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Functional Vision and Its Impact on Learning and Motor Organization

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Learning Outcomes

The Participant Will be able to:

1. Describe the interaction of vision and posture.
2. Describe the developmental aspects of functional vision.

The Visual-Postural Matrix

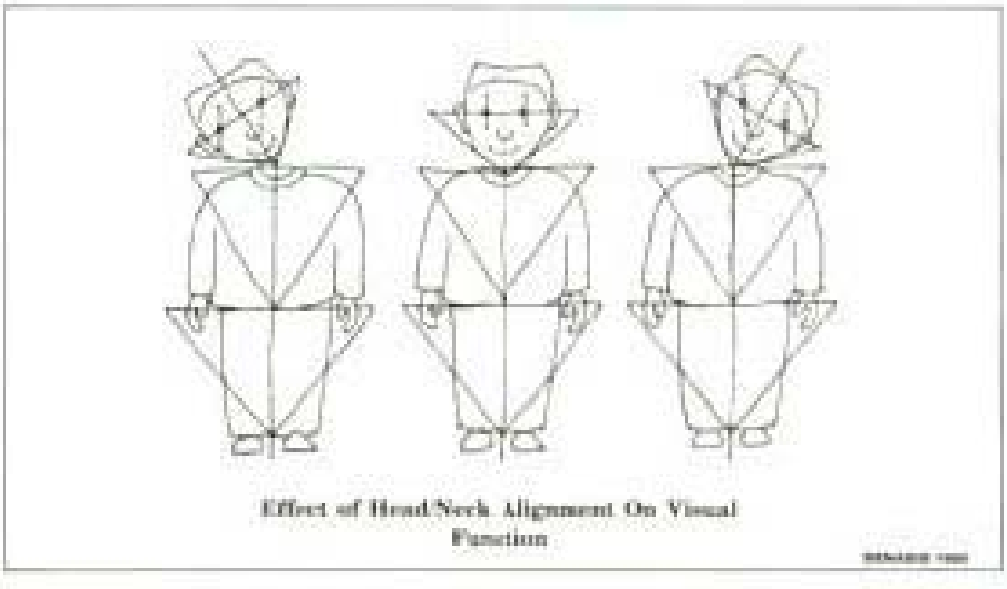
Skeffington, who introduced the functional focus of vision analysis, emphasized how the control of one's posture and movement influences the proper development of complete visual function. Recognition of the interdependence of posture, movement and vision opens a new door of understanding of how the body functions as a single unified entity and the ineffectiveness of isolating various functions in an attempt to understand global human behavior. Once the interdependence of the sensorial systems in all their richness is fully appreciated, there can be a more complete understanding of how what happens in one area affects all other areas.

This presentation emphasizes the parallels and the interactions between the development of posture and movement control, and the optimal development of the basic visual functions essential to learning. It is very important to define vision beyond the simple act of receiving a lighted impulse and to consider vision as a learned process in which meaning is given to the visual stimulus. This stimulus is then combined with other sensory stimuli, resulting in a physical or mental action. Therefore it is inadequate to think of visual function as being located only in the eyes. It is a process that involves much more than just that specific receptor.

Taking this expanded concept of the visual process as a fundamental base, makes possible the analysis of some of the postural factors that affect this complex, varied and extremely broad function of the individual. "Extremely broad," as there are far-reaching effects that will determine the quality of the child's academic performance and how he relates to his environment.

In the school setting at least eighty per cent of the incoming information must be handled through the visual channel and the child must use his vision to move about efficiently and confidently in his physical surroundings. Thinking of the body as a base for the head and the head as the platform on which are set the primary receptors of the visual system (the eyes), it is easy to understand that everything occurring in the central body in terms of stability, orientation, symmetry, independent mobility and functional control of the head will affect this platform. As a direct result, the function of the eyes with regards to stability, orientation, symmetry, independent mobility and total coordination is also affected. Thus the development of postural control goes hand in hand with the development of eye control and a mutual dependency is established in the sensory systems that are involved.

In order to achieve a greater development of the basic visual skills, attention must be given to the development of basic postural control. As illustrated by the drawing below, the specific alignment of the body's components has a direct effect on the functionality of vision.



