six classrooms engaged in weekly social skills/counseling groups with their participating school psychologist. These social skills groups focused on topics such as turn taking, sharing, behavior management skills, and empathetic responding. Upon the initiation of the study, the control group continued the weekly social skills/counseling group ("education as usual") and was not exposed to any components of the HeartSmarts curriculum or emWave technology. The treatment group began the HeartSmarts curriculum during group time. The treatment group engaged in 20–30 min group sessions once a week for approximately 12 weeks. Three weeks were spent on each Module 1–4. The first week the concepts were introduced, the second week the concepts were reinforced with tools, and the third week of each Module was used to promote generalization by discussing how to use the material they learned to make better choices in every day dilemmas (Module 5 components). During the third module, the emWave desktop biofeedback program was introduced in the HeartSmarts curriculum. Through the use of the emWave technology, the students received real-time visual feedback in the form of graphs of their coherence levels via the noninvasive pulse sensor attached to their earlobes. Following emWave training, students engaged in the emWave computer games and activities approximately two times per week for an average of 10 min in addition to their weekly HeartSmarts sessions.

Analysis Plan

The hypothesis that the HeartSmarts intervention would lead to significant increases in on-task behavior and decreases in off-task behavior was evaluated using an independent sample t test comparing the amount of change in BOSS scores pre- and post-intervention. It was expected that significant changes would be observed for the HeartSmarts group but not for the control group. In addition, effect size (Cohen's d) was measured using the following guidelines: small d >.2, medium d >.5 and large d >.8 (Cohen 1988).

Results

Descriptive statistics for BOSS data are presented in Table 2. Initial inspection of the means for the percent of intervals on-task indicate that the treatment group evidenced slightly less on-task behavior in the pre-treatment phase than the control group while the reverse is seen in the post-treatment phase with the treatment group evidencing higher on-task behavior compared to the control group. Examination of the mean change scores demonstrates improvements in on-task behavior for the treatment group but a decrease for the control group.

Table 2 Descriptive statistics for BOSS

	Pre		Post		Change score	
	Means	SD	Means	SD	Means	SD
Treatment						
On-task	66.71	21.13	82.28	15.66	15.57	24.42
Off-task	60.21	25.67	29.21	30.58	−31.00	41.50
Control						
On-task	71.35	17.56	68.52	25.44	−2.80	26.97
Off-task	52.35	31.96	56.82	42.23	4.47	30.81

With regard to off-task behavior, the treatment group mean pre-treatment were slightly higher than the control group mean. The reverse is seen in the post-treatment phase with the treatment group evidencing lower off-task behavior compared to the control group. Finally, mean change scores show a large decrease in off-task behavior for the treatment group but a slight increase in off-task behavior for the control group.

An exploratory data analysis was conducted to determine if the observed percentage of intervals on-task and off-task for the pre-intervention observations were normally distributed for both groups. Results from the Kolmogorov-Smirnov test for normality indicated that the percentage of intervals observed on-task and off-task pre-intervention for both the control and treatment groups did not deviate significantly from a normal distribution (on-task: control (D = .160, p = .200) and treatment (D = .169, p = .200), off-task: control (D = .116, p = .200) and treatment (D = .171, p = .200). Levine's test of homogeneity of variance confirmed that the variances in BOSS observations for the HeartSmarts treatment group and the control students were statistically equivalent (F (29) =1.147, p = .293).

An independent samples t test was conducted on the change scores (from BOSS pre-treatment scores to post-treatment scores) for students exposed to the treatment and students not exposed to the treatment (Table 3). Results for on-task behavior approached significant levels (t (29) = −1.971, p = .058) with a moderate but not significant effect size (d = −.710; 95% CI = −1.44, .019). Specifically, students that participated in the treatment were on-task an average of 18% more of the intervals than their counterparts in the control group. Results for off-task behavior indicate that students in the treatment group were significantly less off-task following the treatment as compared to the control group (t

Table 3 Results from independent samples t test for change scores

Condition	t	p value	df	Cohen's d [95% CI]
On-task	−1.971	.058	29	−.710 [−1.44,.019]
Off-task	2.730	.011	29	.985 [.237,1.73]

(29) = 2.730, $p = .011$) with a large effect size ($d = .985$; 95% CI = .236, 1.73). Specifically students that participated in the treatment were off-task an average of 54% less of the intervals compared with students in the control group.

