

Supplemental Materials

Enhancing Cognitive and Social-Emotional Development Through a Simple-to-Administer Mindfulness-Based School Program for Elementary School Children: A Randomized Controlled Trial

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Importance of Translational Research

Many have noted the importance of translational research that brings together researchers across several disciplines to work collaboratively in order to make new discoveries that ultimately lead to more effective preventions and interventions (e.g., DelCarmen-Wiggins, 2008; Mind and Life Education Research Network, 2012). Despite this call for transdisciplinary research, such collaborations are rare. In general there is a paucity of research that has examined the effects of programs on multiple systems, including social and emotional competence, executive functions (EFs), and neuroendocrine regulation as assessed via circadian rhythms of the stress hormone cortisol.

In light of these limitations, the current study represents a critical advance by (1) exploring the effect of an SEL program that incorporates mindfulness practices on multiple neurological, biological, cognitive, emotional, and social systems together in one study, and (2) utilizing multiple methods and multiple informants, including third-person objective measures of EFs, neuroendocrine regulation as assessed via circadian rhythms of the stress hormone cortisol, child self-report measures of well-being and prosociality, and peer reports of prosocial behavior. Given that previous research on SEL programs has found an increase in academic achievement as a result of SEL interventions (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger 2011), and of research showing a positive and significant link between EFs and math achievement (Oberle & Schonert-Reichl, 2013), we also examined the effects of the *MindUp* program on math grades obtained from school records.

Child Well-Being and Neuroendocrine Regulation

The hypothalamic-pituitary-adrenocortical (HPA) system is part of a larger neurobiological stress response system that functions to maintain an individual's ability to respond to acute and prolonged changes in the environment (see Gunnar & Quevedo, 2007). The HPA axis is a primary system of interest in developmental literature due to its established links with behavior and ease of sampling cortisol in children's saliva to assess their stress physiology (e.g., Alink, Cicchetti, Kim, & Rogosch, 2008). Healthy HPA axis functioning is thought to require the presence of strong diurnal or daily patterning in cortisol. Specifically, cortisol exhibits a typical diurnal pattern of secretion, with levels rising within 20 - 45 minutes after waking, then gradually declining across the day (Gunnar & Quevedo, 2007).

Short-term cortisol release in response to stress serves an adaptive function; however, prolonged exposure to chronic stress in childhood (i.e., maltreatment, peer rejection) may result in dysregulation of the HPA axis, possibly due to alteration of the sensitivity of receptors in the HPA axis that affect the production of cortisol (Tarullo & Gunnar, 2006). Deviations from strong daily patterning of the HPA axis may provide valuable information about the role of the HPA axis in the development of children's well-being and stress physiology in late childhood and early adolescence (see Alink et al., 2008; Gunnar & Quevedo, 2007; Gunnar & Vazquez, 2001; van Goozen, Fairchild, Snoek, & Harold, 2007). Research has provided evidence that dysregulation of the diurnal rhythm of cortisol is associated with a number of problems in children. A flattened cortisol circadian rhythm, for instance,

has been found in children with chronic stress and trauma exposure (Bevans, Cerbone, & Overstreet, 2008) and who experience peer victimization (Murray-Close, Han, Cicchetti, Crick, & Rogosch, 2008). Although research examining the effects of mindfulness-based interventions on changes in stress-related cortisol in adult populations exist (Marcus et al., 2003; Tang et al., 2007), to our knowledge there is no research to date that has examined the effects of an SEL program which incorporates mindfulness on changes in daily variations of cortisol in children; however, as can be surmised from the literature reviewed above, preliminary work suggests that this is an important avenue for additional research.

Consistent with the methodology employed by investigations of preschool children in child-care settings (i.e., Badanes et al., 2012) and school-age children attending day camps (e.g., Alink et al., 2012; Murray-Close et al., 2008), the current study sampled daily variations of cortisol from children residing in their classroom three times across the school day (9am, 12pm, and 3pm) at baseline and again at posttest. The average approximation of daily variations in cortisol, or linear slope (Stetler & Miller, 2008), is commonly used as an index of long-term patterning of HPA axis functioning (e.g., Catherine, Schonert-Reichl, Hertzman, & Oberlander, 2012; Shirtcliff & Essex, 2008).

Description of Interventions

***MindUp* Program**

MindUp's twelve lessons are divided across four units: 1) Introduction to Mindfulness, 2) Mindfulness and Our Senses, 3) Mindful of Our Thoughts and Feelings, and 4) Mindful of Ourselves in the World. Each component of the program

builds on previous skills learned, moving children from focusing on internal experience (senses) to cognitive experience (thoughts and feelings) ending with students' focus on themselves in relation to others via acts of kindness and community service learning.

Units 1 and 2 of the *MindUp* program, for instance, introduce children to the concept of mindfulness through a series of six lessons that focus on physical senses (sound, breath, taste, sight, smell, and heart rate). One lesson has children focus on a small pebble or marble, with the instruction to focus on this object, consistently bringing their attention back to the object whenever their minds wander, and to notice the particular details of their object (e.g., any distinctive markings or colors). At the end of this exercise, the pebbles/marble are collected and placed in the center of the class, with each child then being asked to find their own pebble/marble via the distinctive markings or colors that they had identified. The objective of this lesson, and other *MindUp* mindfulness lessons, is to teach children to focus their attention. It is at the beginning of Unit 1 that children also begin the daily core *MindUp* practices, which consist of focused listening and breathing exercises to a resonant sound (i.e., chime) three times per day.