Effect of Head/Neck Alignment On Visual Function

In order to function adequately the eyes must have the possibility of stabilizing their position and fixating on a visual target. For this to happen, the eyes need a stable and well-oriented base with respect to the horizontal and vertical axes. In addition to this anchoring role, this base must allow for independent movement so that once the visual fixation has been made, the eyes will be able to leave and move to another target, always moving in unison and able to change targets or pursue a mobile target. This pursuit of a target has to be done in a smooth and harmonious fashion, changing direction or velocity as necessary with the eyes always together and without immediately experiencing fatigue.

The pursuit of movement of the eyes is referred to as "sweeping" and the movement should be able to occur in horizontal, vertical, diagonal and circular directions. Besides the visual fixation on a stable target and the ability of the eyes to free themselves from one target and come to rest on another, a third skill consists of being able to establish a visual fixation at different distances from the body. It is necessary for the eyes to adjust their focus to permit switching from close-up to distance vision. Again, one must be able to do this without having to make a great effort and without either of the two eyes ceasing to participate. This is the skill of convergence and it is what allows the individual to experience a three-dimensional world while maintaining a single image.

In order for a child to develop these skills of fixation, sweeping and convergence, he must evenly develop good postural control and a proper dominion over his movement while working against gravity. Once the parallels and the inter-relationships between posture, movement and vision are established, it becomes very clear that when there is a deficiency in the quality of one's posture it is very probable that there will also be a deficiency in the quality of one's visual skills.

Besides having a positive or negative effect on the development of basic learning skills, conditions of image distortion can be linked to posture control. One example of this is astigmatism. When there are body or cranial asymmetries, the eyes work to correct this condition by attempting to maintain a correct balance through forcing some muscles to work excessively, and others to relax too much. This results in the distortion of astigmatism. The astigmatism is produced when rays of light enter the eye at different angles. This disperses the focal point, making it difficult for the brain to interpret the confused message and making correct visual judgments impossible. Thus the individual "perceives" straight lines with slight irregularities and things or people are "seen" as elongated or flattened. Vertical lines can be seen clearly while horizontal lines are seen as wavy, or vice versa, depending on whether it is a case of a simple myopic astigmatism or a simple hyperopic astigmatism. While this is a simple explanation of the functional effects of an astigmatism, there is extensive and more detailed information in the literature of Behavioral Optometry.

From the same resource there is an explanation of how myopia occurs as a response to environmental demands. Myopia is the way in which the visual system compensates for the impossibility of carrying out a task (close-up work) for which the individual is not physiologically prepared. Our modern world makes new demands on our close vision that did not exist in simple societies and each time that we encourage younger children to start with reading and writing earlier, we increase the number of visual problems. These same children often have less opportunity to move and develop a solid postural base.

The organizational interdependence of posture, movement and vision means that a therapeutic intervention to improve the quality of posture and movement establishes the basis for improved visual functioning, just as a visual intervention will lead to an improvement of posture and movement. For this reason, when a child with behavioral and/or learning deficiencies is treated by applying treatment methods to improve the quality of his posture and movement, there should be observable changes occurring in his basic visual functions as one result of the physical intervention. Likewise, the effects of a behavioral optometric intervention on posture and movement should be monitored, as the reduced stress of the visual system will allow the body to adapt itself more readily to the demands of gravity. The professional clinician will have to decide for him or herself which of these two paths is the most appropriate for each child, depending on factors such as the manifestation of individual incapacity, its extent, the age of the child, and the resources available.

Each time there is an advance toward refinement, be it in vision or in posture and movement, one reaches a new level of possibilities which will affect the whole child, taking him from the fulfillment of a simple task to success with one of greater complexity. In terms of the body, one can take the example of going from moving with confidence in space to being able to ride a bicycle, roller-skate, etc. Visually the child will not only be aware of himself in space, but in addition, will be able to establish a precise relationship with his environment. The child will not only realize where things are but also know their attributes, and will thereby be able to visualize and mentally manipulate visual images.

These skills are fundamental to being successful in school as this process accelerates learning from the written word. If the child is unable to visualize, spelling becomes an impossible task; mathematics has little meaning. Furthermore the child will have great difficulty in making social judgments as he lacks the ability to imagine (from the ability "to image") the reactions that his behavior will provoke. The child will consequently feel indecisive and lack confidence

.

