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The PrehensionVision Connection

HAND FUNCTION SERIES
THE PREHENSION/VISION CONNECTION
Implications for Skill Development

** Editor's Note: This is the second installment of a four-part series on hand function and development. Succeeding articles will appear on July 7 and July 21.*

By Rhoda P. Erhardt

Most pediatric OTs are aware that children with fine-motor problems usually have gross motor delays also, but they may not recognize the children's struggles with oculomotor control. Early in my career, like many other therapists, I was absorbed in evaluation and treatment of obvious functional deficits, especially in children with cerebral palsy. Finally I noticed the similarity of eye muscle performance to that of all the other muscles.

Children with spasticity moved their eyes slowly, with limited range. Athetoid movements in the arms and legs were linked with irregular, uncontrolled eye movements. Distal eye control, especially in the child with low muscle tone, seemed to depend on the quality of head and trunk proximal stability. In children with learning disabilities and sensory integrative dysfunction these problems may be subtle, but they affect the motor as well as the perceptual components of vision.

To really understand the relationship between vision, posture, and movement, I needed to learn a great deal about the visual system. After a period of seven or eight years, I had gathered enough information through literature review, research and clinical observations to produce the Erhardt Developmental Vision Assessment (EDVA), following the same format as the Erhardt Developmental Prehension Assessment (EDPA).

Then the comparison of normal visual development with normal hand development provided a framework for the process of how vision stimulates hand use and vice versa, culminating in a very complex sensorimotor system.

Even at six months, the human baby demonstrates a highly adaptive interaction of eye, hand, and mouth, as he or she regards a toy, grasps it, mouths it, removes it, regards it again, transfers it, shakes it, regards it, and so on. The infant is establishing an important foundation for the eye-hand coordination that will be necessary for independent adult life. The infant first uses the eyes to see, then uses the hands to perform acts in which the eyes either lead or follow. Soon the child will be able to name what is seen and touched, and eventually describe those visual and tactile experiences in amazing detail. Thus vision is intricately integrated with the posture, hand skills and intelligence.

Let's examine the development of eye-hand coordination.

At first, the eyes and head operate in isolation from the hands. Both eye and hand movements are primarily random, reflexive, and involuntary. Asymmetrical postures preclude midline control.

Then comes the exploration stage. A child functioning at this level will need to engage in visual and tactile exploration separately, motivated by pleasurable sensory experiences and cognitive awareness of cause and effect. Parents will gain successful visual responses by presenting toys that make noise, have moving parts, light up and/or exhibit bright, contrasting colors in near and middle space (within 6 inches)--at the sides at first, then gradually closer to midline. The child may need assistance with tactile

exploration of objects of differing sizes, shapes, textures, temperatures, etc. until recognition motivates her to progress to the next stage: repetition.

The eyes are attracted to movement. The hands activate in response to visual stimuli. Accidental touch may occur while the baby is observing his own hand or other object, and he repeats it purposefully. Eyes, head, and arms begin to coordinate in swiping motions. Alternating glances allows the visuo-motor systems of eye-object and eye-hand to be compared.

In this, the repetition stage, a child will need opportunities to repeat purposeful visual control of hand movements for reaching, grasping, and manipulating one or more objects. Positioning must ensure that eye/head control is optimal for viewing both hand and object/s simultaneously. Toys must be within reach, easily grasped, and both cognitively and visually stimulating.

Now, eyes and hands demonstrate increased symmetry and midline orientation. Mutual fingering in midline, combined with visual monitoring, links vision and touch by a double feedback system--that is, each hand is simultaneously touching and being touched, and the eyes are seeing what the hands are feeling. Eye movements have become increasingly precise and accurate. Hand grasps have matured and can be differentiated for either precision or power tasks.

In the competence stage, a child enjoys the ease of accomplishing familiar tasks, which have become efficient and automatic. He will have the self-confidence to attempt new challenges. Novel visual and tactile objects and activities will stimulate increased mobility, which, in turn will lead to the next stage: generalization.

The eyes and hands now possess the essential motor components of vision and prehension. The eyes are able to localize, fixate, track, and shift gaze smoothly and rapidly. The hands can reach, grasp, manipulate, and release objects skillfully and without extraneous movements.

A child functioning at the generalization level will need further challenges in order to integrate his repertoire of new skills, and be able to adapt them appropriately for specific tasks. Although we can provide and suggest a variety of environments, positions and activities, the child should ultimately be given as much freedom as possible to discover the world in his or her own way.

And so we return to exploration, a lifelong process!

At any age, each of us moves through these stages as we learn new skills. As therapists, we may be simultaneously exploring a new therapy technique, practicing a new piece on the piano, feeling more competent in documentation, and generalizing those writing skills by submitting a paper to a professional journal. Vision serves an important regulating function.

Careful observation of eye-hand interactions in children with disabilities will help us determine their current stages of skill development, respect their need to move through those stages at their own rates, and suggest ways to guide them to the next stages.

** About the author: Rhoda P. Erhardt, MS, OTR, FAOTA, is currently in private practice in the Minneapolis/St. Paul area, providing evaluation and consultation services to a variety of health agencies, educational systems, and national corporations. She is internationally known for her publications and workshops on topics such as prehension, vision, eye-hand coordination, and feeding in children with CP as well as perceptual problems in children with LD. You can reach Ms. Erhardt at (612) 730-9004 or online atrperhardtdp@worldnet.att.com.*