Physical Intelligence (PQ)

An early childhood development approach for optimizing Cognitive (IQ) and Emotional Intelligence (EQ)

Theory developed by

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INTRODUCTION

Parents hope to bring up happy, well-adjusted children with the skills and traits to become successful adults. Society depends on it.

Increasingly, this is not the case. Alarming trends in developmental and social-emotional delays, disruptive behaviors and mental illness, indicate a need to reevaluate factors contributing to such conditions. We must reimagine ways to optimize whole-child health as early as possible.

The PQ Theory asserts that early physical movement patterns, experienced in progression and paired with caregiver attunement and proper nutrition, can alter a child's brain development in ways that increase foundational traits for life success; namely, self-awareness, self-regulation, and self-agency. Moreover, these traits help children mitigate the effects of exposure to adverse childhood experiences (ACEs); thereby making early movement an effective prevention and treatment modality for addressing exposure to childhood trauma.

Most people are aware of cognitive intelligence (IQ) and the concept of emotional intelligence (EQ). This paper presents a theory of *Physical Intelligence (PQ)*; not merely a stand-alone element of human intelligence but *as a necessary foundation and precursor for IQ and EQ*. **PQ is physical intelligence gained via mindful movement patterns that mold essential neural circuitry.** Put simply, to a large extent, a person's PQ will determine their IQ and EQ. Movement is imperative for self-agency, emotional resilience, academic and career performance, and healthy relationships with oneself and others. Considering the prime window of brain

development in children occurs within the first three years of life, this is the critical time to apply movement-based interventions for optimal development.

This paper outlines two key developmental milestones tied to physical movement, which, if missed during the earliest years of life, affect a person's ability to learn and manage emotions. These two milestones are: 1) integration of primitive reflexes and 2) development of the vestibular system. Together, these developmental factors determine the extent of sensory integration and organization; foundational elements for a healthy nervous system and, subsequently, for attainment of self-awareness, self-regulation and self-agency.

Starting in utero, an infant's volitional movement patterns, and even the mother's activities, begin to shape the child's brain structure and function that later determine his or her level of physical coordination and social-emotional resilience. When this development is delayed or disrupted, early intervention is key. This theory proposes that targeted and consistent early movement activities can remediate developmental delays and the impacts of trauma exposure, placing children on a trajectory for physical, emotional and academic success.

BACKGROUND

It has long been established that physical activity is beneficial for a healthy body and mind. Physical activity strengthens bones, muscles and immune function. Regular bouts of exercise support weight management, improved sleep, mood and energy levels. Research clearly shows that certain types of physical activity stimulate growth of new nerve cells, capillary networks, and mitochondria, the body's energy-producing structures. One often overlooked aspect is the significant role physical activity plays in enhancing brain function. According to Voss et al., "physical activity promotes the release of neurotransmitters such as serotonin, dopamine, and norepinephrine, which are crucial for mood regulation and cognitive function" (2013). Author and Harvard Professor, Dr. John Ratey, states that regular physical activity does more than benefit the cardiovascular and musculoskeletal systems of the body, impacting the structure and function of the brain, fostering neuroplasticity, neurogenesis, and improved cognitive function across the lifespan (Ratey & Loehr, 2011).

Recent research around mind-body movement practices, such as yoga, illustrates the top-down and bottom-up interplay between movement, breath, interoception, emotional regulation and mental health. Findings indicate that the integration of thought with movement enhances self-awareness, activating the interoceptive sensory system. This type of awareness plays a role in how we interpret and respond to emotional states, as interoceptive signals are often linked with feelings of stress, anxiety, and relaxation. Mindful breathing practices provide similar benefits, facilitating a shift from the sympathetic nervous system "fight-or-flight" response to stress, to the parasympathetic "rest-and-digest" response. The mechanism for this shift involves activation of the vagus nerve. In a review of the positive impacts of yoga and its activation of the vagus nerve, Sullivan et al state, "This work will contribute to yoga therapy being understood as a distinct healthcare profession which benefits physiological, psychological and behavioral well-being for diverse patient populations through the cultivation of self-regulatory skills, resilience and eudaimonic well-being. (Sullivan et al, 2018). This knowledge is beginning to be applied in some settings among adult and child populations; however, little mainstream application is occurring.

The stress-reducing benefits of mindful movement and breath practices presents a significant opportunity for using movement as a therapeutic approach in mental health treatment. The physiological benefits of reduced stress and enhanced self-awareness are essential for effectively regulating emotional states. This is the foundation for Emotional Intelligence (EQ).

