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Developing the Brain Through Movement

by

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DEVELOPING THE BRAIN THROUGH MOVEMENT

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Abstract

Movement has long been seen as facilitating learning. Recent research in neuroplasticity tells us the brain is a dynamic organ capable of change and that movement can affect executive function. This paper proposes to explore the relationships between movement, motor function and executive function in typical primary children. The role of primary reflexes in motor function and executive function is examined. A research study is proposed. The purpose of the study is to find if a specific movement program can facilitate the integration of primary reflexes, thus aiding in motor function, and the affect this may have on executive functioning in children in the primary grades. Results could have implications in the early years for practices that may lay a strong foundation for healthy neurodevelopment, responsible for executive function such as reading and self-regulation.

Key Terms: neuroplasticity, movement, executive function, reading, self-regulation, motor function, primary reflexes, early years, learning.

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Dedication

This work is dedicated to my family: my husband, St. Clair and my children John Michael, Noah and Keegan who believed in me; and to my parents who valued education and made it possible for me to pursue my dreams. I am forever grateful for your love, encouragement and support.

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It does take a village!

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Chapter One

I step on to the water taxi in the dim light and slide onto a bench, thankful for the warmth coming from the heater under the seat. The boat carries me through the water, to a nearby island. I watch the morning come. It is not unusual to see seals and sea lions or bald eagles. Occasionally I may see a pod of orcas breaching the surface before retreating to the depths.

I have the good fortune to live on one of the Gulf Islands on Canada's west coast. I have been a primary teacher here for 15 years and along with my husband, have raised three boys. My position now is Primary Coordinator for our school district. One of my responsibilities is to support literacy primary classrooms. Teaching in these small communities, it is not uncommon to have multiage classrooms with 3 or 4 grade levels. Along with the joys of teaching these blended classes come challenges. As a passionate teacher and support teacher, I am curious to find out what makes learners successful and how can I effectively help children and my colleagues with some of these challenges.

Personal Relevance

My narrative continues on one of the tiny islands in our archipelago. The class I was visiting that morning on an outer island had a bright eyed eight year old who was so delighted to be at school that morning. This was Emma's third year at the school. She was a happy, friendly child who was a pleasure to be with. She had many friends and loved being at school. She participated enthusiastically in activities and loved to play.

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Emma wasn't yet reading and this was a concern for her teacher. She had had two and a half years of practicing alphabet letters and sounds, doing word work, being read to, looking at books and playing with literacy. Emma enjoyed the books, songs, games and rhymes. She loved school. But what was going on with her reading? She sometimes wasn't even sure of the letter names and sounds. Emma was in the 2nd half of her grade two year. Her teacher wanted to be sure she was doing everything she could to help Emma learn to read. The teacher noticed that Emma had difficulty sitting at circle time, sometimes lying on the floor or slouching at her table. On the playground, Emma was uncoordinated, often tripping and falling. Her teacher noticed that she sometimes had difficulty going down stairs one foot at a time.

Emma's teacher had called her parents in for a chat and mentioned her observations. The parents weren't the least bit concerned and called her fondly, 'our clumsy child'. We decided to enlist the help of the school district physiotherapist.

In my capacity as primary coordinator, I facilitate a reading inquiry group for primary teachers. We meet once a month to collaborate, share teaching practices, challenges and successes, resources, as well as read and discuss the recent research in reading instruction. Each teacher in our inquiry group chooses a student in his or her class to focus on, and change their practice in some way with that student in mind, but for all the students in the class with the understanding that all the children may benefit from the intervention. For example, one teacher chose to teach self-regulation strategies, another to build in a reading buddy program, another wanted

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to offer more choice to her students, still another wanted to work on self esteem with his students. Emma became the focus child for her teacher's inquiry.

Our school physiotherapist has many years experience working with young children with learning difficulties and is highly dedicated to her work. She believes that movement is the key to building strong neurological pathways that lay the foundation for learning. Working collaboratively our school physiotherapist, the early leaning coordinator, and Emma's teacher, we developed and implemented a movement program with Emma in mind. The teacher would practice specific, playful movement exercises with the class, for at least 10 minutes everyday at transition times, and in the gym. The whole class would participate in the movement program, with expectation that all the children would benefit.

Results were swift and surprising. Within a few months Emma's teacher reported that she was physically more coordinated. There were fewer spills on the playground and she was able to sit on the carpet and at her table for longer periods of time. Her coordination seemed to be quite improved. Moreover, Emma was reading! It had all come together for her. Emma was picking up books at her grade level, reading proficiently.

I was curious. What was going on here? Was it maturation? Was it just the right timing for Emma? Was it the movement program? Emma's teacher and her parents were both convinced that it was the movement program that had made the difference.

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When children are struggling with reading, grade 3 is the time they often get extra support. Our school physiotherapist has noticed that many of these children who struggle with cognitive learning show difficulties in motor skills as well. She has also found that some children show significant improvement after only 2 or 3 movement sessions. Teachers in our school district noticed this. They were interested in this idea of movement for cognitive remediation and wanted to know more. We decided it would be most beneficial to start with the kindergarten classes as we agreed that early intervention is most effective. Working together, our early learning coordinator, school district physiotherapist, kindergarten teachers, and myself, the primary coordinator, assessed the motor skills of children in five kindergarten classes we for evidence of retained primary reflexes. Our school district physiotherapist designed the assessment based on Goddard Blythe's *INPP Developmental Screening Test (2012)*. Kindergarten teachers attended a series of workshops on the theory behind this intervention and were taught a program of movement exercises. The physiotherapist followed up monthly to check in with the teachers, and to ensure consistency and accuracy in the teaching and implementation of the movement exercises. The exercises were playful and often taught to music. Teachers implemented the movements for 10 minutes a day to the whole class during gym time, at breaks, or during transitions. A follow up assessment was done at the end of the school year. The program went from September until June.

We found that the children did improve motor skills after the movement program, and that the children who scored highest on the pre-assessment showing

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motor difficulty and retained reflexes, improved the most. Teachers also reported improvement in academic skills and self-regulation. We did not have a control group, nor did we have any measure of academic achievement. Still, the kindergarten teachers believe the program made a difference. Teachers noticed that children had better motor coordination, were able to sit more calmly at circle time, and improved at cognitive tasks. Parents also reported positive changes, not only in movement coordination but also in their child's social and emotional maturity.

Our school district physiotherapist has found reflex integration therapy to be highly effective. She uses movement exercises to integrate aberrant primary reflexes, thereby building strong neuropathways. Primary teachers in our school district are very interested in her work and want to know more. Educational Assistants (SEAs) often work closely with our physiotherapist and are convinced this method works. The program seems to be successful, but with no control group, and no measurable link to academic gains, how can we be sure these results aren't due to maturation and/or the regular school curriculum?

I was skeptical but curious. After conversations with the physiotherapist and many anecdotal success stories, I decided to delve deeper. This idea of movement as an intervention to cognitive learning fascinated me. As a primary teacher, I had often chosen cognitive methods of intervention (practice, word work) when children were struggling with reading. I had not considered movement as an intervention strategy. Moreover, I wondered if movement in the early years could help with integration of these primary reflexes, facilitating cognitive learning, and helping to

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prevent future learning difficulties? This has become the focus of my capstone project.

Rationale

Neuroscientists agree there is a powerful connection between mind and body. It has been well documented that movement and cognition are interrelated (Diamond, 2000; Hannaford 1995; Jensen, 1998). Due to recent developments in neuroscience, the brain is no longer seen as static, but a dynamic organ with the ability to grow and change (Doidge, 2008). Movement is seen as an effective strategy to change the brain. Movement has been shown to improve cognition, improve memory and retrieval, and to enhance motivation and morale (Jensen, 2005; Ratey, 2008).

Recently, the burgeoning scientific area of neuroplasticity, once held firmly in the field of medicine has made a shift into the field of education. New information in the field of educational neuroscience is exploding.

With parental concerns, pushing children to get ahead, and a trend today in education toward a more traditional style of teaching focused on academic learning (Clements, 2000), many young children are spending more time sitting at desks working on pen and paper tasks rather than moving and playing. There are preschools that push formal learning on younger and younger children (Stipek, 2008). We hear of recess and physical education taken out of the school day to make room for more math, reading and science (Clements, 2000). More screen time means children spending more time at sedentary activities (Anderson, 2008). All this leads to less movement for children, and ironically, a potential problem for cognitive or academic learning.

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Many young children may not yet have the neurological maturity that enables them to be 'ready to learn'. An immature neurological system can take on many guises. Children who are unable to sit still for long periods of time, who have difficulty following directions, or with fine motor tasks, and children who are awkward or clumsy, may require more time before being ready for this kind of schooling. Moreover, children who struggle with behavioral and cognitive tasks in primary years may have neurological differences that may be remediated through movement.

Both Piaget (1952), and Vygotsky (Masgutova 2015), saw movement and reflex integration as a foundation to neural development. Goddard (2002) indicates that higher brain functions, such as literacy acquisition, are dependent on the successful earlier development of lower brain functions. The laying down of neural networks in the cortex and prefrontal cortex, essential for higher level cognition (such as reading) is influenced by how efficiently the brain stem deals with sensory input. Vestibular functioning, motor regulation, proprioception, and emotion all emerge from the brain stem. Without the full development of this lower brain, the higher brain works inefficiently. Children can still learn, but it takes more effort.

Expectations of children in the early years of school, for example; sitting still, paying attention, or tracking a line of print from left to right, and pencil and paper tasks, may be unrealistic for these children. Neurological differences can affect the child's ability to learn.

The primitive and postural reflexes form the foundation of pathways that support efficient brain highways that lead to more complex learning. These reflexes begin

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very early on in infant brain development (Piaget, 1952) and emerge in a particular order and time in the child's development. Primitive reflexes emerge in utero. The Moro, or startle reflex, the Palmar or grasping reflex, rooting and sucking reflexes are also known as survival reflexes. The Galant and ATNR (Asymmetrical Tonic Neck Reflex) assist in and reinforce the birth process. These primitive reflexes are usually integrated in the first years of life, allowing for the development of more complex neurostructures. It was once thought that these primitive reflexes disappear. Neuroscientists now believe that they become integrated, laying the foundation for more complex neuropathways (Goddard, 2002; Masgutova, 2010).

Postural reflexes are built on the foundation of these integrated primitive reflexes. Postural reflexes are to do with posture, movement and stability and are with us for life (Goddard, 2002). These reflexes are required for children to be able to stand, walk, balance and sit for periods of time on the floor or at a desk. Movement facilitates the integration of reflexes. There are many factors that can affect this integration: illness, stress, trauma, developmental neurological impairment, as well, movement deprivation can have serious neurological consequences (Goddard, 2002).