Unit 3, *Mindful of Our Thoughts and Feelings*, moves beyond the sensory experiences of Unit 2 by teaching children adaptive thinking strategies. In the first lesson of Unit 3, children learn to take the perspective of others via an activity using children's literature. The next lesson on perspective-taking sets the stage for children to learn about adopting a positive outlook in a lesson on "learning optimism." Drawing from the pioneering work of Seligman (1991), during this

lesson, children work through several scenarios (e.g., “I was walking down the hall and the principal was frowning”) taking on both a “glass half full” outlook and “glass half empty” perspective. Unit 3 ends with children learning a strategy to help regulate positive emotion. This is achieved via visualizing and savoring a happy memory. Research has shown that savoring interventions can induce and extend pleasant emotional experiences (Sheldon & Lyubomirsky, 2004, 2006).

Unit 4 of the *MindUp* program focuses on fostering children’s prosocial behaviors. Drawing from research and theory on gratitude (Froh, Sefick, & Emmons, 2008; McCullough, Kilpatrick, Emmons, & Larson, 2001), the Unit begins with an activity to foster students’ sense of gratitude. Research with both adults and children has found the practicing gratitude is related to a variety of well-being outcomes such as optimism, life satisfaction, and decreased negative affect (Froh et al., 2008). The next lesson of the *MindUp* curriculum has children engage in a discussion about the definition of kindness and then individually perform “acts of kindness” throughout the week in their classroom, at school, and at home. The final lesson focuses on having children “take mindful action in the world” by engaging in a service learning activity designed to benefit the larger community in which children work cooperatively to plan and then perform an act of kindness for their school or community. Afterward, children reflect on how they felt before, during, and after they performed the kind act. A full description of the program is available at Scholastic Books: <http://teacher.scholastic.com/products/mindup/>

Prior to implementation of the *MindUp* program, teachers underwent an intensive one-day training session wherein they were provided with information

about the theory and research guiding each unit and its lessons, and a curriculum manual in which lesson plans were explicitly delineated (Hawn Foundation, 2008). The training session also included interactive discussions on social and emotional learning, the developmental characteristics of children's social and emotional competence, and presentation of material through lecture, video and readings, and role-plays of curriculum instructional techniques. In addition, program teaches received a "booster session" midway through the implementation of the program conducted by the *MindUp* trainer. This session allowed an opportunity for instructors to share their experiences with each another, ask questions, and obtain assistance for any issues that they confronted with regard to program implementation. As a means of facilitating internal validity, all training was conducted by one of the program developers.

Social Responsibility Program

The social responsibility program that represented the business-as-usual comparison in this study was informed by guidelines and resources provided by British Columbia's (BC) Ministry of Education (see www.bced.gov.bc.ca/perf_stands/social_resp.htm). Since 2001, social responsibility has been identified as one of four performance standards considered to be "foundational" for students in BC (the other performance standards include reading, writing, and numeracy). The framework for BC's Social Responsibility Performance Standards includes a common set of expectations for the development of students along four categories: (1) contributing to classroom and school community (e.g., sharing responsibility for their social and physical environment); (2) solving

problems in peaceful ways (e.g., using effective problem-solving steps and strategies; (3) valuing diversity and defending human rights (e.g., treating others fairly and respectfully; showing a sense of ethics); and (4) practicing democratic rights and responsibilities (e.g., knowing and acting on rights and responsibilities [local, national, global])).

In the public school district in which the present study took place, the promotion of social responsibility had been identified as one of the district's goals. Accordingly, the full-time job of one of the district's administrators was to assist teachers in schools throughout the district in the implementation of programs and practices designed to promote students' social responsibility. Teachers in the study had received a minimum of three days of professional development by the District Social Responsibility coordinator at the start of the school year. The professional development included information about the performance standards for social responsibility that included ideas and strategies for promoting the four dimensions of social responsibility in the classroom and school community. Teachers introduced the performance standards to children and children participated in activities in which they either wrote or illustrated examples of each of the dimensions of social responsibility. For example, one activity would have children role play scenarios that illustrated students "solving problems in peaceful ways." Other examples included having teachers use books with themes of social responsibility and have students discuss the ways in which the characters of the book would be rated on the social responsibility standards.

The *MindUp* program and the social responsibility standards covered some of the same academic content (e.g., perspective-taking), but they differed in the extent to which students actually practiced the skills being taught. Unlike the *MindUp* curriculum, the social responsibility curriculum included no activities that promoted EF skills or the development of self-regulation skills through the practice of mindfulness. Additionally, there were no explicit activities in which children learned strategies to promote optimism or enact acts of kindness toward each other or to the larger school community. In the social responsibility classrooms, the focus of the curriculum was primarily teacher-imposed, and there were few activities in which students were expected to actually practice to develop their self-regulation or prosocial skills.

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