An increasing body of research highlights the role emotional intelligence (EQ) plays in achieving positive life outcomes. Numerous books and journal articles indicate that EQ plays a significant role in academic and work performance, as well as improved health and social well-being. An article by Mayer, et al, characterizes emotional intelligence as "a predictor of significant outcomes across diverse samples in a number of real-world domains. It predicts social relations, workplace performance, and mental and physical well-being" (2008).

PROBLEM STATEMENT

Children are increasingly demonstrating significant physical, cognitive, and social-emotional disruptions. Today's kids engage in less play and are more sedentary than previous generations.

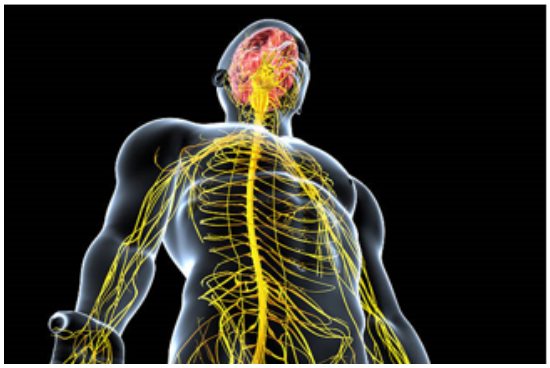
Exposure to environmental toxins, traumatic experiences and poor nutrition combined with the lack of physical activity increasingly contribute to the development of disordered nervous systems in children, and the general population. “Children are increasingly presenting with symptoms tied to ADHD, sensory integration and autism spectrum disorders. Mental health conditions among children are at alarming rates” (Visser et al., 2014).

Recent research emphasizes that a “sedentary lifestyle, becoming common among children and adolescents in the contemporary world [18], is not only harmful for the metabolic aspect of their health [19] but could interfere with critical periods and have an influence on motor development and central vestibular connections and impact cognitive functions. Moreover, it could cause changes in genetic material that could be passed from generation to generation [20–22], (Božanić et al, 2023). Additionally, devices that “containerize” children further disrupt developmental opportunities afforded by natural movement patterns. To develop properly, children must move in repetitive patterns that send signals from the inner ear to the brain. Research is clear that the ideal window for such movement-based approaches occurs during the first years of life, before a child even reaches school-age. This is because the neuroplasticity of the brain is highest during the earliest stages of development, with 90% of the brain formed by age six (Brown & Jennigan, 2012). Thus, the importance of educating parents about these critical developmental milestones and the role they can play in helping their child reach them.

One can argue that social media, screen time in general, socio-economic inequities and other social issues play a role in the current state of childhood development. An argument can also be made that children who are more resilient, who have the ability to adapt to and bounce back from adversity, fare better than their counterparts despite many of these factors. The question then becomes, under which conditions does resilience develop?

One’s level of adaptability and capacity for self-regulation in response to stress depend to a large extent on the function of the central nervous system (CNS); the brain, spinal cord and nerves responsible for processing and transmitting information throughout the body. The development of a healthy CNS is a complex process, beginning in utero, reliant on proper nutrition, movement, caregiver attunement and perceptions of safety.

The Central Nervous System receives and communicates information between the brain, body and its organs.



Controls most of the body's functions, including:

- Awareness
- Sensations
- Movement
- Thinking
- Memory

Communication and regulation between physiological and emotional sensations and the brain rely on proper functioning and organization of sensory sensations, including visual, auditory, proprioceptive, interoceptive and tactile. According to Godoy et al, "We are able to adapt to the dynamic and challenging environment we live in, as well as to unexpected life events," thanks to brain areas that integrate "sensorial, physiological and emotional signs" (2018). These processes are increasingly out-of-sync during the formative years of brain development, contributing to an increase in mental health disorders.