Although there is an established link between movement and cognitive learning, is there sound evidence that reflex integration through movement facilitates cognitive learning? The prefrontal cortex is responsible for executive functioning. Therefore, not only cognitive skills such as literacy acquisition are centred there but also self-regulation skills. If we can remediate or prevent neurological dysfunction through movement, the educational implications could be enormous.

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Could the presence of retained primary reflexes indicate neurological differences that affect executive functioning? Can specific movement exercises change the brain and help to integrate persistent primary reflexes whereby remediating executive function? Can movement in the early years facilitate neurological integration, preventing future difficulties in learning and self-regulation? These are the questions I endeavor to answer in my proposed research.

Summary

As illustrated above, scientific evidence supporting the link between movement and learning is robust. Recent research in neuroplasticity tells us the brain is a dynamic, changing organ. There is some evidence that specific movements may help to change the brain, facilitating healthy neurological integration whereby preventing or remediating problems in learning. In my personal professional practice, I have seen evidence that leads me to believe that movement programs do facilitate learning. Parents, and teachers and educational assistants believe that these movement programs are working. There is theory and science supporting this work. There are also gaps and questions and a need to find out more.

Chapter 2 will look at the literature, the theoretical underpinnings and the research behind this approach. This chapter is organized under the following headings; Theoretical Perspective, Neuroplasticity, Executive Function, Reflex Integration, Movement as a Means to Integration and finally, I will look at the challenges that have come to light.

In Chapter 3, I will put forth a research proposal to investigate the effects of a movement program on the motor and executive function of primary children. The

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purpose is to find if movement can change the brain and if reflex integration can facilitate this change. This chapter will reveal research questions, design, methodology, ethical considerations, measurements, timeline, questions, data analysis, costs and rationale.

Chapter 4 will include reflections on my journey in the Masters program at the University of Victoria: salient learning, thoughts, challenges, recommendations and future directions.

Chapter 2: Literature Review

There is a complex and interconnected relationship between body and brain that cannot be separated, “The body is in the brain and the brain is in the body” (Caine & Caine, 1997 p. 88). Over the past 20 years, the importance of movement in developing children’s cognitive learning has been documented (Bjorkland & Brown, 1998; Hannaford, 1995; Jensen, 1994; Pelligrini & Bohn, 2005). With parental concerns, pushing children to get ahead, and a trend today in education toward a more traditional style of teaching (content driven, teacher directed, based in rote learning and memorization) (Clements, 2000), many young children are spending more time sitting at desks working on pen and paper tasks, rather than moving and playing. There are preschools that push formal learning on younger and younger children (Stipek, 2008). We hear of recess and physical education taken out of the school day to make room for more ‘academic’ learning (Clements, 2000). Teachers report a disturbing trend: more children coming to school with signs of neural immaturity, indicated by a deficit in motor function (Goddard Blythe, 2011). More screen time means children spending more time at sedentary activities

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(Anderson, 2008). All this leads to less movement for children, a potential problem for learning.

Many young children may not yet have the neurological maturity that enables them to be 'ready to learn' (Goddard, 2004). An immature neurological system can take on many guises. Children who are unable to sit still for long periods of time, who have difficulty following directions, or with fine motor tasks, and children who are awkward or clumsy, may require more time before being ready for this kind of schooling. Moreover, children who struggle with behavioral and cognitive tasks in primary years may have neurological differences that may be remediated through movement (Goddard, 2002).

In my inquiry, I wonder if movement can help to develop strong neurological pathways in young children and affect self-regulation and academic skills? Can we help to strengthen neural pathways through movement, and by doing so support children to learn more efficiently? Furthermore, can we prevent difficulties in executive functioning by ensuring young children have opportunities for movement, supporting reflex integration and strengthening neural pathways? Could we consider this type of specific movement as a method of remediation for school age children struggling self-regulation and cognitive demands?

In this chapter, I will begin to put forth the theoretical framework in which this work is set. I will look at the research in neuroscience on movement and learning that has taken place over the last 30 years. I will look at the studies that link movement and exercise, specifically for reflex integration, to executive function-self-regulation and cognitive skills in children.

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Ecological Systems Theory.

The way in which the brain works is incredibly complex. The prevailing scientific paradigm based on Newtonian and Cartesian science, has been seen through a reductionist and mechanistic lens: The parts are separate from the whole (Davis, Sumara, & Luce-Kapler, 2000). There are neuro-scientists who believe that the mind can be explained in terms of brain events, putting aside the rest of the organism and the surrounding physical and social environment (Damasio, 2008). This Cartesian split between body and mind pervades research and practice. In complicated systems, components are taken apart from the whole and studied separately, in pieces. Another paradigm has emerged. In complexity systems theory, we see systems that are dynamic, adaptive and self organize in a non-linear manner. These systems are more than their components or fundamental parts. They are organic, ecological and evolutionary (Davis et al, 2000).

If we look at a complex system such as learning, movement and the brain through the lens of Bronfenbrenner's Ecological Systems Theory (Özdoğan, 2011), instead of a mechanistic view where all parts are separate and operate independently, we see human learning as dynamic, diverse and interdependent. Environmental influences are nested within and between systems. Concentric circles of family, school, community, society, and culture all play into a child's growth and development. The child's environment, whether emotional, physical, social, or cultural, plays a role (Özdoğan, 2011). Freedom and opportunity for movement is a vital player in the complex, diverse and interconnected fabric of what makes healthy growth and development.

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Complex Learning Theories

Piaget. Piaget saw that movement was essential to the formation of intelligence. He called his first stage of intellectual development the *sensorimotor stage*. In this stage infants learn through their senses and motor abilities. For Piaget, the sensorimotor stage is the foundation on which intelligence is built, where body and mind work together in a complex interplay with the environment. In Piaget's theory of cognitive development, children pass through a linear series of developmental stages before they construct the ability to reason and understand. The *sensorimotor* stage begins at birth and lasts for about 2 years (Singer & Revenson, 1997).

The theory of reflex integration as it relates to movement and healthy neural development is not new. According to Piaget, during this sensorimotor stage, infants perform certain motor-based movements called reflexes in response to a stimulus. They are 'wired in', and designed for survival. The infant cannot control his movements. As she moves and grows, interacting with the environment, these reflexes become integrated. These stereotypic, infant movements will form organized patterns of activity that will enter into and be basic to the development of more complex functioning later on.

Piaget suggests that these early reflexes are the building blocks for infant sensorimotor development (Singer & Revenson, 1997). For example, the tonic neck reflex may help development by bringing objects into the infant's field of view. In Piagetian theory, intellectual development happens on a continuum, build on previous stages.

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The sensorimotor stage has several sub-stages: The first two have to do with brain development and reflexes. Piaget saw movement as being vital to children's growth and development, and reflexes as important in developing neural pathways (Piaget 1952).

In the first month of life, infant behaviour reflects a series of innate reflexes: automatic responses to particular stimuli (Piaget, 1952). For instance, if you put a nipple or pacifier in or near a newborn's mouth, she will automatically suck on it. If you put a finger in the palm of a newborn's hand, his fingers will automatically close around it. Many of these inborn reflexes are designed to keep the infant alive. The infant soon begins to modify some reflexes to better accommodate to the environment—for instance, by learning to distinguish between a nipple and the surrounding areas of a breast or bottle. Other reflexes, such as the tendency to grasp onto something placed in the hand, seem to fade away over time (Singer & Revenson, 1997). We know now that these primary reflexes do not disappear or fade away. They become integrated, forming the foundation for future and more complex neurological pathways (Goddard, 2002; Masgutova, 2010). One of the reasons we know this, is that they can re-emerge in times of stress or trauma (Masgutova, 2015).

In the first few months of life, infants' behaviors are focused almost exclusively on their own bodies. In Piagetian terminology, the behaviors are primary and recursive (Piaget, 1952). Infants begin to refine their reflexes and combine them into more complex actions. For example, an infant might now open and close her hand and then put it in her mouth. Infants repeat the movements over and over, until

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they become integrated, making way for voluntary movement. Piaget saw the infant's ability to construct knowledge through adaptation to the environment (Singer & Revenson, 1997). 'Their body-minds require that they move and be moved by their surroundings' (Rui Olds, 1994 p2)

Vygotsky. Vygotsky wrote of the 'natural crisis' that occurs during transitions in a child's development. In his theory, the maturation of the reflex system adds to the development of inner control (self-regulation), and leads to language and abstract thinking (Masgutova, 2015).

According to Vygotsky, children construct early knowledge based on the social and cultural interactions and observations in their environment. Vygotsky coined the term *the zone of proximal development (ZPD)*. Here, a problem too hard for the child to master independently can be done with the guidance and encouragement of a more knowledgeable person, an adult, or a more capable peer. In this manner, Vygotsky described how teachers, parents and other children could *scaffold* child's learning (Berk & Winsler, 1995).

Vygotsky saw movement and reflex integration as the foundation for neural development: "*The first infant movements do not disappear; they continue to work in unison with the higher nervous formations:* (in Masgutova, 2010, page v).

Luria. A student of Lev Vygotsky, Alexander Luria was a Russian neuropsychologist. Luria separated himself from the mechanistic thinking of previous theorists. Like Vygotsky, Luria believed that learning is a complex, involving interconnected process that takes place in a social and cultural context. Luria believed that reflexes played an important role in children with trauma, neuro-

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deficits and delays. Luria worked with Svetlana Masgutova to create and implement a method of neurosensory motor and reflex integration (Masgutova, 2015). The Masgutova method is used in Russia, Poland, and more recently in the United States to help those with reflex re-emergence, particularly in the case of trauma. This method has been successful in helping those with Post Traumatic Stress Disorder. It has been used to help children who have experienced trauma, particularly, after Chernobyl in 1986, and in the case of the 1989 Ufa train disaster, where hundreds of children were killed and badly injured. More recently this method has been successful in treating traumatized children after the Sandy Hook school shootings in the United States, as well as soldiers returning home from the Iraq war (Masgutova, 2015).

