Title: The Effects of Mindful Awareness Teaching Practices on the Executive Functions of Students in an Urban, Low Income Middle School

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Executive Summary:

This research project evaluated the effectiveness of a school-based program of mindful awareness on the self-regulation and the executive functions of 40 sixth grade students, ages 11-12 years, in an urban, low income, public middle school in a randomized control study. Core classroom teachers rated treatment and control students on the *Behavior Rating Inventory of Executive Function* before and after the mindful awareness program. Although mindful awareness is often viewed as a multi-faceted construct, this study operationally defines mindful awareness as defined by the Wellness Works in Schools™ program and is based primarily on research on the executive function behaviors that are manifested cognitively, emotionally, and physically. Wellness Works is a mindful awareness program that focuses on both executive attention and executive control behaviors in students. In this study, eight domains of cognitive and behavioral regulation were assessed and analyzed in the children. These eight domains of self regulation behavior and executive function are 1) inhibiting, 2) shifting, 3) emotional controlling, 4) initiating, 5) working memory, 6) planning & organizing, 7) organizing of materials, and 8) monitoring.

Research literature on self-regulation including executive attention and executive control indicates the positive effect of these behaviors on academic outcomes and on student temperament in the classroom. To date, this study is the first in the literature to investigate the impact of self-regulation behavioral training program on the executive function skills of an urban, low income, middle school student population.

The study findings indicated a significant effect ($p < .05$) for the treatment group in the ability to shift. Treatment scores showed a positive trend in improvement of the overall scores on the Metacognition Index and Global Executive Composite (Figure 1) of the BRIEF. The findings for the treatment group are encouraging in consideration of the limitations of the study. In addition, the findings are important when compared with the analysis of the executive function scores of the control group. The control group students who did not receive Wellness Works training scores (Figure 1) demonstrated a decline in scores on the two indices and on the composite score. Overall, treatment students maintained or improved executive function skills while the skills of control students regressed.

Recommendations:

Based on the research literature and the limited findings of this study, the authors recommend 1) continued programs in self-regulation for students and 2) training of regular classroom teachers in teaching and modeling self-regulation.

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Purpose

This research project evaluated the effectiveness of a school-based program of mindful awareness practices (MAPs) on the self regulation and the executive function (EF) behaviors of 40 sixth grade students, ages 11-12 years, in an urban, low income, public middle school in a randomized control study over a period of three months in 2009-2010. Core classroom teachers rated treatment and control students on the *Behavior Rating Inventory of Executive Function* (BRIEF) before and after a mindful awareness program was conducted for treatment students.

The 2010 study was designed as a replication of empirical research in this area. Flook et al (2010) conducted randomized control studies of the effects of MAPs in elementary and in Pre-K children. Teachers and parents assessed the executive function of the two age levels of children before and after the treatment periods. In the Flook et al study, children in the MAPs group who were less well regulated showed greater improvement in EF as compared with the control groups.

In the 2008-2009 school year, the author conducted an observational study of the impact of MAPs on the cognitive, physical, and emotional behaviors of six learning support and emotional support sixth grade students in the same middle school over a five-month period. MAPs had the most significant effect on the behaviors of the three emotional support students, supporting the research findings of the Flook et al study. The observational study, however, was limited 1) by the small number of the students in the program, 2) by the influence of the observer's bias on the rating of student behaviors, and 3) by the study being conducted on student behaviors as they participated in the treatment class. It did not investigate the transference of the changes in students' behaviors to their regular, subject content classrooms.

Mindful Awareness

Mindful awareness is often viewed as a multi-faceted construct. Shapiro et al (2006, p. 375) constructed three axioms of mindfulness-based on Jon Kabat-Zinn's definition, "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (1994, p.4). These axioms include 1) **intention** or personal vision of self-regulation, 2) **attention** or the observation of one's moment-to-moment, internal and external experience or behavior, and 3) **attitude** or the quality one brings to his/her attention to the experience or behavior without evaluation or interpretation. According to Shapiro et al, "Through intentionally bringing the attitudes of patience, compassion and non-striving to the attentional practice, one develops the capacity not to continually strive for pleasant experiences, or to push aversive experiences away" (p.377).