In summary, the statistical evidence presented provides some support for the hypothesis. Specifically, the mindfulness and biofeedback intervention (HeartSmarts curriculum with emWave desktop technology) resulted in improved on-task behavior and significantly lower rates of off-task behavior for these participants.

Discussion

Finding effective interventions for students identified with ED who often engage in problematic behaviors and have difficulty controlling their emotions can be challenging (Landrum et al. 2003; Lane et al. 2001; Lehr and McComas 2004). Recent research suggests that mindfulness and biofeedback interventions can decrease disruptive behaviors and improve emotional regulation in children and adolescents with emotional and behavioral deficits (Arns et al. 2009; Knox et al. 2011; Lloyd et al. 2010). The results from the current study provide some further evidence of the potential utility of a biofeedback mindfulness program as an intervention for ED students. Our results indicate that the HRV biofeedback and mindfulness program consisting of the HeartSmarts curriculum and EmWave desktop technology may be an effective means for decreasing off-task behaviors in elementary and middle school students with ED. These findings were additionally supported by a large effect size with a small ranging confidence interval suggesting that the changes in behavior resulting from the intervention would be notable to an outside observer. Decreasing student off-task behaviors can positively impact school careers. Off-task behaviors distract from academically engaged learning time and can lead to decreased academic performance in school (Gettinger and Seibert 2002). Unfortunately, students with ED spend more time than their non-disabled peers engaging in inattentive and/or disruptive behaviors in the classroom (Lane et al. 2001; Lehr and McComas 2004). By potentially decreasing distracting behaviors, the HeartSmarts and Emwave curriculum may help students who often struggled to control their behaviors in the classroom.

Mindfulness programs have also been shown to increase self-regulation and focus (Felver et al. 2013; Flook et al. 2010). The results from the current study lend some support for mindfulness and coherence training as a means to increase focus or on-task behavior. The upward trend for improvements in on-task behavior paired with a moderate effect size is commensurate with previous results (Felver et al. 2013; Flook et al. 2010). However, the upward trend was not statistically significant and the confidence interval range for effect size included zero thus these findings should not be over-interpreted.

There are some significant limitations to the current study. First, the potential threats to internal validity should not be underestimated. Data on inter-observer agreement were not conducted due to the long distance between schools and limited personnel resources. Reliability probes were conducted and provide some evidence of inter-rater reliability but the lack of observations conducted concurrently by two raters is a significant weakness in the current study. In addition, treatment integrity data were reported by the implementing school psychologist and not an independent observer. Authors of a systematic review of the use of fidelity-of-implementation with mindfulness interventions reported that fewer than 20% of the studies reviewed evaluated program adherence thus noting that this is a widespread weakness across research in this area; they recommend a multi-method approach as optimal for evaluating treatment integrity (Feagans Gould et al. 2016). While instructor-reported data is one approach, more objective measures such as observational coding of intervention sessions should be included as well because they are less prone to bias and more highly correlated with program outcomes (Feagans Gould et al. 2016). A multi-method approach would strengthen the present study.

Only one 30-min pre- and post-intervention observation was conducted with each student; thus, it is possible that our brief observation did not adequately capture student behavior. Ferguson et al. (2012) recommend two 30-min observations for achieving acceptable levels of dependability. In addition, the timing of the post-intervention BOSS observations was also a potential limitation. The majority of the post-intervention data were collected the last 2 weeks of the school year. Conducting observations at the end of the school year should be avoided when possible because end of the school year behavior typically differs from behavior observed throughout the school year (Stuhlman et al. 2010).