Movement and the Brain

Neurophysiologist Carla Hannaford (1995) has stressed the importance of movement to learning for 20 years. While many scientists believed that the cerebellum's purpose was simply for motor control, Hannaford found links between the cerebellum and the rest of the brain. Supporting this, Schmahmann and Pandyat (1997) and Diamond (2000), found a close interrelation of motor development and cognitive development in the cerebellum and prefrontal cortex. Hannaford (1995), states the vestibular and cerebellar systems together are the first systems to mature. The inner ears semicircular canals and the vestibular nuclei gather information and provide feedback for movement. The information travels through nerve tracks from the cerebellum to the rest of the brain, including the sensory cortex and the visual system. The vestibular, cerebellum and RAS (reticular activating system) are all

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closely linked and together they help us to keep our balance, coordinate our movement and turn thinking into action. Cheatum and Hammond (2000) also support Hannaford. They recommend movement activities for integrating primitive reflexes, thus improving children's learning and behavior. Movements such as crawling, spinning, rolling, jumping and swinging are beneficial for healthy neurological and physical development, facilitating cognitive learning.

Jensen in *Teaching with the Brain in Mind (1998)* supports Hannaford. He speaks to the importance of movement in boosting cognition. Studies suggest strong links between the cerebellum and memory, language, non-verbal cues, spatial perception, attention, emotion and decision-making (Tompsonowski, Davis, Miller & Naglieri, 2008; Bjorklund & Brown, 1998; Pelligrini & Bohn, 2005).

Neuroplasticity

Throughout the last 20 years, brain research has shown conclusively that the brain is 'plastic', designed to adapt and change. There is evidence, that neuro-pathways may be influenced by stimulation in the form of movement (Boyd, L personal communication October 2014; Doidge, 2007; Ratey, 2008). There has been a plethora of new information coming out on neuroplasticity, most of this in the medical field. We are just now seeing studies in the field of education. In 2010 there were 147 medical papers published on stroke and neuroplasticity and only 4 on neuroplasticity and education. By 2014, 1600 papers had been published on stroke and neuroplasticity and 71 on neuroplasticity in education (Boyd, L. personal communication, October 2014). It is a field that is exploding. The next few years we may see major changes in education on how we view movement and its' affect on brain change.

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As the field of neuroplasticity grows, neuroscientists such as Norman Doidge (2007), and John Ratey (2008), purport the importance of movement, physical exercise, and repetition as pathways to neural change. Findings in neuroscience continue to support the amazing neuroplasticity of the brain. We know that reflexes can re-emerge in trauma (Masgutova, 2015). Findings with stroke patients show that slow repetitive movement exercises can change the brain and help it to heal. In a lecture on October, 24 2014 at the Arrowsmith Neuroplasticity Conference in Vancouver, neuroscientist Dr. Lara Boyd spoke of the ‘dose problem’: Change is slow and only happens after many repetitive movements. Specific movement exercises must be repeated often, everyday to facilitate neurological change.

As we look at the complex relationship between body and brain, we see movement and exercise affecting brain chemistry. Serotonin, norepinephrine, and dopamine neurotransmitters have a strong affect on our thoughts and emotions (Ratey, 2008). The cerebellum was once thought to control only motor coordination. We now know that the neural pathways that travel through the cerebellum are interwoven in a complex and interconnected manner through the brain (Diamond, 2000). It is not, as was once thought, a separate and distinct (mechanistic) part of the brain for only motor control.

Neuroscience like complex systems theory, now tells us that the brain is complex, interconnected and dynamic.

Executive Function

Self-regulation, the ability to be calm focused and alert (Shanker, 2013), involves sound decision-making, control over emotions and body, metacognition, empathy and

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morality. These are functions of the prefrontal cortex, responsible for executive function. Executive function is involved in cognition.

Cognitive learning, including mathematics and reading are strongly influenced by executive functioning. Physical activity has been shown to improve executive function (Best, 2010; Blair, 2013; Pelligrini, 2005). Bedrova and Leong (2005) have found children are able to learn self-regulation through play. Research indicating that mindfulness training, yoga, aerobic exercise, and traditional childhood active games such as Simon Says, can help to improve self-regulation and executive functions in preschool and school-aged children (Bedrova and Leong, 2005; Diamond & Lee, 2011). Movement clearly is involved in children's cognitive development and self-regulation, all governed by executive function in the prefrontal cortex.

Sensory Integration

The seminal work of Jean Ayers (1972) on sensory integration laid much of the groundwork for reflex integration theory. Based on how the brain integrates sensations, Ayers work suggests that movement stimulates the brain stem sensory and motor mechanisms, aiding the development of vestibular and other neurological functions. Sensory integration is the ability of the brain to receive, organize interpret and use the information gathered by the senses. We do not use just one system at a time. Many sensory systems operate together and support each other, giving more information if needed. (Cheatum & Hammond, 2000; Hannaford, 1995).

Sensory integration techniques are used by doctors, therapists, and medical professionals primarily or children with severe learning difficulties (Ayres & Robbins, 2005). Failure of the primitive reflexes to be stimulated and inhibited (integrated) and

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postural reflexes to be established can result in sensory integration problems (Goddard Blythe, 2005). Reflex persistence is not the only cause of sensory problems. Although Sensory integration is different from reflex integration, the two therapies are complementary.

There are critics of sensory integration therapy (Hyatt, Stephenson & Carter, 2009), though some studies report success (Ottenbacher, 1982). Sensory integration therapy is widely used among professionals in schools today, However, there is little research that would establish it as evidence-based practice.

Bipedal Evolution Theory

Humans are born immature. More than any other mammal, we are born completely dependent on a caregiver. Thousands of years ago, when humans evolved from walking on four legs, to walking on two legs, the female human body adapted to an upright posture. The pelvic region became narrower, to allow for efficient bi-pedal movement, resulting in a narrower birth canal. This combined with our relatively larger brain size, and in order to give birth successfully, the gestation period was shortened to allow for smaller babies (Rosenberg & Trevathan, 1995). Thus, more development of body/brain happens after birth than any other animal. This '*obstetrical dilemma*' (Wittman & Wall, 2007) an evolutionary trade off between child birth and a pelvis adapted for walking upright, led to the human infant being born immature, and dependent on a caregiver. It is the primary reflexes that aid the immature infant to survive. These automatic, involuntary responses help the infant to root (to find food), to grasp, and aid in the birth process (Musgatova, 2010; Goddard, 2002).

Reflex Integration Theory

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Goddard (2002) indicates that higher brain functions, such as executive functioning and literacy acquisition, are dependent on the successful earlier development of lower brain functions. The laying down of neural networks in the cortex and prefrontal cortex, essential for higher level cognition is influenced by how efficiently the brain stem deals with sensory input.

Vestibular functioning, motor regulation, proprioception, and emotion all emerge from the brain stem. Without the full development of this lower brain, the higher brain works inefficiently. In this case, children can still learn, but it is more difficult for them (Cheatum & Hammond, 2000; Goddard 2002; Masgutova, 2010;). Expectations of children in the early years of school can be challenging. These neurological differences can affect the child's ability to learn (Blythe, 2000).

Primary Reflexes. Primary, or primitive reflexes emerge in utero and help the infant to navigate the birth canal, survive the first months of life, and to move. These reflexes begin very early on in infant brain development and emerge in a particular order and time in the child's development. They are the precursor to voluntary motor development. There are more than 40 primitive reflexes that govern children's movement (Zafeiriou, 2004). Familiar reflexes are the Moro reflex, or startle reflex, the rooting and sucking reflex (where the baby will turn her head at the touch of her cheek, or the Palmar reflex, where the infants' hand will close around a finger at the touch (Zafeiriou, 2004).

The Asymmetrical Tonic Neck Reflex (ATNR), also known as the 'fencing' reflex assists in and reinforces the birth process. Research shows that we often see the persistence of the ATNR in children with reading difficulties (Goddard-Blythe, 2005; McPhillips and Sheehy, 2004; McPhillips & Jordan-Black 2007).

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Primitive reflexes become integrated in the first months of life, allowing for the development of more complex neuro-structures. It was once thought that these primitive reflexes disappear. Neuroscientists believe that these reflexes become integrated laying the foundation for more complex neuro-pathways (Goddard, 2002; Cheatum & Hammond, 2000; Masgutova, 2010). The strong and efficient myelination of the superhighways that support higher and more complex learning interconnected neo-cortex, responsible for higher-level cognitive tasks, executive functioning and academic learning.

There are many factors that affect the integration of primary reflexes: genetics, neurological damage, illness, stress, neglect, trauma, or developmental neurological impairment. Movement deprivation can have serious neurological consequences, impeding the natural process of primary reflex integration (Goddard, 2002).

Postural Reflexes. Postural reflexes have to do with posture, movement and stability and are with us for life. Postural reflexes are built on the foundation of successfully integrated primitive reflexes. The integration of these reflexes is responsible for the formation of strong neural pathways that support efficient brain function: highways that lead to more complex learning (**Goddard-Blythe, 1992; Masgutova, 2010**).

The Problem of Retained Reflexes

Sally Goddard Blythe (2011) sees a trend in children upon school entry who show neuro motor immaturity:

There is a growing body of evidence that indicates that an increasing number of children are entering formal education lacking the physical skills which are necessary to support all aspects of formal education. These children are at risk of

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under-achieving and/or developing various social or behavioral problems unless this immaturity is recognized and addressed. (p. 19).

The presence of retained primary reflexes may indicate neurological differences that can affect motor development, executive functioning and therefore cognitive learning (Cheatum & Hammond, 2000; Goddard, 2002; Mastgutova, 2010). These reflexes are required for children to be able to stand, walk, balance and sit for periods of time on the floor or at a desk (Cheatum & Hammond, 2000). Persistent reflexes can interfere with hand-eye coordination (both ATNR, TNR). Children with persistent reflexes that have not successfully integrated may not be able track a line of print, read or copy from a board, print, or write. Persistent primary reflexes affect postural reflexes and can cause problems with not only with gross and fine motor control skills but with speech and articulation, as these are required for the successfully development of reading and writing. The educational implications are clear.

It is movement that naturally helps to integrate these reflexes. Sedentary children may not be getting the movement they need to create a strong neurological foundation. Specific movement exercises may help to change the brain and to integrate these reflexes, remediating cognitive learning.

Physicians, kinesiologists, physiotherapists, and chiropractors are familiar with primitive and postural reflexes, and their effects on movement, cognition, and executive function. Much work has been done with children with learning disabilities such as dyslexia, ADHD, cerebral palsy and autism (Connell & McCarthy 2014; Melillo, 2011; Goddard, 2002). The association between primitive reflexes and motor activity has been established (Capute, 2008). Reflexes are not isolated, but work together and influence

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early motor development. Primary reflexes are one of the many components affecting motor development. However, few educators know the function or the neurological/cognitive connection associated reflex integration. Movement may be the key to neurological change, change that can affect cognitive ability.

