Rhythmic Movement Training International (RMTi) Curriculum

Evidence-Based Rationale and Relevance to Occupational Therapy Practice

by Sonia Story

Occupational therapists (OTs and OTAs) help individuals particpate in activities, or occupations, that are important to the specific individual's daily life, goals and interests. Using a holistic approach and a variety of therapeutic tools, occupational therapists help individuals develop skills for success in meaningful activities (AOTA, 2017).

In the Rhythmic Movement Training (RMTi) courses, we teach neurodevelopmental movements. Neurodevelopmental movements are the innate developmental, rhythmic, primitive reflex, and postural reflex movements of early infancy and childhood. Occupational therapists utilize these neurodevelopmental movements to improve balance, posture, motor skills, muscle strength, stamina, coordination, sensory processing skills and overall functioning for individuals of all ages.

Primitive and Postural Reflexes

The Rhythmic Movement Training courses give theoretical and experiential learning of primitive and postural reflex patterns useful to occupational therapists for both assessment and intervention.

Innate infant reflexes have long been used as signs for determining the health or dysfunction of the central nervous system (CNS) (Fiorentino, M., 1973). The infant reflex movements are crucial for development; they fuel brain growth and build the neuro-sensory-motor skills needed to progress to an upright, walking toddler. These same neuro-sensory-motor skills are the foundation for balance, posture, strength, speech, gross and fine motor skills, social-emotional skills, and future learning. Because of their importance to development, assessing the primitive infant reflexes is part of newborn neurological exams (Fletcher, M. A., 1998).

Though primitive reflex movement patterns are present in normally developing infants, ideally most are integrated (i.e., no longer active, inhibited) by the end of the first year. As the brain and body mature, volitional movements and

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postural reflexes replace primitive reflexive movements. Children and adults with unintegrated, retained primitive reflexes and underdeveloped postural reflexes often experience mild to severe obstacles in functioning and learning. Observation of sensory and motor reflex patterns beyond infancy informs assessment of how the CNS is functioning. Use of innate reflex patterns also serves as part of an overall plan for intervention.

Consequences of Retained Primitive Reflexes

Primitive reflexes are stereotypical movement patterns that should be integrated in infancy as the cortex develops and overrides reflex expression at the brainstem level. However, for many children these reflex patterns are not fully integrated or inhibited. Even if an individual does attain fully integrated primitive reflexes, the movement patterns are still underlying at the brainstem level and may reemerge in cases such as brain injury, stroke, dementia or trauma. The persistence of primitive reflexes beyond infancy is associated with developmental delay as well as neurological and physical challenges. Retained reflexes also are a reliable predictor of emotional, functional and cognitive challenges across the age span.

For example, retained primitive reflexes are common in children with challenges such as Developmental Coordination Disorder (DCD) (Goddard Blythe, S., 2009), Attention-Deficit Hyperactivity Disorder (ADHD) (Konicarova, J., Bob, P., Raboch, J., 2013), and dyslexia (McPhillips, M., Jordan-Black, J. A., 2007), and in adults with schizophrenia (Hyde, T. M., Goldberg, T. E., Egan, M. F., Lener, M. C., Weinberger, D. R., 2007).

Additionally, retained primitive reflexes are commonly found in frontal lobe disease, Parkinson's disease, dementias, and advanced HIV infection (McGee, S. R., 2001).

Recent research shows that the reappearance of primitive oral-facial reflexes in nursing home patients was associated with challenges in eating function, risk of malnutrition, and risk of developing aspiration pneumonia (Hobo, K., Kawase J., Tamura, F., Groher, M., Kikutani, T., Sunakawa, H., 2014).

Retained primitive reflexes and underdeveloped postural reflexes correlate with abnormal muscle tone, poor postural control, and poor coordination (Fiorentino, M., 1972; Goddard, S., 2005). Extensive studies explore this relationship in individuals with cerebral palsy and with other known neurological conditions such as stroke. Retained reflexes that are less severe than those occurring in cases of brain injury can still drive changes in muscle tone and postural control. These reflex-driven tonal and postural changes, though less severe, may still significantly affect function (Kohen-Raz, R., 1986; Goddard, S., 2005).

Specific Reflexes and Supporting Research for Reflex Integration

Looking at specific retained reflex patterns and their impact on functional tasks helps us understand why it is important to address retained reflex patterns.