An additional limitation of the study was the sample size. While statistically significant results were found for a decrease in off-task behavior and results approaching significance for an increase in on-task behaviors, other results may be observed with a larger, more representative sample of student participants. Of particular note was the small number of female participants ($n = 4$).

Finally, the HeartSmarts program was a multi-component curriculum that included both social-emotional components and mindfulness components. A component analysis was not conducted, thus one cannot say with certainty that the mindfulness components were responsible for the observed changes in behavior.

Directions for Future Research

Future research should address some of the previously mentioned limitations. For example, multiple observations conducted by two or more raters during the school year would increase the reliability of the observation results (Hintze and Matthews 2004; Hintze et al. 2002; Shapiro 2011). In addition, observations of peer interactions could provide valuable data on how the intervention impacts peer relationships. A larger sample size is also recommended to increase the external validity of the study and would allow for comparison of the age, gender, and diagnosis.

Similarly, a multi-method approach to treatment integrity data should be utilized and data should be collected on the treatment acceptability of the intervention (Feagans Gould et al. 2016). Given that research suggests that students identified as ED can be resistant to interventions, data on how well they accept an intervention and the fidelity with which it is implemented is important (Sutherland et al. 2013). Thus, future studies should assess these variables in a systematic manner.

Including objective measures of participants' academic performance, such as curriculum-based measures, is another means of providing more information on the effects of a mindfulness biofeedback intervention. While this study focused on the effects of the intervention on the students' on-task and off-task behaviors, future researchers may wish to examine how such an intervention affects academic performance. Research shows that decreasing off-task behaviors and increasing academic learning time can positively affect students' academic performance; therefore by using curriculum-based measures (pre- and post- intervention) can be an effective means of evaluating this relationship (Gettinger and Seibert 2002; Shapiro 2011). It would also be important to collect data from parents and teachers to determine if the skills have generalized to the home and classroom.

Finally, most mindfulness-based programs include both social-emotional and mindfulness components making it difficult to determine if the behavior change is the result of one component (mindfulness or social-emotional programming) or the comprehensive treatment package. A component analysis would allow for identification of the treatment variables responsible for behavior change. Future studies should examine mindfulness components in isolation to better determine the effectiveness of such interventions.

Future Implications for Practice

The findings from this study suggest that the HeartSmarts curriculum and emWave desktop technology could be an effective intervention for reducing off-task behaviors in students with emotional and behavioral disorders. In addition, part of the intervention (the emWave desktop computer games) can be implemented within the classroom independently by the student. Once trained in the emWave technology, students can request a break from a lesson and independently complete an exercise on the computer in the classroom. By allowing students to stay in the classroom to regain focus and calm down, the intervention can prevent the need for students to be removed from the room, thus potentially increasing instructional time and reducing strain on personnel resources for the school.

In conclusion, the results of this study provide some evidence that a mindfulness biofeedback program may be an effective intervention for children with emotional and behavioral disorders. This intervention has many aspects of what is needed in an effective intervention with this population such as a focus on self-regulation, ease of use, and time efficient independent implementation. While additional research is needed to address the limitations noted above, the potential of this noninvasive game-based intervention is exciting.

Acknowledgements The authors would like to thank Dr. Richard Erdlen, Dr. Nicholas Kenien, Tanya Merchant, Karen Webster, Val Kater, Joshua Schmalzer, Stephanie Schmazler, and John Burton for their assistance with this project.

Compliance with Ethical Standards

Funding Information This study was partially funded by a Millersville University Faculty Grant.

Ethical Approval All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflicts of Interest Statement On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Arns, M., DeRidder, S., Strehl, U., Breteler, M., & Coenen, A. (2009). Efficacy of nerofeedback treatment in ADHD: the effects on inattention, impulsivity, and hyperactivity: a meta-analysis. *Official Journal of the EEG and Clinical Neruoscience Society ENCS, 40*, 180–189 MEDLINE Complete, EBSCOhost (accessed March 23, 2016).