Retained Reflexes and Learning Difficulties

Studies indicate a relationship between retained primary reflexes and learning difficulties in school. McPhillips and Jordan-Black (2007) examined the effects early neurological system persistence on core literacy skills. In their large sample of grade 2 students, they found a statistically significant relationship between poor reading attainment and a high level of ATNR reflex persistence. Over half of the bottom 10 percent of readers showed persistent ATNR. This indicated a correlational, not a causal relationship. Gender and socio-economic effects were also noted; with males more at risk of reflex persistence than females and children from socially disadvantaged backgrounds showing higher levels of reflex persistence (McPhillips & Jordan-Black, 2007).

A similar study conducted by McPhillips and Sheehy (2004), included a cross section of primary schools in Ireland. They found significantly higher levels of persistent ATNR with the poorest readers. Note there are only 13 or 14 children in each of the 3 groups, so although they began with a large sample they only studied 41 children. Because of the small sample size we must be careful to draw conclusions. These studies indicate there may be a connection between retained primary reflexes and cognitive learning.

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Since 2004, a number of schools in the U. K., Hungary and Germany have screened primary children for reflex retention and found a significantly high incidence; especially in children already identified as having special needs Teachers also reported a clear trend of neuro-motor immaturity prevalent in their classes (Goddard Blythe, 2011).

Movement as a Means to Integration

Several studies indicate that movement programs targeted on reflex integration for those children who show retained, persistent reflexes are effective. A 2005 study looked at the effectiveness of a primary movement program on core educational skills (reading, spelling and mathematics) in 6 to 11 year olds. In this large, longitudinal study (Jordan-Black, 2005), 683 children were assessed at the beginning and end of year 3, 5 and 7. They were assessed individually on a wide range of standardized tests for reading, spelling, and math and a clinical diagnostic test for the ATNR. The children participated in a primary movement program for ten minutes a day. It was found that the children who scored higher on the ATNR, indicating primary reflex retention, made the most significant gains in core educational skills. Jordan-Black found, in agreement with McPhillips and Sheehy (2004) as mentioned above, that persistence of ATNR played a significant role in predicting delay the reading progress of these primary children. Children with learning difficulties that did not show signs of retained reflexes were the least responsive to the movement intervention, indicating that movement programs will not work for all learning difficulties. Still, specific movement programs appear to have an effect on those children with persistent retained reflexes, specifically

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ATNR. It must be noted that there was no control group, so gains could be due to maturation. However, given that the children with reflex retention made the most gains shows promise to further investigation.

Home exercise programs have been for children who exhibited retained primary reflexes and a poor standard of reading have indicated favourable results. Sixty children took part in 3 trial groups; one group practiced specific exercises at home each evening for ten minutes over the course of a year. Parents were taught the specific exercises and monitored at intervals throughout the study. The second group had non-specific movement exercises they practiced at home for 10 minutes each evening for a year and the third group had no exercises. The group that practiced specific exercises, designed to help integrate retained primary reflexes showed significant decrease in the level of retained reflex over the course of the study and reading gains were clinically significant. The researchers (McPhillips, Hepper & Mulhern, 2000) found all groups showed significant improvement over time, but the experimental group- the one practicing specific exercises, showed a substantially greater increase in not only reflex integration, but also reading scores. This is one of the few studies with a control group. Note the difference was not statistically significant, but substantial and clinically significant. As the exercise program happened at home, we have no way of knowing what other variables may have affected the results.

Similar research has been undertaken in South Africa. Fredericks (2006) and colleagues Krog and Kruger (2011) researched the theory that higher-level cognition requires effective functioning of the lower level neurological systems to

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perform adequately. They looked at vestibular, proprioceptive, tactile, visual and auditory systems. A developmental movement program for grade one learners included a control group, a free play group and a group that played with educational toys. The movement group showed significant improvement in special development, as well as reading and mathematical skills, compared to the other 3 groups. Another study looked at a specifically designed movement program, targeting these neurological systems with the aim of improving the child's 'learning readiness'. A sample of 14 grade 2 learners showed significant results, but as the sample size was so small, little can be concluded. Moreover, there is no agreed upon standard of what makes a child 'ready' for school.

A literature review on this topic would be incomplete without mentioning the work of Peter Blythe (1992, 2003) and Sally Goddard-Blythe (2000, 2003, 2005, 2011) who have written extensively on movement as a means to reflex integration facilitating cognitive learning. Goddard and Blythe, who founded the Institute for Neuro-Physiological Psychology (INPP) in the U.K., developed a test battery to assess neurological dysfunction as well as a developmental exercise program to remediate retained reflexes. In her 2005 study, *Releasing Educational Potential through Movement*, Goddard-Blythe summarized results of a large study that included 810 children. She found indications supporting the work of McPhillips, Jordan-Black, and colleagues, that children with neurological dysfunction had the most severe reading problems and those who show the most neurological dysfunction benefit the most from a specific movement program. The research design included a control group (children who received no exercise), and a

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nonspecific exercise group. There were some variations in the research design between schools (in some cases teachers put the children they felt most at risk in the experimental group) and there were variables that may have affected outcomes (one school had a population where more than 80% were second language learners).

The Schilder test (1972) was the assessment tool used in these studies to identify children with reflex integration persistence. The assessment tools used to measure reading ability were the Wechler (WORD) and the Neale Analysis of Reading Ability; all the previous studies used these same assessments, allowing comparative reliability.

It is worth noting that all four studies were done at the Queen's University in Belfast Northern Ireland. These studies, especially the one carried out by Jordan-Black (2005), show the most promising results in terms of reliability and validity, as it had a large sample size, a control group and standard measures for assessing persistent reflexes and measuring academic skills. As well, a standard movement program was implemented.

Goddard Blythe reports on movement intervention programs in schools in Ireland, the U.K., Germany and Hungary. As a result of her findings she states:

In many cases immature primitive and postural reactions can be improved with the use of physical intervention programs. These programs can be used with individual children in a clinical setting or with groups or a whole class of children in schools. (Goddard Blythe, 2011, p. 33)

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Challenges

There is little peer reviewed published research on the effectiveness of Goddard Blythe's *INPP Developmental Exercise Program*. Lack of evaluative research has led critics to discount the work of the INPP. Supporting evidence by Goddard Blythe and Masgutova often take the form of in-house reports, case studies or unpublished research studies. Websites selling books, manuals, training programs and other products lead to questions of conflict of interest. It is difficult not to question the validity of these studies, and possible researcher bias, when favourable results could lead to financial gain on the part of the researchers.

This does not necessarily discount the validity of reflex integration theory. Academics, practitioners with years of experience and parents stand by this work. Testimonials and case studies abound. As we see from a review of the literature, some empirical studies suggest positive results.

It was difficult to find primary studies where specific movement exercises were used to remediate reflex integration in children with motor and cognitive difficulties. There is some evidence that work has been done in the Czech Republic, Russia and Poland although translated articles were not accessible.

Much work has been done in related fields in Australia using perceptual motor programs that are widely accepted in school curricula (Hyatt, 2007). Hyatt, Stephenson & Carter, (2009) question the effectiveness of these programs purporting that they are not effective in improving academic or other skills. However, in their critique, these researchers lumped reflex integration movement programs together with sensory integration programs, perceptual motor programs

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and bi- lateral movement programs such as Brain Gym. In effect, these programs have methods so different, they cannot be validly considered as one.

Reflex integration theory can be mistaken as rooted in the Doman-Delacato Patterning Approach (Doman, Spitz, Zucman, Delacato, 1960). The Doman-Delacato program was designed for children with brain damage. This method included a diet and exercise home program. Based on Haeckel's recapitulation theory, (*Ontology recapitulates phylogeny*- long since discredited) this method used re-patterning therapy as an apparently non-invasive approach, mimicking patterns of fetal movements (Robins, 1966). This popular albeit controversial theory has been discounted as being based on questionable and over simplified concepts of hemispheric domains (Hines, 2001). The Doman-Delacato method involved some similar aspects of reflex integration theory, such as crawling and rolling. Other controversial methods; such as gagging, masking, and sensory stimulation; pinching, experiencing intense heat and cold, as well as loud noises were administered by parents many times a day. Critics denounced this program as bordering on abusive, stressful and unmanageable for parents, as well as being based on undocumented claims without empirical evidence (Hines, 2001). There may have been some aspects of the Doman-Delacato programs that were effective. With such an array of techniques it is difficult to separate out the methods that may or may not have been of benefit for children with disabilities.

There are few peer reviewed, empirical studies available researching the relationship between persistence of primary reflexes, executive function and the effect that movement programs may have on brain development. Those that are

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available, for the most part, have been by small groups of like-minded colleagues at Queen's University in Northern Ireland and at the University of South Africa. These studies look only at ATNR although other persistent primary reflexes may be present. We know that most often, reflexes retain in clusters. Many reflexes are working together in an interconnected and dynamic system. It may not be helpful to look at one reflex in isolation.

Many research articles have been published examining neurological differences in children with special needs: dyslexia, ADHD, autism, and cerebral palsy, examining the role that retained reflexes may play. In my inquiry, I am interested in teaching to learning difficulties of typical children. These 'grey area' children are in in all primary classes. They may not have a diagnosis or an IEP (Individual Educational Plan). Dr. Lara Boyd, who studies the neurobiology of motor learning at U.B.C., is not convinced that the brain plasticity of children with learning disabilities is much different than that of typical children (personal communication, Oct.23, 2014). As teachers, we often use very different remediation methods for learning disabled children than for our typical children. We most often go to cognitive remediation (repetitive practice, word work). Movement is not often considered. We may want to consider Dr. Boyd's thoughts, looking at learning for all children as being on a continuum. This could lead to more research becoming available regarding movement as an alternative remediation practice.

The literature review gives rise to many questions about the validity and reliability of the research available. As mentioned previously, problems with methodology; small sample sizes, questions as to the validity of non standardized

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assessment tools used to measure reflexes and delayed cognition, some studies lack a control group, a variety of movement programs used as interventions- making comparisons invalid, many studies are correlational and do not show cause. In a review of the literature available, more questions arise: Why are there no North American studies? Why are there few recent published works? More research is needed. Peer reviewed, replicated studies with sound methodology are called for.

Summary

It is clear from the literature that there is a strong connection between movement and cognitive learning. Movement is widely accepted by educators and scientists as a benefit to children's learning. Evidence indicates that the integration of primary reflexes is necessary for postural reflexes to emerge. It is believed that strong neural networks supporting primitive and postural reflexes are important for efficient cognitive and executive function. Some studies appear to show a link between persistent retained primary reflexes and difficulties in cognitive learning (McPhillips & Jordan-Black, 2007; McPhillips & Sheehy, 2004). Favourable results seem to have been shown with the implementation of specific movement programs to remediate persistent reflexes (Blythe, 1992; Goddard, 2005; Krog & Kruger, 2011; McPhillips, Hepper & Mulhern, 2000; Jordan-Black, 2005).