Tonic Labyrinthine Reflex (TLR)

When retained, TLR can cause weak muscle tone, exaggerated muscle tone, tone that fluctuates with head movement, center of balance that changes with head position, visual dysfunction, impaired balance, and poor posture (Blomberg, H., Dempsey, M., 2011).

Asymmetrical Tonic Neck Reflex (ATNR)

A retained ATNR may cause various difficulties for the growing infant and child: lack of normal hand-to-mouth and hand-to-hand play, which can result in imbalances in oral sensitivity and poor bilateral, symmetrical upper extremity use; poor control of eye muscles resulting in poor visual perception (Bly, L., 1983); and poor ability to cross midline and poor laterality (Goddard, S., 2005).

In addition, a retained ATNR can set the stage for scoliosis (Bly, L., 1983) and may cause further difficulty with specialized movement tasks such as handwriting and use of tools (Goddard, S., 2005). A retained ATNR is also associated with ADHD symptoms (Taylor. M., Houghton, S., Chapman, E., 2004; Konicarova, J; Bob, P., 2013), and reading challenges (McPhillips, M., Hepper, P. G., Mulhern, G., 2000; Jordan-Black, J. A., 2005). Intervention programs based on replicating innate infant movements, including ATNR reflex patterns, showed significantly greater improvement in reading and writing speed for the experimental group (McPhillips, M., Hepper, P. G., Mulhern, G., 2000), and in a related study, correlated with higher reading and mathematics scores (Jordan-Black, J. A., 2005).

A 2012 study found evidence of ATNR reemergence following stroke. When voluntary neck rotation elicited ATNR, the authors concluded that ATNR expression likely utilizes "a common neuroanatomical link" with "flexion synergy—the abnormal torque coupling of elbow flexion with shoulder abduction—***resulting in loss of independent joint control in stroke patients***" (Ellis, M. D., Drogos, J., Carmona, C., Keller, T., Dewald, J. P. A., 2012, emphasis added).

Symmetrical Tonic Neck Reflex (STNR)

STNR, when retained, may cause impairment of visual skills and learning challenges (Goddard, S., 2005). Utilizing movements to integrate STNR is highly useful in overcoming the symptoms of ADHD (O'Dell, N., Cook, P. A., 2004). In her book *Reflexes, Learning and Behavior*, Sally Goddard highlights studies focusing on STNR integration that show improvement in learning as well as reduction of hyperactivity (Goddard, S., 2005).

It is worthwhile to note that ADHD symptoms—linked to both a retained ATNR and a retained STNR—also are significantly associated with balance deficits. Balance deficits were measured even in individuals with ADHD who have no history of medication and no neurological disease present (Konicarova, J., Bob, P., Raboch, J., 2014). In clinical situations, we see that when we mature infant reflexes, balance skills improve measurably. Recent research also shows that improving balance ameliorates anxiety and increases self-esteem (Bart, O., Bar-Haim, Y., Weizman, E., Levin. M., Sadeh, A., Mintz, M., 2009).

Moro Reflex

When the Moro Reflex fails to mature, we observe numerous sensory processing challenges and underlying stress, as the nervous system remains in a state of fight-or-flight (Goddard, S., 2005). In addition, a retained Moro Reflex is associated with ADHD symptoms and learning challenges (Taylor. M., Houghton, S., Chapman, E., 2004).

Combined Reflexes

In a study implementing movement corrections for several retained infant reflexes, children showed significant improvement in reading fluency and reduction of headaches (Wahlberg, T., Ireland, D., 2005).

In another study, oculo-motor functioning and reading skills improved as retained reflexes were corrected (Bein-Wierzbinski, W., 2001, as quoted in Goddard, S., 2005).

Rationale for Addressing Retained Reflexes and the Problems that Arise Subsequent to the Retained Reflexes

According to Shereen D. Farber, MS, OTR, FAOTA, author of *Neurorehabilitation: A Multisensory Approach*, a delay in primitive integration may result in:

> decreased segmentation of the trunk, decreased isolation of movement, decreased rotation component in any action, postural insecurity, decreased ability to develop antigravity muscles, increased synergy patterns (mass movement patterns) and increased dependence on environmental stimulation for changes in posture. ***One of the main goals of multisensory theory of neurorehabilitation is to integrate primitive reflexes while facilitating higher-level responses.*** (Farber, S., 1982; emphasis added)

The action of integrating primitive reflexes develops the foundation for function. The basic premise supporting the use of neurodevelopmental movements for occupational therapists is that the brain recognizes and responds to these innate movements whose original function is to support brain, body and sensory development. These innate neurodevelopmental movements stimulate and develop important neuro-sensory-motor and brain pathways as a regular course of human development, and we can use these movements at any age to create effects similar to those we see in infancy (Blomberg, H., Dempsey, M., 2011).

