NEURO-MOTOR MATURITY AND THE EMERGENCE OF VISION: A Look at Primitive Reflexes and Their Role in Visual Sensory Motor Development

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NEURO-MOTOR MATURITY AND THE EMERGENCE OF VISION:
A Look at Primitive Reflexes and Their Role in Visual Sensory Motor Development

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Disclaimer

I am not receiving any financial benefit for mentioning any program or products. I am not endorsing any one program over another. Furthermore, there are other notable programs not mentioned in this lecture that may be especially helpful to you.
My Journey...

- Married to Alex Andrich, OD, FCOVD
- Therapy Director: The Vision Development Team
- Motor skills have always been a part of my therapy model
- Early days: Master’s Degree in Special Education
- State coordinator for special education services in Ohio
- Member of the Ohio Motor Task Force (Ohio Department of Education)
My Journey...

- Received Occupational Therapy Degree in 1999 and began working in collaboration with Alex providing vision therapy services
- 2009 - COVT
- 2011 Studied in the UK and received certification and license to teach and use the INPP method. (Institute for Neuro-Physiological Psychology)
How do I Use Motor in VT?

COMPREHENSIVE VISUAL SENSORY MOTOR EXAMINATION

PERCEPTUAL EVALUATION → VISION THERAPY

REFLEX EVALUATION → REFLEX PROGRAM → VISION THERAPY
"Movement is essential to our ability to walk, run, and play; to seek out and eat the food that nourishes us; to communicate with friends and family; to earn our living---in essence to survive."

- Terri Nash, MS, CPM
Brain Function

“Brain function might be considered to have four principal aspects: emotional experience, perceptual appreciation, motor activity (involuntary and voluntary) and cognitive activity.” - James Koetting, OD, PhD
Motor Control

- It is the coordination of muscular, skeletal, and neurological functions used to produce a movement
- Skills that develop over time
- Infants use motor skills to access and touch the world around them
- As clinicians our ultimate goal is to give the child the opportunity to develop intelligence
- Vision and motor are the power tools for this!
Why Should Optometrists Be Involved With Motor?

- What is the value of vision if we do not possess a dynamic, efficient and automatic motor component?
- If we define vision as “the deriving of meaning and directing of action” then how do we accomplish the “action” part?
- Most offices that provide optometric vision therapy include motor activities as a core component of therapy
- These motor activities are necessary to build up vision skills that become automatic and resistant to decompensation from stress
Why Should Optometrists Be Involved With Motor?

- Optometrists spend a lot of time analyzing visual motor skills. It is a core component of optometric VT.
- Entire books have been written on the topic of eye movements alone.
- Let's talk MOTOR!
Terminology

You say po-tay-toe

I say po-tah-toe

Some can spell it as: gh-ough-phth-eigh-tte-eau
Primitive Reflexes

- Automatic, repetitive movement patterns
- Initiated and controlled by the brainstem
- Emerge in utero - integrated within 1st year of life
- Important for survival and movement learning
- Inhibited by higher brain areas and then integrated within the nervous system
- Retained with atypical neurology, poorly developed motor systems
- Reappear with trauma, dementia, or brain injury
Postural Reflexes

- Reflexes that help us to support our posture against gravity so that we can sit, stand, and move without falling over
- Mediated by midbrain
- Through childhood and into adulthood, we rely on these reflexes to maintain balance
Neuro-Motor Maturity

- The maturation process of the nervous system beginning with simple reflexive movements to complex brain processes that lead to optimal functioning.

