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Exploring School-Based Contemplative Neuroscience Practices with At-Risk Early Elementary Students

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Abstract

Increasing percentages of children are entering kindergarten with clinically significant attentional, social-emotional, and behavioral difficulties associated with trauma, attachment, and/or other developmental factors (Rosen, 2023). These difficulties interfere with self-regulation and meaningful engagement in school. Without more intensive treatment during the early elementary years, many of these children will likely experience deleterious outcomes.

Integrated Multi-Tiered Systems of Support (I-MTSS) have become a widely adopted, comprehensive service delivery framework in schools for enhancing academic, social-emotional, and behavioral outcomes (National Center on Intensive Intervention, 2021). However, despite decades of I-MTSS training and technical assistance, system, grade, and student level outcomes have remained relatively stagnant. Therefore, it is critical that the extensive body of knowledge and empirical support associated with contemplative neuroscience make its way into I-MTSS models and the hands of school-based practitioners.

Importantly, neuroscientific findings related to neuroplasticity and mind-body connectedness have shown that contemplative practices strengthen the neural networks associated with positive mental health (Luberto et al., 2018). Given the heightened advantage of neuroplasticity during early childhood development, practices such as breathing, stretching, and gratitude play a salient role in helping at-risk children cultivate improved levels of self-regulation toward resiliency (Fandakova & Hartley, 2020). This paper will explore the critical role of contemplative neuroscience within early elementary school-based prevention

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efforts. Further studies are needed to inform the impact of mindfulness intervention relative to the development of self-regulation and resilience during earlier stages of neural development.

Keywords: mindfulness, contemplative, neuroscience, at-risk, self-regulation, resilience

Exploring School-Based Contemplative Neuroscience Practices with At-Risk Early Elementary Students

There is an urgent need for the application of contemplative neuroscience within school-based prevention and intervention for young at-risk children. It is estimated worldwide that 6.81% of young children (ages 5-9) have a diagnosable mental disorder (e.g., anxiety disorders, attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder, bipolar disorder, conduct disorder, depressive disorders, eating disorders, intellectual disability, schizophrenia, etc.) and the prevalence increases to 20% by early adolescence (Kieling et al., 2024). In addition, epidemiological data indicate that exposure to trauma is pervasive among children and adolescents in the United States, and 66% of children will experience a traumatic event before they graduate from high school (Crouch et al., 2023).

Too many young children with the aforementioned predispositions and/or exposure do not have access to the evidence-based supports and conditions that are needed to foster long-term resilience and well-being. While schools continue to do their best to mobilize increasingly intensive evidence-based academic and behavioral supports and services for at-risk children and adolescents, long-term difficulties and maladaptive outcomes have persisted and given rise to school-based mindfulness intervention as a viable alternative to the status quo.

There is much to be learned about the pivotal role that educators might play in helping young children mitigate risk via school-based contemplative practices. Contemplative or mindfulness practices are commonly referred to as "mind-body" activities that include but are not limited to meditation, gratitude, compassion, yoga, journaling, dance, etc. When used with fidelity that includes consistency in exposure, intensity, and practice, mindfulness intervention serves to strengthen neural systems associated with the development of self-awareness, self-regulation, and ultimately resiliency and equanimity (Davidson & Dahl, 2017). Neuroscientific findings have shown that the underlying neural networks that support the development of self-awareness are malleable following mindfulness practice (Berkovich-Ohana et al., 2019). Therefore, the potential for interdisciplinary empirical investigation during the primary years could have profound implications for helping practitioners, as well as families, harness the art and science of their young child's journey to toward a permanent state of well-being.

Emergence of Contemplative Neuroscience

Over the course of hundreds of years, neuroscience has made significant efforts to understand the human brain and the biological foundations of behavior. Behavioral neuroscience or biopsychology is a sub-field that emerged from neuroscience and is concerned with the empirical study of the relationship between internal and external behavior and the role of the brain (Garrett & Hough, 2021). Behavioral neuroscience has focused on the role of neural networks in mental processes such as thinking, memory, emotion, and consciousness. There is now an understanding that these more complex mental processes are a result of synergistic activity within and among the frontal polar cortex, parietal lobe, cingulate gyrus, and insular cortex (Garrett & Hough, 2021). These four parts of the brain map to a combination of more complex mental processes referred to as meta-awareness.