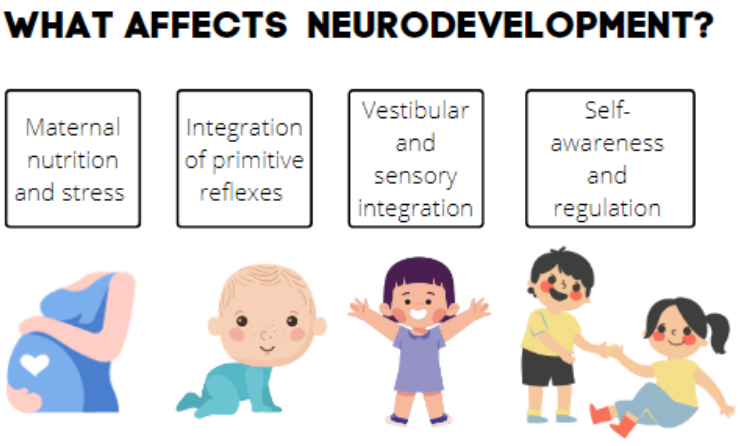
Chronic stress and trauma exposure activate the sympathetic nervous system (SNS), known for its role in initiating the fight-flight response to stress. When this becomes chronic, it results in functional changes to key areas in the brain, including suppression of executive function and a concomitant activation of the Hypothalamus-Pituitary-Adrenal (HPA) axis, as described by Godoy et al. Diaphragmatic breathing practices, mind-body activities and other forms of exercise, along with various types of therapy and even nutrition have been shown to mitigate many of these effects. However, these approaches are not mainstream and generally not implemented until well into adulthood.

The underlying drivers of a disordered CNS are not generally considered, nor are there standardized nonpharmacological treatments for mental health conditions and trauma in young children. Renowned physician and researcher, Vincent Feilitti, brought to light the lifelong health impacts of early adverse childhood experiences, commonly referred to as ACEs (2009).

This research has prompted more universal screening for and awareness of ACEs. Unfortunately, there is little understanding of effective treatment for the impacts caused by ACEs. To date, the majority of efforts have centered on reducing the incidence of trauma exposure. While this is both necessary and laudable, it is also difficult to implement. With the knowledge that attunement, nutrition and movement experiences build resilience by rewiring and organizing sensory systems of the brain, it is imperative that early childhood interventions and environments include these key components.

This paper argues that the organization of the central nervous system is dependent, in large part, upon specific movement patterns which, when performed in sequence during the earliest stages of development, set the stage for a more organized and resilient nervous system. "Early experiences, including simple activities such as sensory stimulation and motor play, have a profound impact on the organization and wiring of the central nervous system. These formative activities help shape neural connections and contribute to the development of cognitive and motor skills, fundamentally influencing brain architecture" (Shonkoff & Phillips, 2000).

During infancy, “tummy time,” rolling and crawling help integrate primitive reflexes and strengthen the vestibular system; which as stated earlier, are foundational for a well-functioning nervous system. Early movement patterns integrate and organize the CNS, influencing development of the auditory, visual, tactile and proprioceptive sensory systems. These processes determine a child’s: 1) physical coordination, 2) ability to learn to read and write, and 3) capacity to recognize and regulate emotional states and behavior.



We move to learn.

So, we must learn to move.

APPROACH

SHARED PATHWAYS FOR MOVING & LEARNING

Discoveries in brain research during the 1960's have led to more recent research findings regarding how physical movement affects brain development. While current brain research has shown that the brain's neural pathways are "plastic" and can therefore be modified throughout a person's life, there is an optimal window for this change to occur. During the first three years of a child's life, sensory and movement experiences have a significant impact on future learning (Kolb & Gibb, 2011; Shonkoff & Phillips, 2000).

According to an established body of research, development of motor and cognitive functions begin early and occur through specific, shared brain structures, including the dorsolateral prefrontal cortex and the neo cerebellum (Diamond, 2000; Hannaford, 1995; Heineman et al., 2018). This association is recognized by the U.S. Department of Health & Human Services Head Start **"I am moving, I am learning"** preschool curriculum. All parents, care providers and educators must understand the importance of early movement experiences for cognitive development. Furthermore, all environments in which children develop must prioritize movement opportunities from the earliest age possible to optimize these benefits.

Current cultural norms, care environments, and early childhood programs tend to focus on movement for fine and gross motor development, rather than its impact on the brain's architecture through motor function influence on cognition and self-regulation. With the latter in focus, targeted movement activities can be prescribed during those formative years to optimize cognitive and social capacity, in addition to fine and gross motor development. It is worth noting that, at the time of this publication, the U.S. Physical Activity Guidelines provide no guidance for physical activity prior to age three.

Established research and brain imaging studies support the role of the cerebellum and its involvement between movement and learning. Tasks which engage the prefrontal cortex of the brain (known for higher thinking) also engage the cerebellum (known for movement and balance), (Leppo et al., 2000; Diamond, 2000; Stevens-Smith, 2006).