Children's gross motor movements may be an indication of neurological dysfunction. Movement exercise may provide stimulation to the neurological systems necessary to help to integrate these reflexes. Certain movements may help to form strong neural pathways that may lead to efficient cognitive learning and executive functioning.

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Some empirical research indicates a positive correlational relationship between retained primary reflexes and learning difficulties. There is research evidence to believe that movement programs may benefit learning. However, there is a lack of good empirical evidence to substantiate the theory that specific movement exercise aides in reflex integration, thus supporting intellectual and self-regulating functions in children.

There is a difference of opinion between some researchers and practitioners on the validity of reflex integration theory. Although different from perceptual motor programs (PMPs) and sensory motor programs, reflex integration complements these theories as they purport movement, or stimulation changes the brain. These programs are controversial. Using movement to change and strengthen neuro-pathways is not yet widely accepted. Still, we must be careful not to discount the work of experienced practitioners and academics due to the lack of quantitative empirical evidence. Valuable knowledge has come out of qualitative research.

There is evidence to pursue further exploration on the role movement and reflex integration may play in learning. Some of the research looks promising. More research is needed.

In Chapter Three I will put forth a research proposal to investigate the effects of a movement program on the motor and executive function of primary children. The purpose is to find if movement can change the brain and if reflex integration can facilitate this change. This chapter will reveal research questions, design, methodology, ethical considerations, measurements, timeline, questions, data analysis, costs and rationale.

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Chapter 4 will include reflections on my journey through the Masters program: salient learning, thoughts, challenges, and recommendations and future directions.

Chapter 3: Research Proposal

Physical movement has been found to have benefits for learning and behavior (Best, 2010; Bjorkland & Brown, 1998; Hannaford, 1995; Jensen, 2005; Pellegrini & Bohn, 2005; Tomporowski, 2008). Recent research in the field of neuroplasticity tells us that the brain is a dynamic organ that can change and that movement is a means to that change (Ratey, 2008).

Infants are born with primary reflexes that aide in the birth process, in survival, and prepare the infant for more advanced movement patterns (Capute, 1982). In order to progress to more advanced voluntary movements, these reflexes most often integrate in normal healthy infants (Cheatum & Hammond, 2000). This integration forms the foundation for future and more complex neurological growth (Goddard, 2002). There is research that indicates there is a correlation between retained primary reflexes (reflexes that have not integrated), and learning difficulties in primary school children (Goddard, 2004; McPhillips & Sheehy, 2004; McPhillips & Jordan-Black, 2007; Melillo, 2011). Moreover, some research suggests that specific movement programs, designed to help integrate these aberrant reflexes, may benefit children who show reflex persistence. These benefits have been shown in areas of executive function: reading, mathematics, and self-regulation (Goddard Blythe, 2005; Jordan-Black, 2005; Krog & Kruger, 2011; McPhillips, Hepper & Mulhern, 2000; Masgutova, 2015).

This chapter discusses the research approach, research design, and data collection methods for the proposed research study. A systematic process of collecting data, pre and

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post intervention and analyzing the data will be adopted. A quantitative research method data is proposed.

Purpose of the Research

The purpose of the study will be to determine if a primary movement program will significantly improve outcomes for primary children in reflex integration and executive function.

This gives rise to a number of inquiry questions:

- Is there indication of retained reflexes in a selected group of primary children in our school district?
- What is the current level of reading and self-regulation skills in that group?
- Is there a correlation between children who show evidence of retained primary reflexes, and those struggling with reading and self-regulation?
- Will a movement program improve motor function whereby affecting executive function as (measured by scores in reading and self-regulation) in this group of primary school children?

Through this proposed research, the following question will guide the process and outcomes.

Research Question

In light of the literature review in chapter 2, and the purpose of this research study, I propose the following question:

Will there be a significant difference between the experimental group (movement program (MP)) as compared to the children in the control group (no movement program

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(CG)) with regards to changes observed and assessed from baseline to follow up (9 months) in the results of motor function (mf) and executive function (ef) evaluation?

Definitions

Executive function is defined as higher level cognitive function governed by the pre-frontal cortex and responsible for; planning, problem solving, memory, reasoning, flexible thinking, organization, focus and attention. Metacognition, empathy and emotional control are also function of the prefrontal cortex, requiring executive function (Blair, Protzko & Ursache, 2011). Executive function is responsible for self-regulation, and cognitive function: reading and mathematical proficiency. For the purpose of this study, the assessment of executive function will include assessment scores in reading and self-regulation.

Self-regulation is defined calm, focused and alert (Shanker, 2013) and includes emotional, cognitive, pro-social and motivational aspects (Bronson, 2000). Self-regulation is associated with academic achievement (Blair et al, 2013; Shanker, 2013)

Rationale

From the review of the literature, it is evident that movement aids in executive function. There is evidence that movement is required for the development of lower level neurological function, which lays the foundation for effective higher level executive functioning (Goddard, 2002). Movement exercise may help to integrate persistent primary reflexes in children, thus supporting executive function-higher level learning.

In our school district, we have found indication that supports this theory. As part of a primary reading inquiry group, two of our teachers chose to use movement as a classroom intervention. Both teachers incorporated a movement program, design to aid

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reflex integration, into their daily practice. The teachers implemented this intervention for the course of the school year. In both cases, teachers reported what they found to be remarkable improvement, not only for the case study student, but also for the whole class.

In one case, the exercise program was implemented into a kindergarten class. The teacher found the case study student showed marked improvement in self-regulation. The teacher reported improvement for all students, but particularly for the case study student.

In the other case, a multi-aged primary class, the case study involved a grade 3 student who was a struggling reader. After the implementation of the exercise program, the case study student improved significantly to what the teacher described as a “confident, fluent reader”. Again the teacher reported gains for all students.

Implementing movement programs for typical children is a relatively new concept in our school district. Movement programs are often a prescribed intervention for children who have been assessed and designated with a developmental diagnosis. These children have been identified as having a specific learning need and have an Individual Educational Plan (IEP). Teachers, parents and educational assistants report overwhelming success with movement programs for these children. I wonder why these programs are saved for children with special needs, when they could be of benefit to all children, especially children who struggle but do not have a diagnosis.

Another project, involving four kindergarten classes, children were screened in the fall for evidence of persistent reflexes. Teachers were taught a series of playful specific movements, implemented into their daily practice. The movement program changed through out the school year becoming more complex and difficult. It was implemented

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for ten minutes a day. The school district physiotherapist, trained in reflex integration theory and practice, supervised this project. Children were screened again for reflex retention at the end of the school year. The screening showed that fewer children had indications of reflex integration after the movement program. Teachers reported improvements in behavior, attention, and cognitive skills.

This led me to wonder. I was curious whether these perceived improvements in the children's executive function would have happened without the implementation of the movement program. Without a control group, the evidence was not clear. There was a need to investigate further.

Quantitative Research

Creswell (2012) describes quantitative research as a way in which research can provide an explanation for the relationship among variables. In this proposed research study, we look to find a relationship between movement and learning and to see if specific movements, designed to help to integrate reflexes, will have an effect on cognitive learning, and executive function. The literature suggests the research question and data will be collected to prove or disprove a measurable hypothesis.

Research Design

A quantitative research design (Creswell, 2012) of inquiry is selected. This design is used to determine cause and effect if there is a direct manipulation of conditions. There will be no random assignment of subjects as they have previously been assigned to school classes. Our sample will include 2 primary classes (K-3), previously configured. Class configuration is arranged collaboratively, with school staff. The intention is the

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equitable distribution of social, emotional, physical and academic ability. Data will be obtained before and after the implementation of the movement program.

The study will take place in selected primary classrooms in School District 64, Gulf Islands. We are a small, rural school district consisting of 5 islands. Primary classes are most often multiage.

Researchers will administer a pre and post reflex motor assessment. Classroom teachers will complete the self-regulation checklist, both pre and post intervention. The reading assessment will be completed by classroom teachers with support from district learning support teachers and the researcher both pre and post intervention. Two classes of 22 primary age children will take part on the study.

The Intervention Group will receive a specific primary movement program, designed to help integrate primary reflexes. This class will receive 10 minutes a day of specific movements for 9 months throughout the school year (October to June). These movement exercises are playful and often done to music. The movement program will be implemented along with the regular primary curriculum, which includes physical education 30 minutes a day as well as 5 minute recess and half an hour lunch outdoor play.

A Control Group that does not receive intervention reduces the threat of the validity of the results. This group will have no intervention and will follow the regular primary curriculum including physical education for 30 minutes every school day as well as 15 minute recess and half an hour lunch free outdoor play. It is of note that our school district (SD64 Gulf Islands) has a four-day school week. Both the control group and the

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intervention group will be assessed at the beginning and at the end of the study in reading, self-regulation and movement proficiency.

Examiners/researchers will be the school district physiotherapist working collaboratively with the Early Learning Coordinator and the Primary Coordinator and researcher (myself). Both coordinators are teachers employed by School District 64 Gulf Islands.

Ethical Considerations

In the proposed study thought and consideration must be put into ethical measures. Ethical standards will be adhered to and permissions granted as required by School District 64, and the Dept. Of Curriculum and Instruction, University of Victoria (Appendix A). According to Creswell (2012), all data collection should be ethical and respect individuals and sites. The mere presence of a researcher disrupts the site of the study as the students or teacher may be distracted by the presence of the researcher. In the proposed study, classroom visits will be kept minimal. However, the school district physiotherapist will make classroom visits to ensure the reliability of the movement program. Researchers may check in with the classroom teachers occasionally, to offer support and for data collection. This will be done in non-instructional time.

Permission

Parents of students involved in the study will be informed. Parent permission forms will be obtained. A parent consent form is included in the appendix (Appendix B).

Teachers will be invited to join the study. A letter to teachers is included (Appendix C). Participation of classroom teachers will be on a volunteer basis. It must be recognized that participation in this study will create more work for teachers involved.

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Meetings, questions from parents, data collection can be time consuming and cause disruption.

Numbers will be assigned to participants in place of names to protect their anonymity. Individual identities of participants and data obtained will be kept confidential. The wishes of any family not wanting to participate in the study will be respected.

Ethical consideration must be given to both groups not receiving the intervention. If the movement program does help children with learning and behavior difficulties, we must consider the ethical implications of some children not receiving this advantage.