Meta-awareness is the state of deliberatively attending to the contents of conscious experience, whereby an individual experiences whatever is occupying their minds. Chin and Schooler (2009) described meta-awareness as a third level of consciousness in which consciousness itself is used to appraise an experience. Meta-awareness is a state that can result in enhanced learning, just as easily as it can lead to mind-wandering. The discovery of meta-awareness by neuroscience is considered to be a hallmark of human phenomenology, because we now know that most individuals are capable of controlling and directing their thoughts and behavior, including children, when provided with appropriate levels of conditional training, support, and practice (Sandved-Smith et al., 2021).

Mindfulness meditation is typically described as non-judgmental attention to experiences in the present moment and necessitates the ability to maintain focus on the immediate experience of thoughts, feelings, body posture and sensations, etc. (Kabat-Zinn, 2023). Meta-awareness or the ability to control one's thoughts and feelings, develops through the process of enhanced self-regulation, attentional control, emotional regulation, and ultimately alterations in self-awareness (Lutz et al., 2013). According to the Center for Investigating Healthy Minds, there may be different styles of meditation and alterations that impact the aforementioned cognitive processes which is of particular salience when working with young children. Quaglia's Tricolor Model (n.d.) also suggests that there may a wide range of developmentally appropriate activities that can foster attention, intention, and compassion toward self-regulation and awareness. (https://www.jordanquaglia.com/tricolormodel).

As indicated, longitudinal studies and related syntheses have shown that contemplative practices are a path or process for acquiring meta-awareness and the attentional processes necessary for optimal levels of functioning and well-being (Laughlin, 2020). Meta-awareness and increasing levels of self-awareness are associated with decentering and a subsequent decrease in neuronal activity associated with self-centered behavior. According to Berkovich-Ohana, Jennings and Lavy (2019), contemplative practices foster momentary presence, embodied awareness, decentering, and emotional regulation. These are necessary states for young at-risk children to attain in light of their marked difficulties with attention, impulsivity, anxiety, hyperactivity, aggression, and other executive functioning weaknesses (Rosen, 2023). While children in the primary grades are still in the early stages of social-emotional learning, those who are at-risk may not acquire the ability to express and manage their feelings, take turns, and/or solve problems without school-based mindfulness intervention.

Epigenetics and Neural Plasticity in Early Childhood

The term epigenetics generally refers to changes to DNA that can turn genes on or off without changing the DNA sequence. Neuroscience has established that environmental influences serve to alter gene activity, so while genes produce predisposition, the environment determines the outcome (Garrett & Hough, 2021). Epigenetics has given rise to the investigation of contemplative practices with at-risk young children who often possess heritable traits associated with Attention-Deficit Hyperactivity Disorder (ADHD), learning disabilities,

temperament, and behavioral health disorders. Epigenetic research indicates that use of contemplative practices may substantially reduce and/or mitigate risk completely by influencing gene activity (Goldston & Baillie, 2008).

Neuroscience has also informed understanding of the brain's plasticity or ability to undergo morphological and neurochemical changes as a result of experience (Weyandt et al., 2020). Doidge (2015) defined neuroplasticity as "that property of the brain that allows it to change its structure and function in response to mental experience and activity" (p. 349). The brain is an organ that is designed to develop, change, and evolve as a function of experience. Therefore, neuroplasticity is always occurring regardless of whether an experience or behavior is novel or habitual in nature (Garrett & Hough, 2022). Even though it has been established that we can change our minds (mental plasticity), neuroscience has only recently discovered that the mind can trigger changes to neural tissue in the brain (neuroplasticity) (Doidge, 2015).