For example, when a child is learning a dance or tumbling routine, they engage their prefrontal cortex to organize and plan the motor movements. At the same time, the cerebellum is actively engaged, directing the motor control necessary to carry out the physical movements of the activity. As the child practices the routine, the prefrontal cortex is involved in learning the cognitive aspects of the dance, while the cerebellum ensures that the body can physically execute the learned movements with coordination and fluidity. This demonstrates that physical movement patterns that engage the prefrontal cortex also engage the cerebellum and vice versa. This is significant in that interventions involving cognitive motor planning and volitional movement enhance executive function. These activities can be introduced well before a child is school aged, which can then enhance their ability to learn and manage behaviors later on.

Image Credit: https://www.familyeducation.com/toddlers/growth-development/physical/is-toddler-gymnastics-good-for-physical-development

Diamond (2000) also made the connection between motor coordination delays in children with learning challenges such as ADHD, dyslexia, and autism, and their concomitant cognitive and behavioral deficits. Learning difficulties, delayed motor skills, impulsive behavior, and agitation are some common behaviors in children with these developmental delays. Physical activities that integrate sensory stimuli and strengthen a child's vestibular system help to organize the nervous system, which helps reduce such behaviors.

IMPACTS OF TRAUMA

The sense of never feeling "comfortable in one's own skin," is often described by individuals with disordered sensory systems. The sensation of dysregulation is often a precursor to self-medicating with food, alcohol, and other substances, as well as cutting. Treatments for these disorders often involve behavior therapy or pharmacological approaches, which treat the

symptoms but not the underlying neurological wiring causing unpleasant physiological sensations. In *The Body Keeps the Score*, psychiatrist and author Bessel van der Kolk (2014) explores the role of physical activity and movement as a therapeutic approach to mental health, particularly in the context of trauma. He emphasizes the importance of engaging the body in healing and discusses various treatments that integrate physical activity, such as yoga and other forms of movement, as part of trauma recovery.

Highlighting the significance of physical activity in addressing mental health challenges, van der Kolk states, "When people are able to focus on their body and move, they can begin to reclaim their own sense of safety and agency. The body, after all, is the most direct connection to our sense of self, and physical exercises—whether yoga, dance, or other forms of physical activity—can provide a way to reconnect with the body and help process trauma."

Early exposure to optimal movement and nutrition can effectively mitigate symptoms of a disordered nervous system; facilitating increased behavioral regulation and ability to learn. For families and school systems, this is a game changer, reducing undesired behaviors. For the individual, it is life changing as brain structure and function are permanently altered in ways that build self-agency and resilience.

The takeaway here is that there is not one neurological network for movement and separate networks for learning and emotional regulation. They are one in the same; a shared network where regular exposure to movement stimuli functionally alters the brain networks involving self-awareness, learning and behavior. As practiced learning embeds neurological changes, consistently performed movement patterns also strengthen the neural pathways of the central nervous system that govern self-agency. Engagement in specific movement patterns during the earliest stages of brain development, cements neural pathways for later learning and emotional regulation.

SEQUENCE OF DEVELOPMENT: OPTIMAL WINDOWS FOR PHYSICAL MOVEMENT INTERVENTION

PRIMITIVE REFLEXES

In utero and within the first months of a child's life, primitive reflexes are key to healthy development. Primitive reflexes are survival-based, involuntary movement patterns such as the rooting reflex involved in infant feeding. These automatic reflexes are designed to become integrated, as the conditions for volitional movement patterns develop once the child is born.

A child's movement patterns during the first days, weeks and months of life are critical for integration of early primitive reflexes. Retention of early primitive reflexes can result in developmental differences and disordered sensory development, contributing to undesired neurobehavioral patterns throughout the lifespan (Melillo, 2011; Modrell & Tadi, 2023). As outlined in the chart below, the majority of primitive reflex integration occurs within the first year of life. Therefore, movement patterns that help to integrate primitive reflexes during this window of time are crucial for setting the stage for self-regulation, learning and motor control.