Bellack, A., Mueser, K., Gingerich, S., & Agresta, J. (1997). *Social skills training for schizophrenia: a step-by-step guide*. New York: Guildford Press.

Black, D., & Fernando, R. (2014). Mindfulness training and classroom behavior among lower-income and ethnic minority elementary school children. *Journal of Child and Family Studies, 23*, 1242–1246. doi:10.1007/s10826-013-9784-4.

Bogels, S., Hoogstad, B., van Dun, L., de Schutter, S., & Restifo, K. (2008). Mindfulness training for adolescents with externalizing disorders and their parents. *Behavioral and Cognitive Psychotherapy, 36*, 193–209. doi:10.1017/S1352465808004190.

Bradley, R. T., Galvin, P., Atkinson, M., & Tomasino, D. (2012). Efficacy of an emotion self-regulation program for promoting development in preschool children. *Global Advances In Health And Medicine: Improving Healthcare Outcomes Worldwide, 1*(1), 36–50. doi:10.7453/gahmj.2012.1.1.010.

Broderick, P. C., & Frank, J. L. (2014). Learning to BREATHE: an intervention to foster mindfulness in adolescence. In E. Oberle, K. Schonert-

Reichl, E. Oberle, & K. Schonert-Reichl (Eds.), *Mindfulness in adolescence* (pp. 31–44). San Francisco: Jossey-Bass.

Burke, C. (2010). Mindfulness-based approaches with children and adolescents: a preliminary review of current research in an emergent field. *Journal of Child and Family Studies, 19*, 133–144. doi:10.1007/s10826-009-9282-x.

Carboni, J., Roach, A., & Frederick, L. (2013). Impact of mindfulness training on the behavior of elementary students with attention-deficit/hyperactive disorder. *Research in Human Development, 10*, 234–251. doi:10.1080/15427609.2013.818487.

Childre, D. (2013) *emWave self-regulation technology: the theoretical basis*. Retrieved September 12, 2013, from http://www.heartmath.org/education/education-research/emwave-selfregulation-technology-thetheroeticalbasis.html.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale: Lawrence Erlbaum Associates.

Diamond, A. (2010). The evidence base for improving school outcomes by addressing the whole child and by addressing skills and attitudes, not just content. *Early Education and Development, 21*, 780–793. doi:10.1080/10409289.2010.514522.

Feagans Gould, L., Dariotis, J. K., Greenberg, M. T., & Mendelson, T. (2016). Assessing fidelity of implementation (FOI) for school-based mindfulness and yoga interventions: a systematic review. *Mindfulness, 7*(1), 5–33. doi:10.1007/s12671-015-0395-6.

Felver, J., Doerner, E., Jones, J., Kaye, N., & Merrell, K. (2013). Mindfulness in school psychology: applications for intervention and professional practice. *Psychology in the Schools, 50*, 531–544. doi:10.1002/pits21695.

Felver, J. C., Celis-de Hoyos, C. E., Tezanos, K., & Singh, N. N. (2016). A systematic review of mindfulness-based interventions for youth in school settings. *Mindfulness, 7*(1), 34–45. doi:10.1007/s12671-015-0389-4.

Ferguson, T. D., Briesch, A. M., Volpe, R. J., & Daniels, B. (2012). The influence of observation length on the dependability of data. *School Psychology Quarterly, 27*, 187–197. doi:10.1037/spq0000005.

Flook, L., Smalley, S. L., Kitil, M. J., Galla, B. M., Kaiser-Greenland, S., Locke, J., Ishijima, E., & Kasari, C. (2010). Effects of mindful awareness practices on executive functions in elementary school children. *Journal of Applied School Psychology, 26*, 70–95. doi:10.1080/15377900903379125.

Forness, S. R., Kavale, K. A., King, B. H., & Kasari, C. (1994). Simple versus complex conduct disorders: identification and phenomenology. *Behavioral Disorders, 19*(4), 306–312.

Gettinger, M., & Seibert, J. K. (2002). Best practices in increasing academic learning time. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (Vol. 2, 4th ed., pp. 773–787). Bethesda: NASP Publications.