Further, neuroscience has established that the prefrontal cortex is necessary for neuroplasticity and adaptive and/or maladaptive functional and structural rewiring. In an exploratory study with advanced Alzheimer's patients, meta and self-awareness were explored with patients who solely remained indoors, in comparison to others who were immersed in an outdoor healing garden. The results showed a significant decrease in self-awareness for the indoor group versus the outdoor group. Sensory enrichment, familiarity, contact with nature, and supportive social interactions are associated with neuroplasticity, adaptive behavior, and a slowing of prefrontal cortex deterioration (Gueib et al., 2020). This is promising given that many at-risk young children exhibit co-morbid cognitive and related executive function deficiencies.

Neuroplasticity has also been captured through technologies such as electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) (Garrett & Hough, 2021). For example, these technologies have confirmed that reduced blood flow and activity in the prefrontal cortex is associated with inhibition of emotional reactivity and related activation patterns within the limbic system. Further, neuroscientific studies of normal and abnormal brain development, functioning, and related mechanisms have led to major advances in prevention and treatment of a wide variety of mental and physical disorders and diseases including autism, Alzheimer's disease, schizophrenia, addiction, etc. (Garrett & Hough, 2021).

As noted, there is an abundance of research that supports the brain's capacity for change as a function of interacting genetic, biological, environmental, and psychological variables. Cellular, morphological, structural, and functional changes can result in more or less adaptive functioning but do tend to decrease with age (Weyandt et al., 2020). Doidge's (2015) concept of "the plastic paradox" has helped to inform the nature of plasticity and has important implications for helping practitioners understand and shape the behavior of at-risk young children. As indicated, plasticity by nature lends itself to the development of both rigid or more adaptive and flexible behavior, and mindfulness intervention is associated with the latter. According to Doidge's (2015) research, mindfulness practices trigger the brain to change neural tissue in fundamental ways, and temper the activity in areas associated with maladaptive thoughts, feelings, and behaviors.

Rossi's (2002) seminal work related to hypnosis has helped to inform why mindfulness practices are so powerful. Mindfulness intervention usually includes the use of deep breathing to anchor awareness of thoughts, feelings, bodily sensations, and the outer world in the present moment. Through relaxation, attention, and intention, mindfulness practices set the stage for novel learning, because they facilitate a lowering of defenses. Meditation and hypnosis increase frontal cortex activity and associated emotional and cognitive receptivity and flexibility. Simultaneously, there is a reduction in activity in the anterior cingulate cortex (ACC), an area that is typically "on fire" with at-risk children (Doidge, 2015).

As indicated, the beauty of applying school-based contemplative neuroscience within the context of the primary years is that the young brain can display significantly greater levels of neuroplasticity than the adult brain (Kleim & Jones, 2008). Even in the face of epigenetic influences, mindfulness intervention that is implemented with relative levels of consistency and intensity, can facilitate structural and functional neuronal changes associated with positive mental health (Kleim & Jones, 2008). Further, school-based contemplative neuroscience may be used to help interdisciplinary teams of educators investigate whether certain mindfulness practices may be more effective in targeting the development of self-regulation and expediting a given child's road to cognitive, emotional, and behavioral recovery (Dahl et al., 2015).

Theoretical Support for Contemplative Practices

Contemplative practice is a pathway for helping young at-risk children acquire self-regulation and resilience. Neuro-endocrinology studies indicate that the development of morality and/or higher states of consciousness and well-being are contingent upon the interlocking of brain processes associated with caring, connection, and attachment through social-conditioning and nurturing experiences (Churchland, 2015). Unfortunately, many at-risk young children have developed insecure attachments and/or have been affected by trauma. If at-risk children are not taught effective coping mechanisms within the context of supportive attachments and conditions, their nervous systems will remain dysregulated and on high alert (Rosen, 2023). Contemplative practices offer opportunities for engagement in carefully designed sensory experiences that elicit feelings of connectedness, compassion, and love. Specifically, compassion and loving-kindness meditation and gentle yoga have been found to strengthen the activation of brain circuits linked to empathy and vagal tone enhancement that result in inner states of calm and repair (Sivilli & Pace, 2015).