“An indicator of developmental readiness for education”

- Sally Goddard Blythe
Primary Motor Patterns

“Genetically programmed reactions ranging in complexity from simple reflex responses occurring at the spinal cord level, to more complex “survival based” response patterns involving brain stem activity, to sensory-motor coordination systems (eye/hand coordination, visual/auditory integration, etc.), and finally, to application of these fixed patterns in more complex activities (visual tracking of a moving object, articulation for pronouncing sounds, etc). Primary motor patterns serve as the basis for future development, as they are natural resources which support the development of synaptogenesis, myelination, and optimal brain function.” – S. Masgutova
Functions of Reflexes

- Survival - Automatic subconscious responses to changes or stimuli within or outside our bodies
- Maintain homeostasis (heart rate, breathing rate, blood pressure, and digestion)
- Automatic actions such as swallowing, sneezing, coughing, and vomiting
- Serve as early motor experiences that are on course to become refined and complex
Sequence of Primitive Reflex Integration and Vision Skill Development
Clinical Pearl

- When looking at models of motor, it is important to understand that almost nothing in the human body works in complete isolation – remember, the eyes are connected to the rest of the body.
  - When doing the simple task of walking, multiple sensory systems are at work: Visual, vestibular, proprioceptive, etc.
Model of Neuro-Sensory Motor Maturity

- Reflexive Motor
- Gross Motor
- Fine Motor
- Super Fine Motor

- Proprioception
- Vestibular
- Vision
- Tactile
- Auditory
- Taste
- Smell

Sophisticated Perceptions & Cognition

Andrich, P. 2013
Reflexes and
The Development of Vision
The vestibular system is the 1st sensory system to develop in the womb, and starts to develop when the fetus is only 2 GW old.

By day 44, primitive semicircular canals are present.

The vestibular system is fully formed, well myelinated and functioning in the womb by 21 gestational GW (GW).
Reflexes and The Development of Vision

- Wk 4 the tongue bud is formed
- Wk 5 the nasal pits are present
- GW 6–7 the brainstem is formed and matures in a caudal to rostral arc, forming the medulla, pons, and midbrain
- Wk 8 the mouth and tongue are completed and the neocortex begins to develop
- Wk 20 the taste buds emerge

http://www.healthtip.info/pregnancy-in-10th-week/
Reflexes and The Development of Vision

- As sensory and motor fibers emerge, sensory neurons start linking directly to motor neurons - synapsing in the spinal cord, forming a reflex arc.
- By the 7th–9th GW the fetus displays spontaneous reflexive movements occurring at brain stem level.
Reflexes and The Development of Vision

- The Moro reflex can be seen at 9 GW
- Sensory nerve endings in place and functioning by 11 GW - Tactile sense
- Palmar grasp (emerges) emerges at 11 GW
- Tonic Labyrinthine forward at 12 GW
Reflexes and The Development of Vision

- ATNR emerges at 13 GW
- Gallant reflex emerges at 15-18 GW
- Babinski (Plantar) Reflex emerges at 18 GW
Reflexes and
The Development of Vision

- Vision, our most predominant sense after birth, evolves steadily during gestation.
- As early as 18 GW, when the eyes are still closed, a baby's retinas can already detect light.
- By 20 GW each cortex has a billion neurons.
Connections are made between the retina, lateral geniculate nucleus (LGN), and visual cortex at about 20–22 GW.

The fetus’ eyelids remain closed until about the 26th week, during the phase of retinal development.
Reflexes and The Development of Vision

- 23 GW the fetus responds to maternal speech (hearing)
- 25 GW the fetus demonstrates stimulus-induced heart rate accelerations
- 26 GW the eyes open and the baby can blink!
- Between GW 20 and 27, the pons mediates arousal, body movements, vestibular and vibroacoustic perception
Reflexes and The Development of Vision

- 30 GW the baby can see what's going on in utero, distinguish light from dark and even track a light source
- The baby can move his head to follow the light or even reach out to touch the moving glow
- Twins are able to locate each other evidenced by touching faces or holding hands
- 33 GW the pupils of the eye constrict and dilate
Reflexes and The Development of Vision

- 36 GW the midbrain’s inferior-auditory colliculus and the superior-visual colliculus mature.
- The fetus now makes fine auditory discriminations and reacts to sound with fetal heart rate (FHR) accelerations, head turning, and eye movements.
- At 37 GW the tonic labyrinthine in prone and supine is present.
Reflexes and The Development of Vision

During fetal development, awake or asleep, the fetus reflexively moves 50 times or more each hour, flexing and extending its body, moving its head, face, arms and legs. As the baby explores the womb, its hands touch the face, other hand, feet, and umbilical cord.
Reflexes and The Development of Vision

- Full-term newborns have already begun to develop basic visual skills including focused acuity (8 to 12 inches), color discrimination, contrast sensitivity, accommodation, binocular function, and sensitivity to motion patterns.