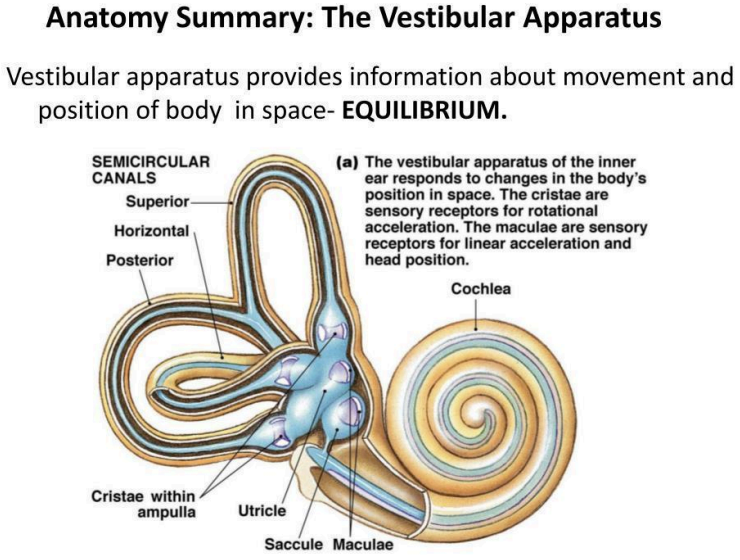
Primitive Reflex	Purpose of Reflex	Appears	Should Integrate By:	Signs of Retention
Moro Reflex	Primitive Fight or Flight Reaction	Birth	2 to 4 Months	Hyper Sensitivity, Hyper Reactivity, Poor Impulse Control, Sensory Overload, Social & Emotional Immaturity
Rooting Reflex	Automatic Response to Turn Towards Food	Birth	3 to 4 Months	Fussing Eating, Thumb Sucking, Dribbling, Speech and Articulation Problems
Palmer Reflex	Automatic Flexing of Fingers to Grab	Birth	5 to 6 Months	Difficulty with Fine Motor Skills, Poor Manual Dexterity, Messy Handwriting
ATNR	To Assist Baby Through Birth Canal and Develop Cross Pattern Movements	Birth	6 Months	Poor Eye-Hand Coordination, Difficulty with Handwriting, Trouble Crossing Vertical Mid-line, Poor Visual Tracking for Reading and Writing
Spinal Gallant Reflex	Assist Baby with Birth Process	Birth	3 to 9 Months	Unilateral or Bilateral Postural Issues, Fidgeting, Bedwetting, Poor Concentration, Poor Short Term Memory
TLR	Basis for Head Management and Postural Stability Using Major Muscle Groups	In Utero	3 1/2 Years	Poor Muscle Tone, Tendency to Walk on Toes, Poor Balance, Motion Sickness, Spatial Orientation Issues
Landau Reflex	Assist with Posture Development	4 to 5 Months	1 Year	Poor Motor Development
STNR	Preparation for Crawling	6 to 9 Months	9 to 11 Months	Tendency to Slump While Sitting, Poor Muscle Tone, Poor Eye-Hand Coordination, Inability to Sit Still and Concentrate

https://www.brainbalancecenters.com/blog/retained-primitive-reflexes-sign-brain-imbalance

VESTIBULAR SYSTEM

One of the earliest sensory systems of the body to develop is the vestibular system, which determines developmental outcomes such as: 1) balance and spatial awareness for motor coordination, 2) ocular-motor coordination essential for reading and writing, and 3) interoceptive awareness necessary for self-regulation and social-emotional skills. Childhood play involving spinning, swinging, jumping, rolling, and turning influences fluid movement of the inner ear, which then activates and strengthens neural pathways in the brain. Without proper vestibular development, children can experience learning and motor delays. These include "attentional deficits, reading problems, emotional dysregulation, weak memory skills, slow reflexes, lack of impulse control, and impaired or delayed writing skills" (Jensen, 2000). Stevens-Smith (2006) referred to the vestibular system as the "doorway to learning" because of the connection between balance and the visual and auditory systems of the body.

Development of the vestibular system is influenced by the movement of fluid in three semicircular canals of the inner ear, each with a unique orientation and thus, affected by three distinct forms of movement involving the head: front-to-back, side-to-side, and rotational movement (Wiener-Vacher et al, 2013). These movements send sensory signals to the brain about where the body is in space in relation to other objects and people, as well as how fast or slow they are moving relative to other factors.



https://image1.slideserve.com/2378670/anatomy-summary-the-vestibular-apparatus-l.jpg

Children presenting with weak vestibular function should be exposed to slow, repetitive movements of the head in three distinct orientations to strengthen the vestibular system and optimize related developmental outcomes.