Appropriate Touch

It must be acknowledged that assessment and intervention will require ‘hands on’ touch by the teacher and examiners. As long as the protocol for assessment and the prescriptive program of exercises is followed, and parents have agreed to participate, there should be no cause for ethical concern. The School District Superintendent and Director of Instruction have agreed that:

“The contact is occurring in a physiotherapy context, is a prescribed activity and one where the adults involved are conscious about appropriate personal contact.” (SD 64, Gulf Islands)

It is agreed that teachers and examiners do not do any hands on exercises other than are prescribed, or part of the motor assessment. None of the exercises involve touch to the areas of genitals or breasts. Teachers and examiners must be conscious of when touch is accepted and appreciated by the student and when it is rejected or resisted. If students do not wish to be touched, their wishes must be respected.

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Measurement Instruments. In order to research and collect data, quantitative measuring instruments will be used to assess the student's pre and post intervention. Movement plays a fundamental role in learning. In terms of the hypothesis formulated for this study, the motor proficiency of the participants must be assessed and measured. Motor assessment is an indicator the persistence of primary reflexes (Goddard- Blythe, 2012). To test the hypothesis, the following assessment tools will be used:

Movement Proficiency Assessment. The literature review in chapter two illustrates the relationship between motor development and learning. To assess neurological motor function, our school district physiotherapist utilized the INPP Diagnostic Assessment (Goddard Blythe, 2012). The Schilder test, included in the INPP Diagnostic Assessment, is commonly used to assess ATNR persistence, commonly associated with reading difficulty (McPhillips & Jordan Black, 2007).

The Institute for Neuro-Physiological Psychology (INPP) developmental screening test has been used widely in research studies involving reflex integration therapy in Europe (Goddard Blythe, 2005). In this motor skills assessment, researchers rely on observation to see if the child exhibits specific signs of reflex retention.

It is important to note that this is not a standardized test, but one we will administer to all children in our research study to determine the presence of persistent primary reflexes and to measure growth, or improvement from the onset to the end of the research study.

A brief discussion of the components of the assessment is listed below:

Rhomberg: this assesses the proprioceptive system. The proprioceptive system is responsible for controlling various parts of the body (Cheatum & Hammond, 2000). The child assumes a standing position, with both feet together, arms relaxed at the side, eyes

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closed. The examiner observes if the child can maintain balance, or is weaving back and forth, lifting or moving feet, or lifting one or more arms.

One leg stand: this assesses the vestibular system, which has to do with balance. The child stands on one foot with the opposite leg bent at the knee, eyes open, then closed (Cheatum & Hammond, 2000). In this assessment, the examiner looks for swaying, movement of arms or hands, or sticking out of the tongue indicating difficulty with balance.

Crawling: Frequently, later developmental delays in movement patterns of children who have learning and /or behavior difficulties are related to problems in crawling. In this assessment the examiner looks for cross lateral movement of arm and legs while crawling. Movement both arm and legs on one side of the body together, or ‘bunny hop’, feet inn the air or hand turned sideways as indication of dysfunction.

Finger thumb opposition: The child is requested to imitate the examiner’s hand movements, touching each finger to thumb, one hand at a time. Examiner looks for ‘mirroring’; Do the fingers of the opposite hand move, mirroring the active hand? Is the child able to make sequential movements?

ATNR Asymmetrical Tonic Neck Reflex. Also known as the Schilder test. It is a commonly used assessment of persistent ATNR (McPhillips et al, 2000; Goddard-Blythe, 2002; Jordan-Black, 2005). This reflex often found persisting in children with reading difficulties (Goddard-Blythe, 2002; McPhillips & Sheehy, 2004).

The child stands upright with feet together and arms held upright in front at shoulder level with the wrists relaxed and hands floppy. The examiner stands behind the child and gives the instruction: ‘ In a moment you will close your eyes and I will turn your head

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slowly, first to one side and then the other, all you have to do is keep your arms in exactly the same position as they are now; only your head moves'. The examiner then slowly turns the child's head to one side, until the chin is over the shoulder, pauses for 5 seconds, and then slowly turns the head to the other side. After another 5 second pause, the sequence is repeated once more (Jordan-Black, 2005). The positive indicators of this reflex include movement of the extended arms in the same direction as the head turn, drooping of the arms, or swaying and loss of balance.

STNR Symmetrical Tonic Neck Reflex: The child is on hands and knees, and slowly turns his head to look up at the ceiling, pauses for 5 seconds, and then slowly looks down. After another 5 second pause, the sequence is repeated. The positive indicators of this reflex are shown when the head bends forward towards the chest, the arms will flex and legs extend. When the head tilts upwards, the arms will extend and legs will flex (Goddard Blythe 2012).

TLR Tonic labyrinthine reflex The child lies on a mat and rolls over from front to back and back to front. The examiner looks for signs of strength needed to overcome the pull of gravity. Does he have to press down with the feet, elbows, knees or head in order to roll over? (Cheatum & Hammond, 2000). Children who have difficulty sitting up and tend to sprawl across their desks, fighting gravity often show signs of retained TLR.

Assessments of Executive Function

Reading. The PM Benchmark is chosen to assess reading ability. This is an assessment of fluency, strategy use and comprehension. We chose PM Benchmarks reading assessment, as it will be less disruptive for classroom teachers as it is regularly used. Teachers in the district are familiar with this assessment, it is available at no cost,

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and it does not require special training. It is usual practice for teachers to assess their students in the fall to plan for instruction. Following the results of the assessment, students are given a numerical value. This is a standardized test. Non-readers will be assessed looking at concepts of print and comprehension (*i.e. Do they know how to hold the book? Where to start? Can they read the pictures?*).

Standardized tests such as the Wechsler Objective Reading Dimension (WORD) the Neale Analysis of Reading Ability and a verbal IQ test developed for non-readers- The Non-Reading Intelligence Test are common in research studies (Jordan Black, 2005; McPhillips et al 2000). Regularly used assessments were chosen to avoid further disruption such as time taken for added assessment.

The Self-Regulation Check List, based on the work of Bronson (2002) who developed a **Checklist of Independent Learning Development (CHILD)**, includes statements under four areas of self-regulation: emotional, pro-social, cognitive and motivational characteristics. This is an observational checklist that will be completed by the classroom teacher for children in both groups, the one with the movement program, as well as the control group, both pre and post intervention

Figure 1: Self-regulation Checklist

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Bronson Self-regulation Checklist

Checklist of Independent Learning Development

		Not Yet	Sometimes	Most Often
Emotional				
	Can speak about own and others behaviour and consequences			
	Tackles new tasks confidently			
	Can control attention and resist distraction			
	Monitors progress and seeks help appropriately			
	Persists in the face of difficulties			
Pro Social				
	Negotiates when and how to carry out tasks			
	Can solve social problems with peers			
	Shares and takes turns independently			
	Is cooperative with peers			
	Is aware of others feelings. Helps and comforts			
Cognitive				
	Is aware of own capabilities			
	Can tell what he/she has done or learned			
	Can speak about planned activities			
	Can make reasoned choices or decisions			
	Asks questions Suggests answers			
Motivational				
	Finds resources without help			
	Develops own ways of carrying out tasks			
	Initiates activities			
	Plans, sets goals			
	Enjoys solving problems			

Procedure

The procedure followed in order to prepare, conduct pre assessments, implement the movement program intervention and the final collection of data will include the following: 1) Initial contact with the school district superintendent, to be sure all protocol

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is in place. 2) Contact school principals of the school involved in the study and obtain permission. 3) An information session with potential teachers, and permission from the educators (Appendix C). 4) Permission letters to parents (Appendix B). 5) Pretesting conducted at the school in individual classrooms.

6) Providing training for the teachers on the movement program. 7) Implementing the movement program through out the school year. 8) Providing follow up, meeting and support for teachers involved in the study through out the course of the research study 9) Post testing conducted at the school in individual classrooms after intervention, at the end of the 11 month study.

Table 2: Proposed Time Line

Time Frame	Dates	Actions
1	September 2015	Administer pretest assessments, both groups.
2	October- December 2015	Initiate Term 1 movement intervention with experimental group.
3	January – March 2016	Term 2 Movement intervention with experimental group.
4	April- June 2016 Latter part of June	Term 3 Movement intervention with experimental group. Administer posttest assessments with both groups.
5	July 2016	Data analysis and documentation.

Time Line

An 11-month research project is proposed, taking place during the school year, September to July. During September, we will confirm classes and teachers involved for the

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control and experimental group. Pre-tests of motor and reading ability will be administered. The movement intervention program will be implemented in the 2nd month, beginning in October of the study. The movement intervention will be implemented for 10 minutes a day, every school day for 9 months. Post-test will take place in the latter part of June. Analysis of data collected and documentation will take place in July.

Movement Program

The movement program, developed by the school district physiotherapist, is based on the INPP school intervention program (Goddard Blythe, 2012). The program will be taught to the intervention group classroom teacher and monitored by the school district physiotherapist for reliability. The movement program is based on a developmental sequence of movements that normally take place throughout infancy including vestibular functioning, proprioception, and reflex integration. The movement program consists of playful, movements, done slowly and mindfully, often set to music. This program will be implemented in to the regular curriculum of the intervention class for 10 minutes a day throughout the school year. The program will start with simpler developmental neurological movements and change three times throughout the 9-month intervention to introduce more advanced and difficult movement patterns (Appendix D). The classroom teacher will teach the movements to all children in the class.

Research Problems/Questions

Uncontrolled variables pose a problem for the reliability of the study. We are measuring reading and self-regulation as indicators of executive function. As previously stated, when looking at children's learning through a complex systems theory lens, there

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are many complex and interconnected variables. It is difficult to take them apart and look at them separately. We are aware of the many uncontrolled variables that can affect children's executive function. Some of the uncontrolled variables may be; the effectiveness of the classroom teacher, the social emotional atmosphere in the classroom of either the control or experimental group, the social emotional atmosphere of the home, or personal events that may affect individual children's cognitive performance (hungry, angry, tired).

Non-standardized assessment tools could pose a problem for the reliability of the study.

Inter-observer agreement will be estimated to ensure observers agree on their interpretation of observation of motor function. Observations will be discussed and identified to raise awareness and seek to prevent distortion of readings. To calculate these estimates, it will be necessary for two observers to observe the same child doing the movement tasks on the motor assessment and then directly compare their ratings. A percentage agreement score will then be calculated. A criterion level of 80-100% agreement will be required before the data are considered to be reliable.

Data Analysis

Groups Control Group (CG) Experimental Group (MP)

Assessments

- motor function (mf)
- executive function (ef)
- reading (re)
- self-regulation (sr)

Timepoints

- Baseline

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- Follow-up (9 months post-baseline)

In the primary analysis, scores on motor function (mf) will be compared with scores on executive function (ef) to see if there is a relationship.