- Through the process of child development, ongoing sensory and motor experiences will stimulate the process of refining vision skills.
Reflexes and The Development of Vision

- The newborn’s eyes search the environment day and night, showing curiosity and basic form perception

  - Slater, Mattock, Brown, and Gavin, 1991
The Neurophysiological Basis for Vision Development

- The reflexive system is the neurophysiological basis for the establishment of refined gross motor, fine motor (super fine motor) coordination, sensory integration and cognitive processes.
- This includes the developing visual system.
The Neurophysiological Basis for Vision Development

- The level of neuromotor maturity is directly correlated to the proper timing of the emergence, inhibition and integration of our motor reflexes.
- When reflexes emerge or integrate out of sequence, normal maturation of the nervous system is disturbed.
- The degree of abnormal reflex activity influences how well or how poorly nerve fibers are organized, thus affecting muscle tone, coordination, sensory perception, cognition, psychology and vision development.
The Neurophysiological Basis for Vision Development

- Our nervous system (Jenga tower) is only as strong as its support pieces
- These pieces being specific reflex patterns emerging and being put in place at the proper time in development
- High level motor and cognitive skills (top of Jenga tower) developed by a child later in life are reliant on earlier stages of development (the Jenga base)
The Neurophysiological Basis for Vision Development

- Even though the child may have enough pieces in place for intellectual ability, the child may not reach their full potential due to missing foundation pieces.
- When the pieces are not put in place at the right time and sequence, development will occur at the expense of altered automaticity.
- Continuous, laborious and conscious effort will be needed to master even the simplest skills.
The Neurophysiological Basis for Vision Development

- Patients with poorly developed visual systems seek the vision therapy optometrist to “fix” or improve the functioning of the visual system.
- The Optometrist who looks at underlying reflexes that support visual skill development may have an advantage in helping their patients.
- Stabilizing and strengthening the support beams of the nervous system tower will help speed up the process of gaining, mastering and retaining visual skills learned while in vision therapy.
Stabilizing and Strengthening The Tower

- Awareness of the primitive reflexes that influence the development of specific vision skills can help the optometrist isolate which piece(s) (retained reflex) of the Janga tower is faulty or missing.

- The detection of retained primitive reflexes can help to isolate the causes of a child’s visual challenge so that the optometrist can go right to the base of support and solidify the neurological foundation of the specific vision skill(s) in question.
Stabilizing and Strengthening The Tower

- Using specific neuro-developmental movements will help you to facilitate the myelination and proper functioning of the nerves, thereby improving brain circuitry.

- Supporting maturation of the nervous system facilitates communication between neural networks stimulating the development of vision skills as well as other sensory and motor functions.
“As Skeffington, Getman and others frequently said, ‘The wreck we measure is the end point of a visual problem, not the problem itself.’ No, you’re right, they really didn’t say “wreck”, they meant visual problems: refractive error, suppressions, amblyopia, binocular vision disorders, including strabismus. These adaptive conditions are the end points, or in some of the instances, transitions toward an end point, of disorders which begin with problems of integration of the neuro-physiological functioning of vision, Ultimately the difficulties wind up in the perceptual/cognitive domain, to some degree. It is not illogical to say that every visual problem and adaptation creates performance dysfunction.”

- Merrill D. Bowan, OD
From Head To Toe

“The subject matter of body bilaterality cannot be ignored in most patients if efficient binocularity is going to be achieved. From a developmental standpoint, a child first learns to team the two halves of his body before he learns to team his two eyes together…. The problem of strabismus is not strictly an ocular or eye muscle problem. Most strabismics are strabismics from head to toe.”