The study operationally defined mindful awareness as those practices presented by the Wellness Works in Schools™ program. *Wellness Works in Schools™* is a mindful awareness health

and wellness program developed and conducted by Kinder Associates since 2001. According to *Wellness Works* (WW) program, the curriculum is "designed to motivate, educate, and support students, teachers and families in developing the mental, emotional, physical, and social competencies needed to handle life's challenges healthfully, across school, home, work and community. Wellness Works presents mindful awareness practices and curriculums to promote positive nervous system function and behavioral expression" (Kinder Associates LLC, 2009, pp 1-2).

Each *WW* mindful awareness lesson included

- group discussion of selected emotional intelligence and mindbody topics, e.g. handling challenging emotions, managing stress, creating resilience and balance,
- mindfulness skills including focused awareness, attention, and concentration where the student focus shifts from external stimuli to internal awareness to sort out thoughts, emotions and impulses in a non-reactive way,
- healthy breathing to promote slowing down, reflecting, and becoming present,
- mindful movements to energize the mindbody connection by releasing tension and stress,
- relaxation skills to cultivate balance and calm,
- group reflections to allow students the opportunity for inquiry and comment.

As described by its developers, Kinder Associates, the mindful awareness program uses "focused awareness and self regulation practices and curricula to promote positive neurological system function and behavioral expression" (2009, pp 1-2).

Executive Function and the BRIEF

To determine the impact of the MAPs of the Wellness Works program on the population of sixth grade children, the study used *the Behavior Rating Inventory of Executive Function*, (BRIEF) as developed by Goia et al., (2000). The Flook et al used the BRIEF instrument in their study. The BRIEF is a questionnaire for parents and teachers of school age children that enables professionals to assess executive function behaviors in the home and school environments. It is designed for children, ages 5 to 18 years, including those with a wide range of disabilities and disorders. A series of studies were conducted and established the reliability, validity, and diagnostic utility of the BRIEF as a measure of executive function.

The eight domains of self regulation behavior and executive function as assessed in the BRIEF are 1) inhibiting, 2) shifting, 3) emotional controlling, 4) initiating, 5) working memory, 6) planning & organizing, 7) organizing of materials, and 8) monitoring. Lower scores on the eight domains of the BRIEF are measures of higher levels of executive function behaviors.

Brain-based research has determined that the capacity for executive function behaviors occurs within the frontal system of the brain and relies on connections of the frontal regions with the cortical and subcortical regions of the brain. The developmental course of the executive functions within an individual follows the path of one's neurological development. Conversely, dysfunction can arise from a variety of forms of damage to the frontal region as well as to the interconnected cortical and subcortical regions of the brain.

Goia et al contended that the executive functions of self-awareness and control develop in parallel with specific areas of content. For example, as basic memory skills develop, knowledge about how to use and control these memories, or "metamemory," develops concurrently. Based on research studies on metamemory, Goia et al highlighted the importance of self-control strategies within the context of specific processes such as reading or writing (p.3).

Review of Literature: Self-Regulation and Academic Outcomes

As defined by Smith, Borkowski, and Whitman (2008), self-regulation is a "broad construct incorporating behaviors and strategies utilized by individuals across the life span to modulate and control their own emotional and behavioral responses" (p.133). Compliance and effortful control (Kochanska, Coy, & Murray, 2001), inhibitory control and attention regulation (Lengua, 2003), reactivity and impulsivity (Aksan & Kochanska, 2004), and self-monitoring and strategy use (Borkowski, Chan, & Muthukrishna, 2000) have all been identified as components of regulation.

Researchers tend to separate regulation into two forms: cognitive regulation and emotional regulation. In cognitive and affective regulation, the brain network most directly involved is the executive attention network (Bush, Luu, & Posner, 2000). One of the main nodes of the executive attention network, the anterior cingulated gyrus, is consistently activated by situations requiring the regulation of induced emotions (Beauregard, Levesque, & Bourgoulin, 2001; Ochsner, Bunge, Gross, & Gabriele, 2002). In regard to cognitive regulation, the extent of activation of the executive network has been related to the extent of activation of memory processes (Anderson et al, 2004) and other cognitive demands such as perception, response selection, working memory, and problem solving (Duncan & Owen, 2000). Research studies designed to understand individual differences in the self-efficiency of self-regulation from infancy to adulthood have also studied temperament. These studies have defined temperament as reactivity and regulation in the areas of emotion, activity, and attention. Executive attention is a concept emerging from the neurocognitive literature and is linked to the control of cognition and cognitive flexibility. Executive control is a concept developed in the temperament literature that is related to the regulation of reactivity systems and the attentional control and the flexible regulation of behavior.