As mentioned, without sufficient exposure to evidence-based practices, it will be difficult to help at-risk children acquire self-regulation toward states of resilience and equanimity. Resilience is commonly defined as the ability to flexibly respond, bounce back, and/or adapt quickly to emotionally charging situations and experiences (Bockmann & Yu, 2022). As such, resiliency requires a constellation of complex skills such as self-awareness, meta-cognition, and the ability to recognize a negative response to a situation and readily change it.

The assessment of resilience as a related byproduct of self-awareness and regulation should be considered within school-based contemplative neuroscience. Because resilience represents an enduring mind-body state of calmness, acceptance, and effortlessness, it can be measured over

time via changes in thinking, emotions, and rate of recovery from emotional and/or physiological stressors (Desbordes et al., 2014). In fact, skills related to resilience are embedded within evidence-based clinical practices such as Dialectical Behavioral Therapy (DBT) and Mindfulness-Based Cognitive Therapy (MBCT). Variations of these therapies have been used effectively with young children to reduce anxiety and depressive symptoms through incorporation of relaxation techniques (e.g., deep breathing, muscle relaxation, guided imagery, etc.) and coping strategies (Salloum et al., 2016).

Similarly, school-based practitioners may be uniquely poised to look for these primary signatures of developing states of meta-awareness and resilience via reduced attention-seeking behavior and impulsivity, increased wait time, and the ability to more easily accept adult and/or peer feedback without a negative emotional reaction. In addition, at-risk children may exhibit an increase in kind and caring classroom behaviors and reduced states of excitability, self-centeredness, and shorter refractory periods. Further, self-regulation and resilience are associated with changes in heart and breathing rates, as a result of increased parasympathetic activation (Benson, 1975).

As indicated, mindfulness intervention is a pathway for the development of emotional regulation strategies through relaxation, identification of feelings, visualization, and cognitive and sensory processing (Dorsey et al., 2017). In comparison to clinical treatment options, at-risk children can be afforded regular accessibility to free, secular, developmentally appropriate, and nurturing activities and realize more positive trajectories within a relatively short period of time.

Status of School-Based Mindfulness Intervention with Young Children

While school-based mindful intervention is growing in popularity, there is a need to continue to explore its efficacy with young children. In general, meta-analyses of mindfulness intervention with very young children indicate that those who are at-risk realize the most significant and sustained changes to self-regulation within as little as 6-8 weeks of mindfulness intervention (Bockmann & Yu, 2022). Dunning et al., (2019) conducted a meta-analysis of randomized controlled trials and found that children and adolescents in the treatment groups realized significant reductions in symptoms related to anxiety and depression. Similarly, a comprehensive meta-analysis of effects with pre-adolescent children (ages 6-12) showed significant improvement in attention, emotional and behavioral regulation, positive emotion, self-appraisal, and prosocial behavior (Kander et al., 2024).

Mindfulness intervention has also been associated with reduced stress, better immune function, and improved performance on measures of executive function (Davidson et al., 2003). Neuroscience has also shown that mindfulness intervention reduces levels of activity in the anterior cingulate cortex (ACC) and increases frontal cortex activity that reduces and/or suppresses maladaptive thoughts, emotions, and behaviors (Doidge, 2015). Contemplative neuroscience continues to investigate how processes of reflection and self-regulation are made possible by neural circuits that coordinate hierarchically in regions of the prefrontal cortex (O'Reilly, 2010). Given that selective attention, working memory, and goal-directed behavior

influence the neurodevelopment of self-regulation, it has been hypothesized that mindfulness intervention may serve to "fast forward" the development of a young child's reflective reprocessing skills (Zelazo, Chandler & Crone, 2021).

The Mind Up Program *(https://mindup.org/)* is a secular, evidence-based mindfulness program that has been deemed effective with early elementary children (Schonert-Reichl et al., 2015). According to efficacy studies, surveys were used to track lesson delivery, student engagement during lessons, and student engagement in core breathing practices in their classrooms. Teachers and parents also completed pre-post assessments associated with receptive vocabulary and students' executive functioning skills (i.e., inhibition, emotional control, ability to shift, working memory, and planning/organization. At the end of the first year, pre-kindergarten students showed improvements in teacher-reported executive function, particularly related to working memory, planning and organizing, and comparison students showed a decline in executive function. While there were no differences between the treatment and comparison group's receptive vocabulary over the course of their pre-kindergarten year, the treatment group had higher vocabulary and reading scores by the end of their kindergarten year (Thierry et al., 2016).