In the secondary analysis, change in motor function (mf) and executive function (ef) score for each child will be calculated ($\text{change}_{\text{mf}} = \text{mf score at 10 months} - \text{mf score at baseline}$; $\text{change}_{\text{ef}} = \text{ef score at 10 months} - \text{ef score at baseline}$). A *t*-test will be used to determine whether or not there is a statistically significant difference between those children in the *experimental group* (SMP), as compared to children in the *control group* (CG) with regards to these changes. The hypothesis being that:

$$\text{change}_{\text{MF}} \text{ for SMP} \neq \text{change}_{\text{MF}} \text{ for CG}$$

In order to make sure that such a difference is not simply due to baseline differences, baseline scores of the two groups (SMP and CG) will be compared to see if there are any substantial differences. In the event that baseline scores between the two groups differ substantially, linear regression methods, controlling for baseline, or ANOVA analysis will be used.

To determine whether the differences between the control group and the movement exercise group are significant, a *t*-test will be used as in the primary analysis.

If it is determined that the movement program is effective, it may be of interest to investigate whether the intervention is particularly effective for those with higher, or lower baseline scores. To do this, a linear regression model with an interaction term could be used.

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Estimated Costs

The costs for the study will be minimal. The Benchmark assessment, self-regulation checklist and motor function assessment are available at no cost for use in our school district. The assessment for motor function is available through our school district physiotherapist. Much of the procedure carried out will be in the daily course of action, within the professional obligations of the classroom teacher, the school district physiotherapist, and the school district co-ordinators. Incidental costs such as providing materials (music CDs, photocopied movement guides) for the teacher of the experimental movement group will be less than \$100.

Summary

Previous research involving reflex integration in regular primary classes is limited. Four major themes have emerged. 1) There is an established link between movement and cognitive function. 2) Some research indicates a link between the retention of primary reflexes indicated by motor dysfunction, and executive function. 3) Limited research indicates that specific movement programs can aid with the integration of primary reflexes whereby remediating executive function. 4) There is little empirical research that shows reflex integration is important for cognitive learning in typical primary children. The bulk of the research done on reflex integration has been done in medicine, kinesiology and special education with children with diagnosed learning disabilities such as dyslexia, ADHD, autism and cerebral palsy.

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Goals

The major goals of the proposed study are to (i) determine whether there is the presence of primary reflex persistence in 2 classes of typical primary children. (ii) examine the relationship between reflex persistence and executive function. (iii) determine if a specific movement program, designed to help to integrate aberrant reflexes would be effective a) in aiding motor function and b) in executive function.

To address the first goal, both groups will be assessed on motor function. To address the second goal, we will compare the assessments of motor function with the assessment of executive function (reading and self-regulation). To address the third goal, we will determine if the experimental group, with the movement intervention program, has significantly higher scores than the control group on the post-tests of motor and executive function. To control for possible differences in baseline scores in the pre-test, we will incorporate the use of a multiple base-line design across the 2 primary classes to evaluate the effects of the movement program on motor and executive function.

The intension of the research proposal is to highlight the importance of movement programs for executive function in typical primary school children. The proposed study could generate useful information regarding a movement program in the primary grades that could aide in integrating persistent aberrant reflexes. This integration could have a profound affect on executive function in children. This could contribute to a clearer understanding of the role of movement in helping children's growth in executive functioning. It highlights the need for parents, teachers, and administrators to consider the importance of movement programs in the healthy neurological development of children.

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Chapter 4: Reflections

As a primary teacher, I have always believed in movement for young children for motivation, engagement and mental and physical health. Now I see the strong link between movement and cognition. I see the vital importance of movement in the early years to build a healthy neurological foundation for learning. The evidence behind physical activity for cognitive and self-regulatory development is strong. As I primary teacher I would go to cognitive methods to help struggling learners (more practise, word work). Now I would consider movement for remediation.

It was in the course of my Masters of Education program that I was first introduced to systems thinking. After teaching for many years, I knew *what* to do in a primary classroom. Now I was learning the *why*. I became very engaged in learning about the theory behind the practise. My exposure to systems thinking, and ecological systems theory has enabled me to see how children learn, through a different lens. Learning is a complex process, with so many variables and components acting, and interacting. As Aristotle said, '*the whole is bigger than the sum of its parts*'. Mechanistic, linear thinking just didn't work for me anymore. This became a challenge for me while writing this research proposal. With so many interconnected systems working together and interacting with each other, could I really measure the effect a of movement on executive function? There are so many complex and interrelated variables that build the thing we call self-regulation, yet alone reading. Reflex integration relies systems working together. I was concerned that this quantitative study I was proposing would not be able to capture the way in which these systems work together. Still, it is my hope that this

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study, should it be carried out, will shed some light on developing the brain through movement. We will know a little more, and hopefully, keep asking questions.

We live in a data oriented world. As I reflect on my work I recognize that while data can be important to help us find out about the world, let it not be our only source of information. We must listen to the voices of teachers. They have the experience and expertise. We must trust them. Let us consider the views of professionals in other fields who work with children. They too have a wealth of knowledge that comes from experience in their field. We must work together to see a bigger, more inclusive picture. Quantitative studies are not the only way. In the course of my inquiry I have found that case studies, anecdotal reports have merit and must be considered in the bigger picture.

My Personal Journey and Future Directions

I lived this project. After spending hours reading articles and books, perusing websites and listening to lectures, I would walk the mountain. Here my thoughts would percolate. I would, synthesize, critique, contrast and compare. I would organize my thoughts. As my body moved, my brain would work and I would return home to write. The forests and trails of Salt Spring Island became the brewing pot for this capstone. .

As primary coordinator for our school district, I now have a few more tools in my kit to support teachers with children with learning and behaviour difficulties. I now have more information to share with parents, teachers and administrators on the validity of our work in *Foundations for Learning*. There is support, and evidence that justifies our program. There are questions as well. If my proposed research is carried out, I hope it will shed more light on the work we have been doing, and will help to lead us in future

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directions. I will continue to learn, to find out more, and to work with our school district physiotherapist and colleagues to help children who show reflex persistence.

Recommendations for educators:

- 1) Move! Keep learning active for healthy brains and bodies. Make movement be an essential part of the curriculum. Consider movement for remediation. Young children need freedom of movement inside and out of doors for healthy neurological development.

- 2) Provide neuro-motor screening for children upon school entry. Integrate specific movement programs designed for reflex integration in primary classes for all young children. This is especially vital for those who show indications of motor dysfunction.

- 3) Be curious! Ask questions. Be open to new ideas and methods. Find out what professionals in other fields are doing. Work together and share information with parents, teachers, and other professionals. Keep abreast of current research.

Movement will only benefit our children and is vital, especially in the primary years where early the foundations for learning are being laid.

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Appendix

Appendix A: University of Victoria Ethics Approval Form (removed)

Appendix B: Parent Letter and Consent

Appendix C: Teacher Invitation Letter

Appendix D: Example of Movement Program: Terms One, Two and Three

Appendix: B Parent Letter and Consent

Dear Parent/Guardian,

Your child is being invited to participate in a study entitled “Developing the Brain through Movement”. This study is being conducted by Janet Hoag, Master’s candidate in the Department of Curriculum and Instruction at the University of Victoria.

Aim and Objectives

The aim of this research is to further understand the relationships between children’s brain development, movement, and cognitive function.

Importance of this Research

We know there is a strong relationship between movement and children’s learning. There is a concern in British Columbia that children are not getting the physical activity required for healthy brain-body development. Research has shown a correlation between the presence of retained primary reflexes and difficulties in learning. We want to know if movement is a means to help integrate these reflexes and improve cognitive function.

Ultimately, our intent is to help teachers, schools, and school districts enhance physical activity participation and recognize the importance of movement to healthy brain function.

Participants Selection

Your child is being asked to participate in this study because she/he is in a primary class in a School District 64 school.

DEVELOPING THE BRAIN THROUGH MOVEMENT

What is Involved

Your child will be assessed performing fundamental motor skills. These will include fine and gross motor movements. Your child will also be assessed on reading or pre reading skills. Your child will be assessed in area of self-regulation. Your child's classroom teacher will fill out an observational checklist. The classroom teacher will administer the reading assessment, supported by the researcher (Janet Hoag) and district support teachers. The school district physiotherapist will assess motor skills, supported by the researcher and the school district early learning coordinator.

Inconvenience

One of the two classes involved will be the experimental group. This class will receive a 10-minute movement program everyday.

Benefits

Your child's participation in this research will help us better understand the role that motor skills play in cognitive development and executive function; and may help reverse the decline in fitness/physical activity among Canadian children. The fundamental motor skill test results will also help your child's teacher plan their physical education curriculum.

Voluntary Participation

Your child's participation in this research must be completely voluntary. Choosing not to participate in this study will in no way affect your child's physical education lessons. All children in the class will do the fundamental motor skills in physical education, but only the data from consented children will be used for research purposes. If your child does participate, she/he may withdraw at any time without any consequences or any explanation. If she/he does withdraw from the study her/his data will not be used in the study and will be destroyed.

Anonymity and Confidentiality

Your child's participation will not be anonymous, as the fundamental motor skill data will be collected during physical education. There will be many small groups of children performing motor skills at the same time; therefore your child will only be performing in front of a few children. The data we collect will be entered into the computer without names and all presentations will refer only to group data.

Dissemination of Results

Aggregated data from this project may be presented to School District 64 and at professional meetings. Additionally, articles may be published and graduate students will use the data for their theses. The fundamental motor skill data will also be provided to your child's class teacher and to the school. Your child's teacher will receive information about each child's motor skills and the school will receive scores and for the class as a whole.

DEVELOPING THE BRAIN THROUGH MOVEMENT

Disposal of Data

The data will be shredded five years after collection. The computer files (without names) will be kept in a secure database for 15 years. An outcome of this project may be to track the development of children's skills and physical activity longitudinally; therefore it is important to retain the data to compare with possible future data collection.

Contacts

Please contact me if you have any questions or concerns.

Janet Hoag jhoag@sd64.bc.ca Cell phone

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of your child's participation in this study and that you have had the opportunity to have your questions answered by the researchers. We also ask that your child "signs" below to indicate that he or she is happy to be involved in the study.

Child's Name _____ Child's Signature _____

Parent/Guardian Name _____

Parent/Guardian Signature _____

Date _____

PLEASE COMPLETE THIS PAGE AND RETURN IT TO SCHOOL IN THE ENVELOPE PROVIDED.