In a study of 69 children whose mean age was 12.7, Checa, Rodriguez-Bailon, & Rueda ((2008) found that children's executive attention scores were related to academic achievement in general and more consistently to grades in mathematics. They concluded that the executive attention aspects of the brain system resulted in more successful acquisition and application of knowledge at school, in particular those subjects involving complex reasoning such as mathematics (p.184). They also studied a variety of temperamental measures and how temperament may influence school outcomes. Children with higher negative executive control behaviors have trouble following rules, understanding their role as students, socializing with peers, and tolerating frustration. They may have a more difficult time in adapting to the classroom setting and disrupt the classroom routine which affects both achievement and social acceptance (p.185). Children who have more positive scores of executive control are more able to use their self regulation skills to comply with the demands of teachers and peers, and in doing so, increase their social acceptance and their opportunities to learn (Rothbart & Jones, 1998). Checa, Rodriguez-Bailon, & Rueda emphasize the importance of the roles of both teachers and parents. They recommend the design of programs to enhance cognitive and temperamental control systems.

This research is in agreement with Pullis (1985) who found that increased teacher's awareness of how students' temperament relates to their responses to the social and academic challenges is likely to reduce teacher's negative reactions and promote feelings of support, which in turn have the potential to reduce conflict and encourage the use of more appropriate coping strategies by the students.

In a study of 157 children born to adolescent mothers, the majority of whom were African American and living in poverty; Smith, Borkowski, & Whitman (2008), found a strong connection between early reading skills and later reading performance in children. They also found that self-regulation acted as "a partial mediator in the relationship between early reading readiness and later reading competence, even after controlling for intelligence and socioeconomic status" (p. 146). This finding supported earlier research by Howse, Lange, Farran, & Boyles (2003) that provided evidence that self-regulation was related to reading achievement in high risk population samples and by O'Shea & O'Shea in children in general populations with reading problems (1994). Smith, Borkowski, & Whitman recommend both motivational training and strategy instruction as an effective means of promoting reading achievement and support the research of Paris & Paris (2001) that concluded that knowledge of strategy use alone is inadequate for promoting success in reading achievement. Pressley et al. (2001) found that teachers rated as "most effective" in literacy instruction displayed a variety of teaching strategies, including the development of their students' self-regulation. Top-rated teachers taught students to self regulate and also modeled self-regulation and encouraged independence. Smith, Borkowski, & Whitman concluded that their findings "suggest that children in high-risk populations needed training and instruction in self-regulatory behaviors such as exercising self-control during peer interactions, modulating emotional responses, and complying with teacher instructions. This is particularly true for children of adolescent mothers who may not learn cognitive and socioemotional regulation skills at home (Willard Noria et al., 2006) (p.148).

In a meta-analysis of the literature on the use of self-regulation interventions for children with attention deficit/hyperactivity disorder (ADHD), Reid, Trout, & Schartz (2005) found that such interventions can produce significant and meaningful improvements in student on-task behavior, academic productivity and accuracy, and reduction of inappropriate or disruptive behaviors in ADHD children.

Dembo & Eaton (2000) argued that in addition to curriculum changes and improved teacher education in instructional strategies, educators should not neglect the role of the middle school student in promoting his or her own learning. They recommend that educators must teach student how to take charge and overcome obstacles to their educational and personal goals by teaching middle school students self-regulation skills.

Data source

Participants were 40 sixth-grade students, ages 11-12, from a middle school located in the northeast United States. Prior to the study, 25 students were randomly assigned to the treatment group and 25 students were randomly assigned to a control group by the school principal. Fifteen students persisted in the treatment group. Ten students in the treatment group attended less than six of treatment sessions due to scheduling and were not included in the final analysis. Descriptive information about the sample is displayed in Table 1. The study was conducted across a ten-week period spanning mid November, 2009, to the end of January, 2010. Control students participated in a homeroom period while treatment students received MAPs instruction for 25-45 minutes, once a week, across a ten-week period.

