

The Role of Foundational Sensory Processing and Sensorimotor Skills in Development of Reading Skills

The following is a summary of the neurodevelopmental factors influencing reading skill development. It is important for these foundations to be in place in order to facilitate adequate development of higher order executive functions and working memory skills. It is worth noting that children diagnosed with Developmental Coordination Disorder/Dyspraxia often exhibit learning difficulties. Both areas need to be adequately addressed in order to support independence and academic success.

Importance of Supporting Vestibular Function for Visual Skill Development:

The vestibular-ocular system plays a role in visual stabilization, acuity, and the development of visual spatial and perception abilities. Despite this fact, children with learning disabilities are typically not tested for vestibular function and gaze stability, which should be mature by 3 years of age. While vestibular-ocular-proprioceptive integration is not fully mature until 15 years, vision is the dominant source of information for postural control in upright. *Summarized from Chapter 22: Management of the Pediatric Patient with Vestibular Hypofunction in Vestibular Rehabilitation, 3rd ed.*

Deficits in vestibular-ocular integration can impede the development of binocular visual skills and visual spatial/perceptual abilities. Additionally, if there is a deficit in proprioceptive processing and integration with vision and vestibular input, postural control will also be impacted.

Role of Postural Control in Visual Skill Development, Writing, and Reading:

In children with neuromotor dysfunction, there is lack of experience with visual midline in controlled symmetrical postures, and often difficulty crossing midline both with the eyes and hands. With inadequate postural control and stability, comes changes in visual orientation, making movement and visual experiences disorganized. This can create a distorted “bank” of visual-motor experiences and affect the ability of vision and posture to work together when the child is upright.

Reading relies on many visual skills. It is based on visual memory for learning letters/letter sequences and is built through experience with solid 3 dimensional objects (tactile-visual experiences) and then 2-dimensional representations (visual/visual perceptual experiences). Visual attention to reading and writing relies on the ability of the two eyes to work together efficiently as well as coordination between focal and ambient visual processing. Reading builds on foundational experiences with vision, space, and the body’s relationship to the world. **Reading activates images in the brain that acquire meaning as they relate to experiences.**

If foundational postural, visual, and movement experiences were inadequate, development of foundational postural-ocular skills to stabilize the visual field for focal visual skill development for reading is impacted.

Additionally the internalization of experiences as related to interactions with the world is disorganized, compromising the development of images in the brain related to experiences. This affects the ability to attach meaning to words while reading.

Kinesthetic learning strategies are often used to reinforce the shape of letters and support development of visualization. Ex: Holding a weighted ball and using it to “write” a letter in the air activates postural muscles, facilitates midline integration, and increases overall sensory feedback regarding letter formation.

Tactile exploration of objects, letters and letter sequences combined with visual information about objects to correct the visual impression of the object in the mind’s eye. This interaction is what creates knowledge about the shape, size, and textures of objects simply by looking at them. Therefore, it is a strategy that can be used to improve visual perception and memory of letters/words for reading and writing.

Summarized from Chapter 7: Interactive Development of Visual Function and Postural Control in Infants by William V. Padula, OD, FAAO, FNOR and Christine Nelson, PhD, OTR, FAOTA, pages 251-289 of Functional Visual Behavior in Children: An Occupational Therapy Guide to Evaluation and Treatment Options, 2nd ed.

Working memory, Visual Skills, and Reading:

Words/symbols require the brain to take information out of pictorial form, code the items, and extract meaning. It has been found that reading span correlates highly with reading comprehension while digit span does not consistently predict reading comprehension, despite the fact that it is commonly used as an evaluation tool.

Working memory is part of short-term memory and deals with language processing. It relies on the central executive, visuo-spatial scratch pad, phonological loop, and articulatory control. Phonics rules are stored in long term memory. Repeating of words and combining them with phonics information in working memory can help with long-term storage of information. Short term memory relies on phonological encoding whereas long term memory is more influenced by meaning. Disruptions in the contents of the visual state by irrelevant visual information or excess visual information can interfere with the phonological loop.

Therefore, poor visual tracking can prevent a child from gaining access to the passive visual store and affect word processing. Just as the phonological loop is linked to speech, the visuo-spatial scratchpad is linked to control and production of physical ocular motor movement. Poor ocular motor skills will interfere with the visuo-spatial scratchpad just as poor phonics skills interfere with the phonological loop. A deficit in either the phonological loop or the visuo-spatial scratchpad can hinder movement of words getting into long term memory and affect recall. Therefore, it is important to address deficits in visual processing to support reading and writing skills. *Summarized from Chapter 7: Visual Memory in Development of Ocular Motor and Visual Perceptual Skills: An Activity Workbook.*

Ronald D. Davis developed a method to improving reading skills in children with dyslexia and other learning disabilities. While there is not a movement component to his intervention, he does utilize strategies such as forming letters out of clay (tactile-visual), Spell-Reading and Sweep Sweep Spell (which supports development of visual tracking skills while reading), and Picture at Punctuation (Development of visual image associations

with the words). These strategies are consistent with the other information presented above regarding the interaction between sensory systems as it relates to development of reading skills.

More information regarding the efficacy of this method and research studies can be found on <http://www.dyslexia.com/science/research.htm>

Summary:

Foundational sensory processing deficits in combination with ocularmotor deficits can have a significant impact on the development of reading skills as well as impact reading comprehension. Additionally, if the deficit is linked to auditory skills and the phonological loop, then multiple approaches must be used to address all areas of dysfunction. While the exact presentation may differ from child to child, it is important that all areas be explored in order to design specific and appropriate support programming to facilitate improvement in fluidity and reading comprehension skills.

References:

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