Thank you,

Janet Hoag

DEVELOPING THE BRAIN THROUGH MOVEMENT

Primary Coordinator, SD 64

Masters Candidate

Dept. of Curriculum and Instruction

University of Victoria

(Thank you to Dr. Vivianne Temple for this template)

Appendix C: Teacher Letter

Dear Educator,

As you are likely aware our school district has been involved in a primary movement project we call *Foundations for Learning*. Many classroom teachers have been working with our school district physiotherapist, Judith Bradley using this movement program with children in their classes to promote learning and behavior.

As a Master's candidate in the Faculty of Education at the University of Victoria, I am in the process of conducting a research project that will examine the work we have been doing with *Foundations for Learning*. The purpose of the study is to determine if movement plays a role in learning and behavior.

The school district superintendent and the principal of your school have granted permission to conduct this study. This letter is an invitation for you to and your class to take part. If you volunteer to participate, you will be working collaboratively with Judith Bradley, the school district early learning coordinator Kathryn Akehurst, and myself, the primary coordinator.

Pretesting will be conducted to determine each child's level of motor functioning, reading and self-regulation. A movement program, very similar to the one we have been using will be implemented in one of the primary classes in the study. This movement program will be integrated into the regular teaching day for 10 minutes, everyday. Learners will be reassessed at the end of the school year. This post testing will be conducted to determine if there is improvement regarding the aspects assessed.

The following ethical measures are considered in the study:

- Confidentiality is of utmost importance
- The child's name, teacher's name or name of the school will not be mentioned at any stages of collecting or processing the data.
- The child has the right to withdraw from the study for any reason, without any prejudice.
- This study forms part of a Masters degree and results may possibly be included in a publication generated from this study. Data from this study will be kept for 5 years and may be used longitudinally.
- This study is undertaken under the supervision of Dr. Chris Filler with ethical approval from the University of Victoria.
-

DEVELOPING THE BRAIN THROUGH MOVEMENT

Should you accept, and be the teacher of the intervention group, you will be provided with a detailed program and demonstration of the movement program.

You are encouraged to ask any questions regarding the nature and methodology of the study. Please feel free to discuss these with me at anytime.

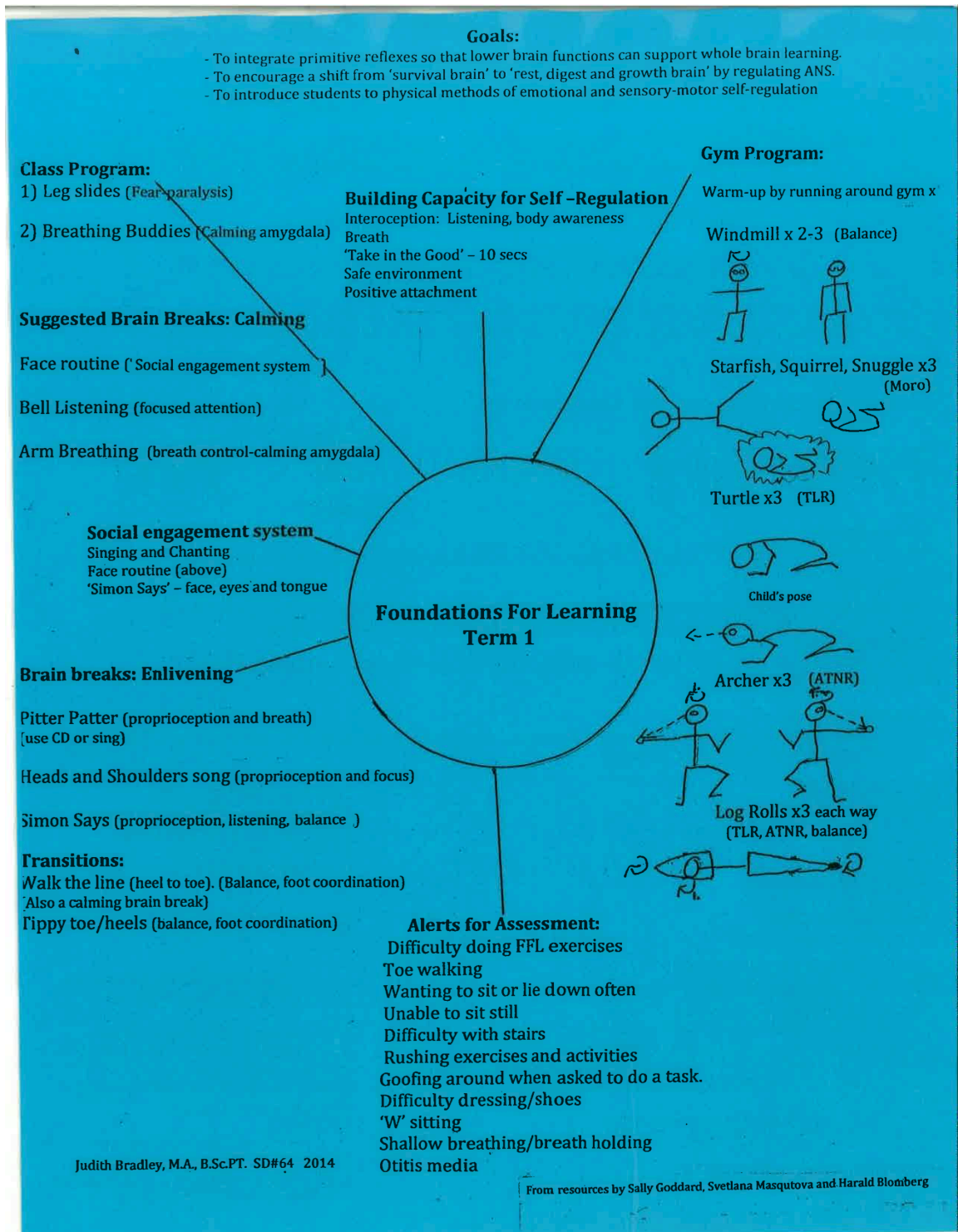
If you choose to participate, please contact me in person at school, by email or telephone. Thank you for giving me the opportunity to incorporate you and your class in this research study.

Sincerely, Janet Hoag jhoag@sd64.bc.ca Phone 25

Appendix D: Movement Program Examples Terms 1, 2 and 3

(Judith Bradley, Physiotherapist, S.D. 64, Gulf Islands, 2014)

DEVELOPING THE BRAIN THROUGH MOVEMENT



DEVELOPING THE BRAIN THROUGH MOVEMENT

GOALS:

- To integrate primitive reflexes so that lower brain function can support higher brain learning.
- To develop Rt/Lt body integration and laterality
- To develop binocular and visual accommodation.

Class Program

- 1) Continue breathing as self regulation
- 2) Balance on 1 leg at every transition

Creating focus:

- Do Archer in standing. Standing on straight leg move bent arm and leg
- 1) up and down
 - 2) apart and together
 - 3) to middle and out

Calming:

- Contract and relax moving thro body parts.

Frustration

- "Whoosh!!"
(see overleaf)

Songs on CD:

- Spin on your bottom
A Rum Sum Sum
Climbing Trees for Apples

Mindful Looking

- Smallest thing (see overleaf)

Gym Program

Warmup by running around gym

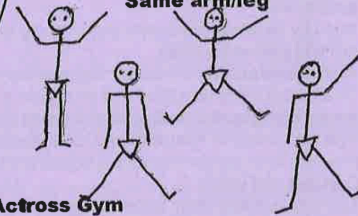
Helicopters x 2 (balance and proprio)



Rocking Cat (STNR)



Snow Angels (Sp G)
Arms only, Legs only
Both arms and legs
Same arm/leg



Across Gym

Belly Creeping one direction



Return varying animal walk

Bear Walk

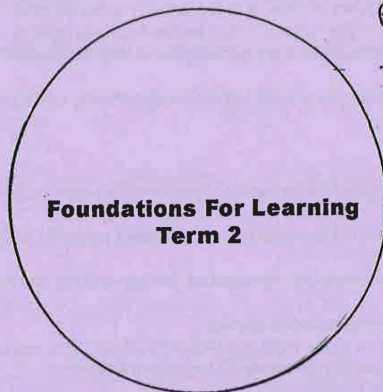


Bunny Hops



Crab walk

FWD, BWD, SIDE



DEVELOPING THE BRAIN THROUGH MOVEMENT

Goals:

- To integrate primitive reflexes so that lower brain functions can support whole brain learning.
- To develop dynamic balance and coordination.
- To develop cross lateral movement and core strength.
- To mature grasp reflex and develop fine motor skills

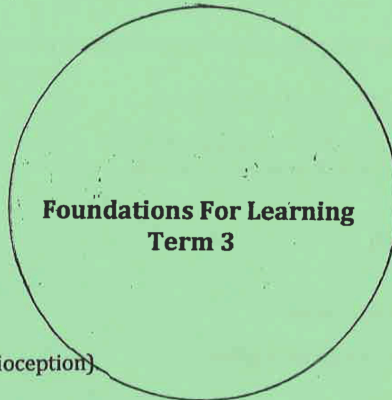
Class Program:

Preposition Play (Song provided later Courtesy of Sylvia)

(Can be done in Gym or Class)

Students spread out and stand holding a beanbag.
Teacher calls out instructions or sings song
with emphasis on word and body action.

- On TOP of head
- In FRONT
- UNDER legs
- Put on floor BEHIND you.
- Walk AROUND
- Jump OVER
- Jump to one SIDE
- Jump to other SIDE



Brain Breaks:

Where is Thumbkin?

(For manual dexterity and proprioception)

Thin as a pin, Wide as a house, Tall as a tree, Small as a mouse.

Robinson Grasp Rap

(For students who still 'fist' and for fine motor development)
See overleaf for instructions and diagrams.

Right hand

I'm shy.
Think I'll take a peek.
Think I'll say hello.
Hi! How are you?
I'm great!
Let's shake.

Left Hand

Me too.
Me too.
Me too.
I'm fine! And you?
Me too!
Me and you.



Judith Bradley, M.A., B.Sc.PT. SD#64 2014

From resources by Sally Goddard, Svetlana Masjutova and Harald Blomberg

Gym Program:

Warm-up by running around gym x

Busy Bee Spins



Flying Eagle

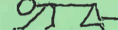


Donkey Kicks



Across width of gym:

(For mid-brain development)



Crawl across on hands and knees.

(Vary speed and deter racing)

Return using these movemen

(For laterality, Rt/Lt brain integration)

Cross- knee stepping using :

1) Hand to opposite knee



2) Elbow to opposite knee



3) Hand to foot in front



Hand to foot behind



1) SAME
2) OPPOSITE