Svetlana Masgutova, developer of the Masgutova Neuro-Sensory-Motor Reflex Integration program (MNRI), also has experienced beneficial outcomes for children with challenges by using the innate primitive and postural reflex movement patterns (Masgutova, S., Akhmatova, N., Sadowska, L., Shackleford, P., Akhmatov, E., 2016).

Using a combination of techniques including innate rhythmic movements and primitive and postural reflex integration, Melody Edwards, a pediatric physical therapist, developed a successful treatment protocol for resolving infant torticollis (Edwards, M., 2017).

It is reasonable that these innate neurodevelopmental movements can help mature the brain and sensory systems beyond infancy. Increased brain maturity via neurodevelopmental movements is the explanation given for the successes of Harald Blomberg, MD, psychiatrist, and one of the developers of the Rhythmic Movement Training program from RMTi.

Use of Innate Rhythmic and Developmental Movements to Support Reflex Integration and Function

Blomberg was a student of Kerstin Linde, who pioneered the use of the innate rhythmic movements to help individuals with developmental and functional challenges. Blomberg found the rhythmic movements especially helpful for adult psychiatric patients with severe mental illness. Psychiatric patients using the rhythmic movements showed more interest in social activities, were less irritable, and had a greater sense of well-being (Blomberg, H., 2007).

Blomberg's results with these adult patients are consistent with findings that show childhood neuromotor dysfunction is a risk factor for adult schizophrenia (Murray, G. K., Jones, P. B., Moilanen, K., Veijola, J. Miettunen, J., Cannon, T.D., Isohanni, M., 2006). Blomberg later used a combination of rhythmic movements and reflex integration to help children (Blomberg, H., Dempsey, M., 2011).

In his work applying innate rhythmic movements and reflex integration with children with ADHD, developmental delay, and learning challenges, Blomberg witnessed immense improvements in function and often a reversal of ADHD symptoms and learning challenges (Blomberg, H., Dempsey, M., 2011).

The fact that research studies conclude that symptoms of ADHD arise from a delay of normal brain maturation (Sripada, C.S., Kessler, D., Angstadt, M., 2014; Rubia, K., 2007) gives further support to the use of innate neurodevelopmental movements as a key factor in promoting brain maturation and creating successful outcomes for this condition.

There is promising preliminary evidence showing that rhythmic and primitive reflex motor intervention can reduce muscle tension, diminish sensory processing challenges, and improve balance, coordination, and physical function (Blomberg, H., Dempsey, M., 2011; Gazca, M., 2012).

Rhythmic sensory input has been beneficial for helping with gait in patients with Parkinson's disease (Kadivar, Z., Corcos, D., Foto, J., Hondzinski, J., 2011) and following stroke (Hayden, R., Clair, A., Johnson, G., Otto, D., 2009). Rhythmic sensory input has been effective for helping children exposed to trauma, most likely by means of regulation of the brainstem (Perry, B., 2006). Neurodevelopmental rhythmic movements such as crawling have played a part in successful rehabilitation after stroke (Doidge, N., 2007).

Common Disorders Linked to Sensory-Motor Abnormalities

Understanding that the innate neurodevelopmental movements of infancy are fueling brain growth and connectivity helps us grasp why they may be highly beneficial for a wide variety of conditions involving sensory-motor challenges, including Developmental Coordination Disorder (DCD), ADHD, sensory processing deficits, stroke, autism spectrum disorder (ASD), anxiety, traumatic brain injury, Parkinson's disease, Down syndrome, and more.

We often see retained primitive reflexes and balance issues in individuals with DCD, ADHD, stroke, anxiety, ASD and many other conditions. Therefore, therapists using neurodevelopmental movement tools may contribute greatly to helping individuals with these and similar disorders.

Recent studies show that motor coordination challenges are present in a high majority of individuals with ASD and "*findings indicate that motor impairment constitutes a core characteristic of ASD*" (Hilton, C. L., Zhang, Y., Whilte, M. R., Klohr, C. L., Constantino, J., 2012, emphasis added). Using innate neurodevelopmental movements may be of huge significance to individuals suffering from ASD, especially considering that autism spectrum disorder is highly associated with mild to severe movement abnormalities.