Examples of movements that enhance spatial awareness and vestibular function include:

Front-to-Back: "Tummy time" (laying facedown in a prone position) facilitates an infant's head orientation and eye gaze moving from the floor to a lifted position.

Performed prone, supine or seated, this can be augmented by moving a toy up and down, encouraging eye-gaze tracking of the toy.

An example for an older child or adult would be the yoga activity called Forward Fold, in which the person looks up to the ceiling from a standing position and then bends at the waist to fold their torso over their legs, placing their gaze at or near their shins. Cat/Cow, Chataranga, Downward Facing Dog and Upward Facing Dog are other yoga movements that support this function.

Side-to-Side: Rocking is one of the simplest ways to help an infant move their head from side to side. In the book, *A Running Start,* author Rae Pica notes that people are aware that rocking a baby will soothe them. She goes on to say that "the vestibular system - the body's sense of movement and balance - conveys sensation calming the child. This motion and sensation also promote early brain development" (2006).

Taking ear to shoulder on one side and then the other, such as a neck stretch, is an activity that could be performed by older children and/or adults. Side Angle Pose in yoga is another activity that facilitates side-to-side orientation.

Rotational: From prone, seated or supine, have the infant move their head from left and right, encouraging eye gaze tracking of a favorite object. Blanket rolling an infant or having older children roll, (as shown in the image) are excellent ways to stimulate this vestibular function.

An activity from the ancient practice of Qigong, called “Owl Gazes Backward” is an activity that can be performed at any age of development. It can be integrated into preschool or elementary curricula where children are encouraged to “be like an owl,” keeping the body still and rotating only the head as if looking for a mouse.

It should be noted that these activities provide a dual benefit in that they serve to integrate primitive reflexes while also strengthening the vestibular system. It is important that these activities be performed slowly and with volitional intention in order for adaptations to occur in neuronal wiring. The “use it or lose it” principle also applies here. When activities are no longer performed, those neural pathways will recede.

While early childhood is the optimal window for integrating vestibular activities, these exercises strengthen the vestibular system throughout the lifespan. This applies to the aging brain, and is why states like Oregon have offered state-sponsored Qigong and Tai Chi: Moving for Better Balance programs as evidence-based interventions for fall risk reduction among older adults.

In the context of trauma recovery, as discussed by Bessel van der Kolk in *The Body Keeps the Score*, yoga poses like those mentioned above, which integrate physical movements with mindful awareness, can help individuals reconnect with their bodies. According to van der Kolk, this reconnection is an essential part of healing, especially when trauma has led to feelings of dissociation or emotional numbness. According to van der Kolk, the gentle movements help release stored tension, regulate the nervous system, and increase emotional resilience (2014).

The PQ theory argues that children who have stronger vestibular and central nervous system development, will have greater resilience and reduced impacts from trauma exposure. Where trauma or maldevelopment have occurred, the PQ theory posits that targeted movement patterns that strengthen vestibular function will soothe the nervous system, providing a remedy for problematic physiological and psychosomatic symptoms.

SENSORY INTEGRATION

It is critical to prioritize movements that strengthen the vestibular system. A child's auditory, visual, tactile and proprioceptive functions are dependent upon the development of the vestibular system (Božanić , 2023). If the CNS does not receive accurate information about movement, space, speed and position, the brain does not accurately process what is felt, seen and heard. Additionally, when information comes into the brain in a disorganized manner, it makes it difficult for the individual to respond in an appropriate and well-regulated manner. Aptly stated by van der Kolk, "People can never get better without knowing what they know and feeling what they feel" (2014).

EXECUTIVE FUNCTION

PQ Theory confirms that movement is necessary for optimal brain development, in particular, for development of Executive Function (EF), which contributes to academic, career, relationship and life success. According to research cited by Zelazo, et al., "EF measured in childhood predicts a wide range of important outcomes, including readiness for school (e.g., McClelland et al. 2007) and the successful transition to kindergarten (e.g., Blair and Razza 2007); school performance and social competence in adolescence (e.g., Mischel, Shoda, and Rodriguez 1989); better physical health; higher socioeconomic status (SES); and fewer drug-related problems and criminal convictions in adulthood (Moffitt et al. 2011), (2016).