Harnett, P. H., & Dawe, S. (2012). The contribution of mindfulness based therapies for children and families and proposed conceptual integration. *Child and Adolescent Mental Health, 17*(4), 195–208. doi:10.1111/j.1475-3588.2011.00643.x.

Heartmath science and research. (2013). Retrieved September 12, 2013, from http://www.heartmath.com/about/research-information.html.

Hintze, J. M., & Matthews, W. J. (2004). The generalizability of systematic direct observations across time and setting: a preliminary investigation of the psychometrics of behavioral observation. *School Psychology Review, 33*, 258-270. Education Source EBSCOhost (accessed October 20, 2015).

Hintze, J. M., Volpe, R. J., & Shapiro, E. S. (2002). Best practices in the systematic direct observation of student behavior. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (Vol. 2, 4th ed., pp. 993–1006). Bathesda: NASP Publications.

Individuals With Disabilities Education Act, 20 U.S.C. § 1400 (2004). Retrieved from United States Department of Education, Federal Regulations, (2006).

Kabat-Zinn, J. (2003). Mindfulness-based stress reduction (MBSR). *Constructivism in the Human Sciences, 8*, 73–107.

Kabat-Zinn, J. (2015). Mindfulness. *Mindfulness, 6*, 1481–1483. doi:10.1007/s12671-015-0456-x.

Knox, M., Lentini, J., Cummings, T., McGrady, A., Wheatry, K., & Sancrant, L. (2011). Game-based biofeedback for paediatric anxiety and depression. *Mental Health in Family Medicine, 8*, 195–203.

Landrum, T. J., Tankersley, M., & Kauffman, J. M. (2003). What is special about special education for students with emotional or behavioral disorders? *The Journal of Special Education, 37*, 148–156. doi:10.1177/00224669030370030401.

Lane, K. L., Beebe-Frankenberger, M. E., Lambros, K. M., & Pierson, M. (2001). Designing effective interventions for children at-risk for antisocial behavior: an integrated model of components necessary for making valid inferences. *Psychology in the Schools, 38*, 365–379. doi:10.1002/pits.1025.

Lantieri, L., & Goleman, D. (2008). *Building emotional intelligence: techniques to cultivate inner strength in children*. Boulder: Sounds True.

Lehr, C. A., & McComas, J. (2004). Students with emotional/behavioral disorders: promoting positive outcomes. *Impact Newsletter*, Retrieved January 23, 2014, from http://ici.umn.edu/products/impact/182/over1.html.

Lehrer, P., & Gevirtz, R. (2014). Heart rate variability biofeedback: how and why does it work? *Frontiers in Psychology, 5*, 756. doi:10.3389/fpsyg.2014.00756.

Lloyd, A., Brett, D., & Wesnes, K. (2010). Coherence training in children with attention-deficit hyperactivity disorder: cognitive functions and behavioral changes. *Alternative Therapies, 16*, 34–42 Retrieved from https://www.heartmath.org/assets/uploads/2015/01/coherence-training-in-children-with-adhd.pdf.

Malow, M., & Austin, V. (2016). Mindfulness for students classified with emotional/behavioral disorder. *Insights into Learning Disabilities, 13*, 81–94.

Mattison, R. E., & Felix, B. J. (1997). The course of elementary and secondary school students with SED through their special education experience. *Journal of Emotional and Behavioral Disorders, 5*(2), 107–117. doi:10.1177/106342669700500205.

McCraty, R., & Childre, D. (2010). Coherence: bridging personal, social, and global health. *Alternative Therapies, 16*(4), 10–24 Retrieved from http://www.alternative-therapies.com.

McCraty, R., & Zayas, M. A. (2014). Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. *Frontiers in Psychology, 5*, 1090. doi:10.3389/fpsyg.2014.01090.