Each lesson for the treatment group included: 1) a preliminary group discussion of selected emotional, physical and social behavioral topics, (e.g. handling challenging emotions, managing stress, creating resilience and balance), 2) the practice of skills on MAP, including self- attention, concentration, planning and organization, and emotional control where the student

focus shifts from external stimuli to internal awareness to sort out thoughts, emotions and physical behaviors in a non-reactive way; healthy breathing to promote slowing down and reflection; and physical movements with cognitive connection to release tension and stress; and 3) closing group reflections to allow students the opportunity for inquiry and comment.

Two teachers, who were formally trained in the MAPs teaching practices, had previously taught in the elementary feeder school to the middle school and had been teaching in the Wellness Works program in this and other school districts for at least six years were the instructors for the treatment group.

A core classroom teacher in one of the children's content areas, e.g. communication arts, mathematics, or science, completed the questionnaire, the BRIEF, assessing both control and treatment student's executive function behaviors immediately before and following the ten-week period. This measure assessed 86 executive function behaviors across eight scales (inhibit, shift, emotional control, initiate, working memory, plan/organize, organization of materials, and monitor). Two broad composites are scored across the eight scales: Behavioral Regulation Index and Metacognition Index, which combine to yield an overall Global Executive Composite. Items were scored on a 3-point scale indicating whether the behavior was observed "never (3)", "sometimes (2)" or "often (1)". Raw scores on the scale were converted to t-scores prior to data analysis.

Results

Using SPSS, a series of data analytic procedures were conducted. First, independent t-tests were conducted. Next, multivariate analysis of variance (MANOVA) with group as a between-subjects factor (treatment v control) and time as a within-subjects factor were conducted to examine group by time effects. Figure 1 depicts the mean t-scores by group and time point (pre and post) for the Metacognition Index, Behavioral Regulation Index, and the Global Executive Composite. None of the analyses revealed a significant main effect of group nor a significant main effect of time. Nor was there significant time by group interactions (all ps > .05). Mean pre and post test executive function scores for each of the scales are presented in Table 2.

To determine the effects of initial global executive composite scores as moderators of change, we conducted a series of multiple regression analyses using pre- to post-test difference scores as outcome variables for Metacognition Index, Behavioral Regulation Index, and Global Executive Composite. Group membership (treatment v control), initial Global Executive Composite score (pre test), and an interaction term (group membership x Global Executive Composite pre test score) were entered as predictor variables. Results from these analyses are displayed in Table 3. There were no significant interaction terms for any of the outcome variables.

Interaction terms among the 8 subscales that measure executive function behaviors were examined. The only significant interaction between Global Executive Composite pre-test score and group membership for predicting executive function difference scores was for Shift (β = -0.82, $p < .05$). Children in the treatment group showed greater improvement in their ability to shift than children in the control group. None of the other subscales yielded significant group by time interactions: Inhibit (β = 0.13, p > 05), Emotional Control (β = -0.44, p > 05), Initiate (β = 0.16, p > 05), Working Memory (β = -0.42, p > 05), Plan/Organize (β = -0.28, p > 05), Organization of Materials (β = -0.27, p > 05), and Monitor (β = 0.26, p > 05).

The Global Executive Composite pre test scores were a significant moderator of change for differences in pre-test to post test scores for Metacognitive Index ($\beta = 0.70$, $p < .01$, for Behavioral Regulation Index ($\beta = .46$, $p < .05$), and for Global Executive Composite ($\beta = .30$, $p < .01$).

Scholarly Significance

The study findings indicated a significant effect ($p < .05$) for the treatment group in the ability to shift. Treatment scores showed a positive trend in improvement of the overall scores on the Metacognition Index and Global Executive Composite (Figure 1) of the BRIEF. The findings for the treatment group are encouraging in consideration of the limitations detailed below. In addition, the findings are important when compared with the analysis of the EF scores of the control group. The control group students who did not receive Wellness Works training scores (Figure 1) demonstrated a decline in executive function scores on the two indices and on the composite score. Overall, treatment students maintained or improved executive attention and one of the executive control behaviors while control students regressed in both areas.