- Donald Getz, OD, FAAO, FCOVD
Past to Present

Highlighting Early Pioneers to Popular Present Day Researchers and Leaders
Pioneers to Present Day Leaders

- Descartes (1596-1650)
- Sir Charles Bell (1774–1842) François
- Magendie (1783-1855)
- Sir Charles Scott Sherrington (1857-1952)
- Rudolf Magnus (1873-1927)
- Arnold Lucius Gesell (1880-1961)
- Temple Fay (1895-1963)
Pioneers to Present Day Leaders

- Jean Piaget (1896-1980)
- Lev Semyonovich Vygotsky (1896-1934)
- Berta Bobath (1907-1991)
- Glenn Doman (1919-2013)
- Peter Blythe & Sally Goddard
- Kerstin Linde & Harald Blomberg
- Svetlana Masgutova
- Wibke Bein-Wierzbinski
Current Popular Reflex Programs

- Today’s most popular therapies and reflex programs are based on the work and discoveries from the above mentioned
The Institute for Neuro-Physiological Psychology

- Peter Blythe and Sally Goddard Blythe
- The INPP program uses testing or screening methods to identify aberrant reflexes patterns
- Treatment begins with the earliest identified aberrant reflex pattern. Movement activities are prescribed to be performed on a daily basis to either stimulate, inhibition, and/or integration the aberrant reflex
- The individual exercises are performed for 5 to 10 minutes, 7 days a week, for a minimum of 8 GW
- This program targets individuals 7 years and older identified with learning disabilities
Masgutova Neurosensorimotor Reflex Integration

- (MNRI) Method uses a number of integration exercises, involving physical techniques by a trained individual
- The exercises are designed to reinforce and optimize the integration of primary motor reflex patterns
- This program is helpful for infants through adulthood with significant to minimal neurological dysfunctions
The NDT–Bobath Approach is used for management and treatment of individuals with central nervous system (CNS) pathophysiology.

Exercises and therapeutic handling techniques are taught to family members who perform the prescribed program on a daily basis.
OT, PT and Reflex Integration

- Occupational therapist and physical therapists also include primitive reflex integration theories and methods when treating postural, vestibular, motor, sensory and perception deficits with their patients.
Many chiropractors are adding reflex integration programs to their services because of the intimate relationship between the spine and the nervous system.

The chiropractic view is that subtle misalignments of spinal bones cause neurological dysfunction which often contributes to developmental difficulties.

Chiropractors may use physical types of therapies such as chiropractic adjustments, exercises and movement patterns to integrate reflexes, and to improve balance, proprioception, vestibular functioning.
Suggestions

- How to use primitive reflex integration motor activities as a powerful tool to facilitate the development of oculomotor control, binocular functioning, visual perception and vestibular functioning
“Developing a model of vision that incorporates the neuromotor system as the base for visual function enables us to understand how postural tone develops. In turn, imbalances in the neuromotor system can affect the visual function and performance.”

“...stress in the neuromotor system will affect eye alignment and ocular motility. The sensory function of the visual system can be limited as well.”

- Dr. William Padula
Tips for Optometry and Reflex Integration

- Seek training from the experts that developed reflex integration theories and programs
- Learn how to evaluate for the presence and degree of retained or underdeveloped reflex patterns.
- Create a plan of how working with reflexes can work with your current philosophy and practice methods.
Choose a Plan to Fit Your Needs

- Refer to a professional certified/licensed to practice a particular method
- Add a separate reflex program to your list of services
- Incorporate reflex patterns along with your current VT program
Some Training Options

- The Masgutova Neurosensorimotor Reflex Integration - MNRI ® Method
  - Svetlana Masgutova
    - http://masgutovamethod.com/

- NDT (Neuro Developmental Treatment)- Bobath Method
  - Berta Bobath
Some Training Options

- **INPP Method**
  - Peter Blythe and Sally Goddard-Blythe:

- **Rhythmic Movement Training**
  - Kerstin Linde, Dr Harald Blomberg and Moria Dempsey

- **Doman Method**
  - Glenn Doman
  - The Institutes for the Achievement of Human Potential
  - [https://iahp.org/contact-info](https://iahp.org/contact-info)
Incorporating Reflex Patterns With Vision Therapy

- When using this strategy it is important to know the links between particular reflexes and specific vision skills.
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Primitive Reflex Integration and Dr. Skeffington’s Model of Vision

Identification

Centering

Anti-Gravity

Speech / Auditory

Skeffington, 1964
The Identification System

- A labeling sub process: A child must learn to match verbal and visual symbols.
- Answers the question “What is it?”
- Dependent on localization and appropriate prior sensory motor experiences.
- Accommodation is said to be the overt oculomotor component of the identification process.
The Centering System

- Sub Processes: attention and orienting the body, head and eyes
- A localization process that answers the question, “where is it?” in space
- Convergence as the overt oculomotor component of the centering process
- Centering allows for identification
- Accommodation is said to be the overt oculomotor component of the identification process
The Speech-Auditory System

- The process that communicates what was identified
- How well can you say what you see?
- The better an individual can describe something the more detailed and sophisticated his visual interpretation becomes
The Speech-Auditory System

“A different language is a different vision of life”
- Federico Fellini

“The language of vision, optical communication, is one of the strongest potential means both to reunite man and his knowledge and to re-form man into an integrated being. ….. Vision is primarily a device of orientation; a means to measure and organize spatial events.”
- Gyorgy Kepes
Skeffington described his anti-gravity circle as the set of sub processes concerned with balance and posture.

It is this vestibular-anti gravity system that describes the process of neuromotor maturation as an individual integrates primitive reflexes and gains postural control.
Dr. Skeffington recognized this system as “the locomotive abilities which is the framework of the learning process. The infant at this stage learns to hold his head erect and to sit up.” *… “At birth an infant enters a gravity-based environment. In order to cope with this new existence the baby must develop an ability to right his body in space. Righting responses occur at an automatic level of the nervous system and start with the lifting of the head off the surface. …that postural response is also creating an opportunity for the visual system to begin to organize.”

- William Padula OD
Anti-Gravity System

- The Anti-Gravity process is established via movement patterns through space
- As we move through space, we develop our brains through motor and sensory experiences

“The child must learn good control of movement (mobility) before he can learn to control non-movement (attention).”

– Dr. Albert Sutton
Dynamic Theory of Vision

“Effective bilateral dynamics and body alignment—good posture—is learned. Without it, visual space is skewed and visual identification and meaning is distorted.”

- Darell Boyd Harmon
Anti-Gravity System

- We now understand that it is the processes of primitive reflex integration leading to postural control that enables us to maintain posture and balance - against gravity so that we can attend, explore, experience and manipulate the environment.
- Through these experiences vision emerges!
Importance of Assessing Reflexes

- Which reflexes are not integrated?
- To what degree are they retained?
- Which reflex will you start with—why?
- Post evaluation—Does the reflex remain integrated?
- Did integration of reflex improve VT outcomes?
Case Studies

- Reflex integration - a motor tool to facilitate the development of visual skills and successful outcomes
Sample Activities

- ATNR Eye control
- STNR Accommodative Games
- Moro Column Jumping
- Vestibular Micro-Brock
- TL tracking
- Segmental Roll Eye Spy
- Proprioceptive Draw a Person
Conclusion

- How does one learn more about motor?
  - Attend motor development courses
  - Attend OT/PT conferences
  - Continue to include motor as a theme at optometry conferences beyond activities that include motor
Thank You COVD!

Patti Andrich, MA, OTR/L, COVT, INPP/L
The VISION Development Team
10139 Royalton Rd., Suite D
North Royalton, Ohio 44133
440-230-0923
andricheye@gmail.com
www.sensoryfocus.com


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