Given the role executive function plays in the development of a resilient, well-adjusted person, we must examine how it is formed and advanced. Physical activities involving volitional motor planning, (e.g. an infant reaching for a toy, a toddler attempting to perform a somersault, a child or adult performing a martial arts kata or yoga poses,) are key to unlocking one's ability to

measurably increase EF. Free play in early childhood provides ample opportunities for such development. is is well-established that free play is a significantly less common experience among children in today's society.

It

Executive Function is required for:

Research cited by Diamond (2015) states that, while aerobic exercise alone showed little impact on EF, there were "very encouraging results for traditional martial arts [13]. Those randomly assigned to TaeKwonDo showed more improvement and better post-test scores than those randomly assigned to physical exercise on all dimensions of EFs studied (e.g., cognitive [focused vs. distractible] and affective [persevere vs. quit] and emotion regulation)."

Image Credit: https://www.ldamanitoba.org/executive-functioning

Diamond's research goes on to state that these impacts were more significant the younger the population in the study group. This outcome stands to reason, as neurogenesis and synaptic responsiveness to stimuli are highest during the first years of life, to a lesser degree into early adulthood, and significantly less throughout the remaining lifespan. Hence, the importance of young children and adolescents engaging in movement activities requiring thought for optimal development of EF.

As we learn more about how exposure to early trauma and adverse events impact brain development, we must consider intervention approaches with the greatest potential to mitigate those impacts. To develop a resilient mind and body, we must have a well-developed executive function that allows us to navigate emotions, avoid impulsive behaviors, manage stress and

problem solve. These traits are often unavailable to adults and children exposed to trauma due to the structural and functional changes acute and chronic stress cause in the nervous system. Trauma treatment, then, ideally includes physical movement activities requiring thinking and motor planning. This could include many different types of skills, from martial arts to mountaineering or from dance to disc golf. Exposing young children to a variety of movement opportunities and discovering what they most enjoy are key to effective long-term outcomes.

Brain development is sequential, dependent on ordered genetic and experiential influences. The integrity of this process depends "absolutely upon the availability of the right neural elements appearing at the appropriate moment in developmental time. Often the emergence of a new element depends upon developmental events that immediately precede its appearance (Stiles & Jernigan, 2010). Consistent movement experiences build the neural networks that "wire" changes to the central nervous system that facilitate one's capacity for organized, self-management. This includes appropriate integration of primitive reflexes and development of the vestibular system. If any of these stages are skipped or, as in the case of traumatic experiences, disrupted, it can result in a frustrating, disorganized and unsuccessful future.

Much of today's physical education is directed at addressing the increased prevalence of childhood obesity. It is important to note that a child's desire to move and learn new skills is directly correlated to their level of physical coordination and perceptions of safety when performing new movements. When early developmental milestones are missed, and sensory systems are out-of-sync, children are more likely to *avoid* movement. Requirements for movement beyond a child's skill or comfort level may lead to lifelong negative associations with physical activity. This may serve to exacerbate rates of obesity.

By ensuring the foundations that influence body awareness, sensory processing, and motor planning are in place at a young age, children are more likely to successfully demonstrate more advanced physical and social skills later on. These foundations significantly impact the child's sense of self-agency. When this happens, children are better equipped to pay attention, take in information through the ears and eyes, process that information in a more organized manner, and produce more controlled, more accurate responses to that information. Ultimately, this

improves learning and behavior. These factors will also lead to children being more engaged in sports, dance, play and other physical activities.

Movement patterns, performed with sufficient frequency and duration, functionally alter neural pathways. As previously outlined in this paper, the bottom-up and top-down interplay between the cerebellum (motor activity) and prefrontal cortex (thinking) influence EF. This includes inhibitory control to reduce impulsivity, enhanced working memory and increased cognitive flexibility needed for effective problem solving and self-management. In addition to increasing EF, these traits also contribute to one's EQ.

EMOTIONAL INTELLIGENCE (EQ)

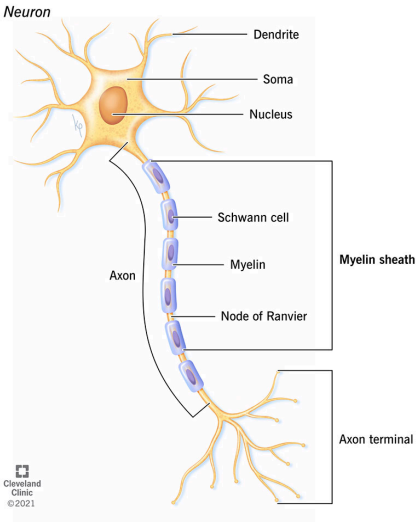
Just as the individual parts form the whole body, patterns of early movement form a child's sense of self. How a child understands where they begin and end as well as their relationship with others is determined by the aforementioned processes of development.