Story-telling and listening may constitute another form of contemplative practice that enhances well-being (Haim et al., 2004). Story books have been associated with improved self-regulation and stress control skills. Children reportedly learn strategies to regulate their emotions, behavior, and attention through self-authored responses to stories and can develop enhanced self-regulation skills and resiliency as early as age four (Tillot et al., 2024). Further, story-telling and listening resulted in co-regulation or the ability of the body to mimic that of others. Heart rates of children have been found to synchronize while listening to stories, and those with higher levels of synchronization have demonstrated increased proficiency on story recall tasks (Tillot et al., 2024).

According to Balconi, Fronda, and Vanutelli (2019), daily gratitude practice is another form of mindfulness intervention that fosters mental, physical, and social well-being. The consistent expression of gratitude has been associated with increased cooperation, improved mood, and sleep quality. Gratitude practice decreases symptoms associated with depression and anxiety, blood pressure, and inflammation and serve to strengthen the neural pathways associated with positive emotions (Emmons & McCullough, 2003; Chowdhury, 2024).

Practical Application of School-Based Contemplative Neuroscience

Because the brain and body are so interconnected, a neurophenomenological approach is needed to bring what is known about cognition, neurobiology, and experience together to better capture and understand the power of mindfulness with at-risk young children (Varela, 2010). Ideally, school leadership teams that include community and family members would explore perspectives and attitudes toward school-based mindfulness practices. School practitioners and families may benefit from conjoint training and direct experience with mindfulness practices before they are implemented with children.

In order to apply contemplative neuroscience within an early elementary setting, it is necessary to provide training in foundational neuroscience and mindfulness concepts. It is also recommended that school-based practitioners use validated secular mindfulness practices and/or established protocols. In addition, educators who engage in their own contemplative practice for a reasonable period of time will be much better positioned to implement mindfulness intervention with fidelity. Further, in order to qualify and quantify a child's responsiveness to intervention, Laughlin (2020) noted how critical it is for third party investigators (classroom teachers) to prioritize and develop their own contemplative attitudes and practices. While the majority of people do not meet the criteria associated with a mature contemplative, a minimum level of training and experience, such as 6-8 weeks of group-based mindfulness meditation, has been deemed necessary (Laughlin, 2020).

School-based mindfulness intervention for children may include 5-10 minutes of daily morning guided mindfulness practices (e.g., breathing, movement, relaxation, and focusing techniques) and a 5-minute gratitude practice in the afternoon. On gratitude days, students may each have one minute to share or draw something that they are thankful for and add it to a classroom gratitude tree or bulletin board.

Outcome Measures

Pre-post outcomes for at-risk young children may be assessed using a multi-method approach that includes physiological measurements, direct observation, parent and teacher rating scales, teacher interviews, and performance-based assessments. A combination of qualitative and quantitative data will be used to gain neurophenomenological insights into mindfulness intervention during early childhood.

Performance-Based Measures

Research has indicated that the development of attentional processes is significant during the 3.5-6-year-old age window and that mindfulness intervention enhances the development of meta-awareness and attention (Kim et al., 2023). Performance-based methods for measurement of attention for preschool and kindergarten students have been developed to address most of the salient components of attention including sustained attention, selective (focused) attention, span of attention (encoding/maintaining), and top-down controlled attention, including freedom from distractibility and set-shifting. The NEPSY® Second Edition (Korkman et al., 2007) is an example of a reliable and valid measure for assessment related to the various components of attention, including visual selective attention (e.g., cancellation tests), motor persistence, and encoding, working memory, and auditory/visual attention span (e.g., digit and spatial span tests) and will be conducted twice with at-risk kindergarten students using a pre-post format.

In addition, most schools conduct universal screening in reading, mathematics, and behavior. School-based teams would be in a position to assess academic and behavioral indices using standardized benchmark and progress-monitoring measures.