Limitations of the Study

In May 2009, the primary researcher and one of the MAPs instructors met with the incoming sixth grade core teachers for September 2009 and the guidance counselor. At this meeting, we requested their agreement to participate in the study and if granted, to introduce the BRIEF inventory which would require their completing the inventory pre and post the program on both control and treatment groups. District approval of the study was completed in August 2009. Principal approval for the program to begin in the last week of September was assured in August 2009. Written parental permission for students to participate in the study was completed by the second week of September. At this time, the principal of the middle school was observed randomly assigning students from eight core classrooms to the treatment and control groups by alternating through the list of students whose parents had given permission for the children to participate. The administrative scheduling of the two groups as well as the overall sixth grade class was not completed until late October. As a result, the treatment program did not begin until the first week of November. Due to school holidays in late November and late December and to music program interruptions in student availability to participate in the program, the instructors were not able to instruct MAPs weekly for eight consecutive weeks, a potential limitation of the effects of MAPs on student EF. In addition, treatment students often arrived to the MAPs training five to ten minutes late during the early weeks of the program, a second potential limitation affecting the consistent practices of the program. A letter from the researcher to the core and homeroom teachers as well as an additional endorsement of the program by the principal improved the promptness of most students.

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Table 1. *Descriptive information for participants, by group.*

Group	N	percent male/female	percent minority [a]	percent low income	percent learning support
Treatment	15	67/33	93	93	20
Control	25	52/48	88	100	36

Note. [a] Within each group, children identified as minority were primarily Hispanic.

Table 2. *Mean pre- and post-test executive functioning scores, by group.*

	Pre-test		Post-test	
	control	treatment	control	treatment
	Mean	Mean	Mean	Mean
Inhibit	69.48 (23.99)	60.13 (19.52)	73.96 (23.63)	60.60 (16.47)
Shift	66.12 (18.64)	53.67 (13.44)	69.96 (21.55)	59.67 (16.91)
Emotional-control	65.44 (22.47)	58.67 (21.41)	71.04 (21.24)	59.40 (21.05)
Behavioral regulation index	68.76 (22.94)	58.40 (18.74)	74.56 (24.04)	60.80 (19.39)
Initiate	65.40 (9.56)	59.53 (13.71)	63.08 (14.27)	61.67 (13.29)
Working memory	67.40 (15.32)	61.47 (16.21)	65.32 (22.46)	62.80 (14.81)
Plan/organize	66.16 (13.22)	59.60 (15.08)	65.96 (15.53)	60.93 (12.83)
Organization	59.20 (26.65)	58.40 (15.52)	65.12 (22.86)	52.40 (19.29)
Monitor	68.60 (14.46)	57.73 (23.32)	71.16 (16.93)	63.47 (16.47)
Meta-cognition index	63.96 (23.60)	58.00 (22.79)	66.56 (23.02)	57.07 (21.21)
Global executive index	64.60 (25.95)	58.00 (23.95)	71.36 (26.15)	56.93 (22.69)

Note. **Lower scores reflect higher executive functioning. Standard deviations are shown in parentheses below mean scores.**

Table 3. *Multiple regression analyses with Pre-test Global Executive Composite (GEC) scores moderating the change in pre to post-test executive function difference scores.*

	B	SE B	β	t
Metacognition index				
Constant	-58.99	12.85		-4.6**
Group	8.61	20.84	0.13	0.41
GEC pre-test	0.87	0.19	0.70	4.72**
Group x GEC pre-test	0.01	0.32	0.01	0.04
Behavioral regulation index				
Constant	-27.72	9.71		-2.86**
Group	21.13	15.73	0.56	1.34
GEC pre-test	0.34	0.14	0.46	2.43*
Group x GEC pre-test	-0.27	0.24	-0.46	-1.10
Global Executive Composite				
Constant	-68.46	13.92		-4.92**
Group	20.71	22.57	0.30	0.92
GEC pre-test	0.96	0.20	0.71	4.76**
Group x GEC pre-test	-0.11	0.35	-0.11	-0.33

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

Figure 1. *Mean t-scores by group and time point (pre and post) for the Metacognition Index, Behavioral Regulation Index, and the Global Executive Composite*