Using a computerized posturographic procedure, children with autism were found to have postural control patterns that differed from normal children (Kohen-Raz, R., Volkmar, F. R., Cohen, D. J., 1992). Delays in motor functioning related to reflexes and development also are seen as reliable early indicators for risk of autism (Flanagan, J. E., Landa, R., Bhat, A., Bauman, M., 2012; Teitelbaum, P., Teitelbaum, O. B., Fryman, J., Maurer, R., 2002). In a recent *Physical Therapy* journal, subtitled "Current Perspectives on Motor Functioning in Infants, Children and Adults with Autism Spectrum Disorders," the authors state: "This article aims to highlight and support our perspective that motor abnormalities seen in individuals with ASDs, if more widely recognized, may affect ASD interventions and eventual outcomes." (Bhat, A., Landa, R., Galloway, J. C., 2011)

Consistent with previous studies, we see that application of primitive reflex patterns for individuals with ASD results in building a foundation that leads to better function. For example, application of the Masgutova Neuro-Sensory-Motor Reflex Integration method (MNRI) for individuals with ASD resulted in significant improvement in the children's cognitive abilities, as well as in emotional regulation, self-awareness, social interaction, stress resilience, physical health and speech (Masgutova, S., Akhmatova, N., Sadowska, L., Shackleford, P., Akhmatov, E., 2016).

Plausible Mechanisms for Brain Maturation and Connectivity

It is helpful to understand plausible mechanisms underlying the increased brain and neuro-sensory-motor maturity fueled by neurodevelopmental movements. In his book *Spark*, John Ratey, MD, cites several studies showing that movement activity stimulates BDNF—Brain Derived Neurotrophic Factor (Ratey, J. J., 2008). BDNF also stimulates myelin formation repair after stroke (Ramos-Cejudo, J., Gutiérrez-Fernández, M., Otero-Ortega, L., Rodríguez-Frutos, B., Fuentes, B., Vallejo-Cremades, M. T., Navarro Hernanz, T., Cerdán, S., Díez-Tejedor, E., 2014).

Myelin, the fatty sheath surrounding neuronal axons, is essential for normal brain function. The development of the myelin sheath enables rapid, effective communication across the brain and is thought to be involved in higher order cognitive functioning. We now know, through quantitative measures, that myelination increases greatly in the first three years of life during normal development (Carmody, D. P., Dunn, S. M., Boddie-Willis, A. S., DeMarco, J. K., Lewis, M., 2004).

Learning a new motor skill also increases myelin. Furthermore, the rate of learning correlates significantly with increased myelin density (Sampaio-Baptista, C., Khrapitchev, A.A., Foxley, S., Schlagheck, T., Scholz, J., Jbabdi, S., DeLuca, G.C., Miller, K.L., Taylor, A., Thomas, N., Kleim, J., Sibson, N.R., Bannerman, D., Johansen-Berg, H., 2013). We can reason that the enormous changes in myelination during infancy are stimulated at least in part by the innate movements concurrent in normal development as an infant learns to be more skillful with motor tasks.

The simple reason that innate neurodevelopmental movements are effective is because human development itself is effective. It seems the brain is inherently wired to recognize and respond to the innate movements of infancy.

What is most significant is that the principles seen in infancy—whereby reflex patterns stimulate the development of increasingly complex sensory-motor skills—can be utilized beyond infancy to promote the foundations of function at any age.

Another possible mechanism explaining the brain maturation and beneficial effects of neurodevelopmental movements is their tendency to promote relaxation and calm. From a basis of calm, our brain and body systems are better able to rest, digest, grow and learn. The innate rhythmic movements especially have been observed for millennia to promote calm in infants. Sucking is one of the first calming rhythmic movements and human beings instinctively rock their infants rhythmically to soothe them. In the multisensory approach to neurorehabilitation, rhythmic movement is suggested to help a client relax and as an appropriate sensory input in cases of hypertonicity (Farber, S., 1982).