Teacher and Parent Rating Scales

A variety of teacher and parent rating scales may also be considered to investigate the development and generalization of behaviors associated with self-regulation and resilience as a function of mindfulness intervention. For example, the Child Behavior Checklist Parent and Teacher Rating Scales (CBCL; Achenbach, 1991) is a component of the Achenbach System of Empirically Based Assessment (ASEBA) and used to detect behavioral and emotional problems in children and adolescents. The CBCL may be used to inform changes in attention and emotional and behavioral regulation using pre-post parent and teacher ratings. A related benefit of use of a rating scale like the CBCL is that the severity of inattention symptoms can be directly compared to "typical" attention problems observed in this age range and used to distinguish clinically significant attentional problems from other cognitive and behavioral issues.

Parents may also complete pre-post ratings of self-regulation development using the Early Emotion Regulation Behavior Questionnaire (EERBQ) (Perry & Dollar, 2021). This questionnaire was designed to investigate the emergence of maladaptive regulatory behaviors prior to the onset of psychological and behavioral disorders among children at-risk, as well as capture specific behavioral components of early emotional regulation and change over time with young children.

Parents of at-risk children may also complete the Child and Adolescent Trauma Screen (CATS) Caregiver-Report (3-6 Years) using a pre-post format. This screener corresponds with post-traumatic stress disorder (PTSD) symptom criteria within the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). The 15-minute interview format is appropriate for use with caregivers of younger children and measures traumatic events, symptoms, and psychosocial functioning. In addition, children may identify their feelings following mindfulness intervention by circling a smiley, neutral, or sad face and briefly explain why they circled a given emotion.

Mindfulness Inventory and Interviews

Teachers and related service providers who are facilitating mindfulness-based intervention may complete the Freiburg Mindfulness Inventory (FMI-1) (Sauer et al., 2011) to assess ongoing attitudes toward mindfulness intervention implementation with interview questions designed to assess teacher thoughts and feelings related to daily intervention practices, associated tasks, difficulties encountered, observations of their own practice and development, and the perceived impact on at-risk students and overall classroom climate. Qualitative analyses of teacher responses may be conducted to determine if there were common perceptions, themes, and/or experiences, as well as any observations that were not reported among the majority of interviewees over time.

Attendance and Physiological Data

School-based practitioners may also consider monitoring weekly student attendance, blood pressure, and heart rate. The aforementioned qualitative and quantitative measures may be

used to assess the effects of mindfulness intervention on the development of self-regulation and resilience. It is recommended that a school-based team comprised of a school psychologist with a background in neuropsychology work together with families to administer and interpret classroom observations, academic and attentional performance-based measures, interviews, parent and teacher rating scales, attendance, and physiological data.

Conclusion

Schools are social learning institutions that continue the enculturation process with children, as they learn and grow in response to their experiences and environment (Laughlin, 2020). A young child's capacity for brain development and functioning is contingent upon these interactions or enculturation, especially for children who enter their early elementary years with measured degrees of cognitive, emotional, and behavioral risk.

One of the major difficulties with neurophenomenological research in schools is finding adults who have consistently engaged in mindfulness practice over a long period of time and have experienced their own mind-body awareness and well-being. Ultimately, the formation of a school-based interdisciplinary implementation team (i.e., school psychologist, school counselor/social worker, classroom teachers, family members, and school nurse) and reliance upon a combination of quantitative and qualitative methods may elucidate how to better support at-risk children with development of self-regulation and resilience, given that these traits represent a more permanent and positive change in overall patterns of cognitive, social-emotional, and behavioral functioning and thus well-being.

Research suggests that current prevention and intervention practices commonly used by school-based practitioners are not having the desired or necessary impact. Interdisciplinary teams may benefit from training in contemplative neuroscience and consideration of mindfulness practices that have been shown to systematically improve mental and physical health. Given the current dearth of evidence related to mindfulness intervention during the early elementary years, there is a need to scientifically investigate the power of these practices during this critical window of neural development. School-based, interdisciplinary teams are well-positioned to champion and implement mindfulness practices and related conditions associated with enduring and positive mental health blueprints.

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