Proper development and integration of sensory systems allow the CNS to process and respond appropriately to stimuli, including stress and trauma. A well-functioning CNS provides the foundation for the components of Emotional Intelligence (EQ): Self-awareness, Self-regulation, Social skills, Empathy and Motivation.

Social-Emotional Learning is a core component of early childhood education. Emotional Intelligence and Empathy training are becoming common in professional settings. It must be recognized that the ability to recognize one's own emotional states and triggers provides the basis for these skills. Accurately feeling what the body feels and knowing how those feelings contribute to how our brain responds is only possible within a well-regulated CNS.

NUTRITION

The PQ theory maintains that movement is essential for the proper development and maintenance of CNS function. The CNS consists of neurons and operates through communication of nerve cells. Nerve cell communication relies on electrical impulses that travel along the axons of nerves. It is well-established that effective nerve cell communication depends on the myelin sheath insulating the axon. In this way, a well-myelinated nerve axon is like a super highway, upon which information can travel quickly and more reliably. Poorly myelinated axons are then like gravel roads, where signals may become weak and/or lost altogether.



Omega-3 fatty acids, particularly docosahexaenoic acid (DHA), are a critical component for the structure and function of myelin. A significant amount of research demonstrates that consumption of foods and/or supplements containing Omega-3 fatty acids positively impacts brain structure and function, including prevention of Alzheimer's Disease, (Thomas et al., 2015) and reduced risk for mental health disorders. As reported in *Nutrients*, "Evidence indicates that a low intake of marine omega-3s increases the risk for numerous mental health issues, including Attention Deficit Hyperactivity Disorder (ADHD), autism, bipolar disorder, depression and suicidal ideation," (DiNicolantonio & O'Keefe, 2020). Additionally, according to Innis, "sufficient evidence is available to conclude that maternal fatty acid nutrition is important to DHA transfer to the infant before and after birth, with short and long-term implications for neural function" (2008).

The clear message here is that movement experiences alone will not be sufficient in forming the neural circuitry of a well-functioning CNS without proper nutrition. Omega-3 fatty acids provide the necessary building blocks for "rewiring" the brain and nervous system. Neural plasticity—the brain's capacity to reorganize its function—relies on a combination of appropriate physical movement and nutrition.

LIMITATIONS

As this is a theory, the primary limitation is lack of research on the type, dose and frequency of physical activities for optimal brain development in children during the first three years of life. Rather than wait for such research, this author recommends that parents, caregivers and educators simply incorporate more movement activities into young children's daily routines, especially those that are known to help integrate primitive reflexes and strengthen the vestibular system, including free play. There are no contraindications for such actions and the potential benefits to individuals and society as a whole are immediate and substantial.

Additional limitations to this theory include the impacts of genetics, birth defects, the degree and frequency of trauma exposure, and parental/caregiver attunement. Finally, positive early childhood experiences, enriching environments and safe, sensory stimuli will further enhance the development of PQ, IQ and EQ.

CONCLUSION

In conclusion, the evidence presented underscores the critical importance of early physical movement in shaping a child's developmental trajectory, particularly in relation to emotional regulation, cognitive learning, and overall well-being. The integration of primitive reflexes and the development of the vestibular system are foundational to a healthy nervous system, which directly impacts a child's ability to navigate the challenges of life. These early milestones, when supported through appropriate movement, caregiver attunement, and nutrition, can help mitigate the negative effects of trauma and foster key traits such as self-awareness, self-regulation, and self-agency—traits that are essential for success in both personal and professional realms.

Given the growing prevalence of developmental delays and mental health challenges among children, it is imperative that we rethink current approaches to child development. Early intervention through movement-based strategies offers a promising and effective way to optimize a child's brain development and prepare them for a healthier, more resilient future. By

recognizing the importance of **Physical Intelligence (PQ)** as the cornerstone of both cognitive (IQ) and emotional intelligence (EQ), we can create a more holistic framework for nurturing well-rounded, capable individuals. With the first three years being so pivotal, now is the time to act, ensuring that every child has the opportunity to thrive through targeted physical movement interventions.

For more information about PQ Theory, and the inspiration behind it, visit www.PQinitiative.com.

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