Mendelson, T., Greenberg, M. T., Dariotis, J. K., Gould, L. F., Rhoades, B. L., & Leaf, P. J. (2010). Feasibility and preliminary outcomes of a school-based mindfulness intervention for urban youth. *Journal of Abnormal Child Psychology, 38*, 985–994. doi:10.1007/s10802-010-9418-x.

NASP- Position Statements, NASP Resources. (2004). *Position statement on students with emotional and behavioral disorders*. Retrieved November 8, 2013, from http://www.nasponline.org/about_nasp/pospaper_sebd.aspx.

Niesyn, M. E. (2009). Strategies for success: evidence-based instructional practices for students with emotional and behavioral disorders. *Preventing School Failure, 53*(4), 227–233. doi:10.3200/PSFL.53.4.227-234.

van der Oord, S., Bogels, S., & Peihnenburg, D. (2012). The effectiveness of mindfulness training for children with ADHD and mindful parenting for their parents. *Journal of Child and Family Studies, 21*, 139–147.

Pop-Jordanova, N. (2009). Heart rate variability in the assessment and biofeedback training of common mental health problems in children. *Medical Archive Journal, 631*, 244–248.

Pop-Jordanova, N., & Chakalarosa, I. (2008). Comparison of biofeedback modalities for better achievement in high school students. *Macedonian Journal of Medical Sciences, 1*(2), 25–30.

Reddy, L. A., & Richardson, L. (2006). School-based prevention and intervention, programs for children with emotional disturbance. *Education and Treatment of Children, 28*, 379–404.

Reddy, L. A., Newman, E., De Tomas, C. A., & Chun, V. (2009). Effectiveness of school-based prevention and intervention programs for children and adolescents with emotional disturbance: a meta-analysis. *Journal of School Psychology, 47*, 77–99. doi:10.1016/j.jsp.2008.11.001.

Saltzman, A., & Goldin, P. (2008). Mindfulness-based stress reeducation for school-age children. In L. A. Greco & S. C. Hayes (Eds.), *Acceptance and mindfulness treatments for children and adolescents: a practitioner's guide* (pp. 139–162). Oakland: New Harbinger Publications.

Schoenberg, P., & David, A. (2014). Biofeedback for psychiatric disorders: a systematic review. *Applied Psychophysiology and Biofeedback, 39*, 109–135. doi:10.1007/s10484-014-9246-9.

Scholten, H., Malmberg, M., Lobel, A., Engels, R., & Granic, I. (2016). A randomized controlled trial to test the effectiveness of an immersive 3D video game for anxiety prevention among adolescents. *PloS One, 11*(1), e0147763. doi:10.1371/journal.pone.0147763.

Schonert-Reichl, K., Oberle, E., Lawlor, M., Abbott, D., Thomson, K., Oberlander, T., & Diamond, A. (2015). Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: a randomized controlled trial. *Developmental Psychology, 51*, 52–66. doi:10.1037/a0038454.

Segal, Z. V., Williams, J. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: a new approach to preventing relapse*. New York: Guilford Press.

Semple, R. J., Lee, J., Rosa, D., & Miller, L. F. (2010). A randomized trial of mindfulness-based cognitive therapy for children: promoting mindful attention to enhance social-emotional resiliency in children. *Journal of Child and Family Studies, 19*, 218–229. doi:10.1007/s10826-009-9301-y.

Semple, R. J., Droutman, V., & Reid, B. A. (2016). Mindfulness goes to school: things learned (so far) from research and real-world experiences. *Psychology in the Schools, 54*, 29–52. doi:10.1002/pits.21981.

Shapiro, E. S. (2011). *Academic skills problems workbook* (4th ed.pp. 35–56). New York: The Guilford Press.

Sigafus, P. (2011). Heart rate variability, biofeedback, and mindfulness: a functional neuroimaging study. *Cleveland Clinic Journal of Medicine, 78*, 102–118 Retrieved from http://www.ccjm.org/content/78/Suppl_1/S102.full.pdf+html.