Visual Processing Example Shows the Importance of Neurodevelopmental Movements

When we examine the development of human visual skills, it helps us see the importance of neurodevelopmental movement as a foundation for function. For most human beings, daily occupations require extensive visual processing. While all of our sensory systems are highly complex, according to Gesell, "Human vision outranks all other senses in the abundance of its sensory, motor, autonomic and higher cortical ramifications" (Gesell, 1952). The relatively large amount of "cortical ramifications"—or brain-body connections—required for visual processing is indicative of the large degree to which we rely on our vision for successful growth, learning and performance of daily activities. Many functional tasks with which occupational therapists aim to help their clients rely in part on visual skills.

Like nearly all of our sensory systems, development of vision is contingent on a variety of sensory-motor inputs over time. For example, as Gesell describes, the important [asymmetrical] tonic-neck-reflex pattern [ATNR] develops in the womb and then "undergoes further developments in the elaboration of the eye-hand-brain complex for months and even years to come" (Gesell, 1952).

Along with ATNR, many primitive reflexes develop and support visual skills throughout infancy and early childhood. Carol E. Marusich, a developmental optometrist, explains that poor integration of early infant reflex movements can be the basis of problems such as "poor ocular movement, binocularity, accommodation, and visual performance" (Marusich, C.E., 2002).

The neurodevelopmental movements are also important for remediation of visual skills. School-age children with visual challenges show significant improvements in visual activities, such as reading, when they are given specific sensory-motor activities based on the ATNR pattern and other early infant movements (McPhillips, M., Mulhern, G., and Hepper, P. G., 2000; Jordan-Black, J. A. 2005; Wahlberg, T., Ireland, D., 2005).

Since most individuals rely greatly on the visual system to be successful in functional tasks, it makes sense to utilize evidence-based sensory-motor tools, such as the ATNR and other reflex patterns that support the foundation for optimal functioning of the visual system. The same premise—using innate sensory-motor tools to support the developmental foundation for function—applies to tactile, vestibular, proprioceptive and auditory sensory systems.

The Rhythmic Movement Training (RMTi) Curriculum Overview

In the Rhythmic Movement Training curriculum we combine an in-depth set of neurodevelopmental movement tools to integrate primitive and postural reflexes.

The curriculum is organized into two main parts—primitive and postural reflexes, and rhythmic and developmental movements.

Part One: Innate Sensory-Motor Reflex Patterns

For each reflex listed, we teach:

- » Original stimulus for the reflex pattern
- » Original motor pattern of the reflex
- » Original functions of the reflex in infancy
- » How to assess for retained or abnormal reflex activity
- » How to recognize various compensatory behaviors and consequences that may relate to a specific retained reflex pattern
- » Various motor and tactile interventions to mature and integrate the reflex pattern

Rhythmic Movement Training, Level 1

Tonic Labyrinthine Reflex
Landau Reflex
Amphibian Reflex
Symmetrical Tonic Neck Reflex
Spinal Galant Reflex
Babinski Reflex

Rhythmic Movement Training, Level 2

Fear Paralysis Reflex
Moro Reflex
Tendon Guard Response

Rhythmic Movement Training, Level 3

Moro Reflex
Asymmetrical Tonic Neck Reflex
Headrighting Reflexes
Hand-Mouth Babkin Reflex
Palmar Grasp Reflex
Hands Pulling (Pull-to-Sit) Reflex

Part Two: Innate Rhythmic and Developmental Movement Patterns

In the Rhythmic Movement Training curriculum, along with reflex assessment and integration protocols, we teach specific developmental and rhythmic movements—the innate, self-initiated rhythmic movements of infancy—that provide tactile, vestibular, proprioceptive, rhythmic-motor, and rhythmic-auditory input. In addition to their calming, maturing and organizing effects in development, many of these rhythmic movements involve weight shifts that are important in developing proper upright posture, balance and gait.

The RMTi curriculum offers the therapist a variety of intervention strategies and integrative movement tools for all ages.

Conclusion

The evidence suggests that through the use of innate neurodevelopmental movements—the primitive and postural reflexes plus the developmental and rhythmic movements of infancy—occupational therapists can create measurable, functional and beneficial outcomes for individuals in their care. Utilizing this inborn sensory-motor template of movements appears to fuel brain growth, connectivity, and sensory maturity. It also seems to provide calming and increased receptivity to learning new skills. These special, innate movements repeatedly show effectiveness in clinical and research settings. And because of their fundamental importance in human life, the neurodevelopmental movements show great promise for helping individuals of all ages overcome a large variety of challenges in order to enhance meaningful participation in work, play, leisure, education and social activities.

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