Singh, N. N., Lancioni, G. E., Manikam, R., Winton, A. W., Singh, A. A., Singh, J., & Singh, A. A. (2011). A mindfulness-based strategy for self-management of aggressive behavior in adolescents with autism. *Research in Autism Spectrum Disorders, 5*(3), 1153–1158. doi:10.1016/j.rasd.2010.12.012.

Stuhlman, M. W., Hamre, B. K., Downer, J. T., & Pianta, R. W. (2010). *A practitioner's guide to conducting classroom observations: what the research tells us about choosing and using observational systems to assess and improve teacher effectiveness*. Charlottesville: The Center for Advanced Study of Teaching and Learning, University of Virginia.

Sutherland, K. S., McLeod, B. D., Conroy, M. A., & Cox, J. R. (2013). Measuring implementation of evidence-based programs targeting young children at risk for emotional/behavioral disorders: conceptual issues and recommendations. *Journal of Early Intervention, 35*, 129–149.

Thayer, J. F., Ahs, F., Fredrikson, M., Sollers, J. J., & Wager, T. D. (2011). A meta-analysis of heart rate variability and neuroimaging studies: implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews, 36*, 747-756. doi:10.1016/j.neubiorev.2011.11.009.

Thomas, G., & Atkinson, C. (2016). Measuring the effectiveness of a mindfulness-based intervention for children's attentional functioning. *Educational and Child Psychology, 33*(1), 51–64.

U.S. Department of Education. (2002). *Twenty-fourth annual report to Congress on the implementation of the Individuals with Disabilities Education Act (IDEA)*. Washington D.C.: Author.

Waters, L., Barsky, A., Ridd, A., & Allen, K. (2015). Contemplative education: a systematic, evidence-based review of the effect of meditation interventions in schools. *Educational Psychology Review, 27*(1), 103–134. doi:10.1007/s10648-014-9258-2.

Wheat, A. L., & Larkin, K. T. (2010). Biofeedback of heart rate variability and related physiology: a critical review. *Applied Psychophysiological Biofeedback*. doi:10.1007/s1048-010-9133-y.

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools—a systematic review and meta-analysis. *Frontiers in Psychology, 5*, 603. doi:10.3389/fpsyg.2014.00603.

Karena S. Rush Ph.D. is an associate professor at Millersville University in the Department of Psychology. She conducts research in the areas of social-emotional interventions; assessment and treatment of childhood disorders, and early childhood risk and prevention. She is also interested in the effects different types of play have on child development and has conducted research with Parents' Choice Organization on the benefits of play with toys and games.

Maria E. Golden (Hoff) is a doctoral candidate in School Psychology with a specialization in Pediatric Psychology at Lehigh University. She has worked in the Center for Promoting Research to Practice on the BEST (Bridges to Educational Success for Teens) project. She recently started her internship in Child Clinical and Pediatric Psychology at Geisinger Medical Center. Her research interests include understanding the impact of medical and mental health needs on the development and functioning of children and the implementation and adherence to medical and lifestyle interventions to improve health outcomes.

Dr. Bruce P. Mortenson is an associate professor and director of the school psychology program at Towson University. His research interests include the efficacy of behavioral and social-emotional interventions applied during the summer months. Dr. Mortenson is fluent in American Sign Langauge and has worked with the deaf and hard of hearing population for more than 25 years.

Daniel N. Albohn received his Master's degree in clinical psychology at Millersville University, and is currently a Ph.D. candidate in social psychology at The Pennsylvania State University. Broadly, his interests include emotion perception and impression formation, the psychophysiology of person perception, and the intersection between social psychology and vision science.

Melissa N. Horger is a Ph.D. student in developmental psychology at the Graduate Center, City University of New York. She is currently working in the Child Development Lab which focuses on early cognitive and motor development. Her research interests include the cognition-action trade offs that accompany the acquisition of new motor skills and the role of sleep in motor problem solving. Before beginning her graduate career, Melissa worked with children and adolescents with Autism Spectrum Disorder. She graduated from Millersville University with her undergraduate degree in 2013.