Another requirement for optimal visual functioning is the maintenance of boundary demarcation and binocularity. In their absence, conditions such as strabismus result. Whether one or both eyes turn inward or outward, it is just one of the ways in which the eyes are adjusting themselves to try to respond to the demands of the environment. Often an apparently insignificant difference in the tone of one side of the body is strong enough to provoke a strabismus. Frequently this" condition appears around the age of three years, when the child is using the two sides of his body in unison and engages in activities crossing the longitudinal midline. If his sensory-motor development is not good enough to support these developmental needs, the deficiency and its accompanying stress will be expressed in the visual system as an identifiable strabismus or simply a tendency to become misaligned inward or outward. In either case, this condition will affect the total behavior of the child. Children with some level of dysfunction in the central nervous system are even more susceptible to strabismus and may show much earlier signs.

When a child has one eye that deviates inward, the child experiences a severely limited perception. Such visual behavior may be the result of an extremely unpleasant personal experience that induces in the individual an unbearable level of stress, and the child's desire to get out of the situation is expressed by the deviation of his eye. Not to see something is one way to avoid experiencing it.

The outward deviation of an eye is less common, but is also a form of suppressing vision. Attention is in this way given to the periphery while what is going on in front of one's nose is lost from sight. The behavior of the eyes indicates a rejection of what is present at the center of the visual field, such as details of close-up work, as needed in the acquisition of reading and writing skills. This occurs between the ages of six and seven, when the child begins formal education.

The personality characteristics found in people whose eyes deviate inward are verbal exacerbation, a constant focus on themselves with very little attention paid to what is happening around them, and a lack of flexibility. Outward deviation is not accompanied by such verbosity but rather, a great creativity -- unless it has been discouraged during the primary school stage. People whose eyes deviate outward have difficulty focusing their attention on one thing and often don't finish what they begin, for they are always distracted by what is occurring on the periphery.

The deviations of the eyes that are mentioned above must be seen as a behavioral response of the total visual system and not as something that occurs on a merely muscular level. Its treatment should therefore take the whole individual into account and an analysis should be made of all the observable behaviors. It is important to note how the head is carried and how it adapts during postural adjustments in any activities in which the eyes are the principal actors. Respect for the complexity of this entire interaction will make it apparent that a local change at the muscular level, such as surgery tries to accomplish, will cause (without adequate follow-up) additional compensations far more difficult to correct. When attempting to correct an ocular deviation, one is affecting physical, mental and emotional behavior because the eyes are part of the visual system and not an isolated entity. The visual system is an important part of the totality of the individual and one that permeates almost all learning experiences. We behave according to how we see the world.

When one eye deviates, the images received by the two eyes are not identical, so the brain must do something to reconcile the difference. This reaction most often results in the rejection of one of the images; that is, the brain ignores the data that is confusing. When this situation continues over time, the eye whose received image is being suppressed is identified as the "lazy" eye and eventually its vision is reduced to the point where it can no longer be corrected by augmentation in lenses. This condition is called amblyopia.

A child who has suppressed the vision in one eye lives in a two-dimensional world. His balance and equilibrium are affected, making the child appear clumsy and uncoordinated. The area in which the problem is most severely manifested is the school, since this child will find everything that requires binocular vision (reading, writing, mathematics) extremely difficult. This will make the child feel restless since his ability to carry out tasks is below his understanding and his potential. The inconsistent and erratic quality of the child's fulfillment of tasks creates

frustration in both the child and in the adults who surround him.

As we delve deeper into our observation of behavior, we are more capable of a true appreciation of the complete interdependence of perception, cognition and emotion. The theoretical division of the human being into isolated systems becomes pointless. Attempting to cure one aspect of behavior by taking only one aspect of the person into account is revealed as sterile and ineffective.

It is impossible to over-emphasize that the child is a whole being and what happens with his posture will affect the ability of his eyes to function as well as his learning and his emotions and later his personality. What happens in his visual system will affect his posture, his learning and his emotions. In short, the child is a totality - interdependent and indivisible - and that is how he should be treated. Constantly keeping this in mind will allow the establishment of priorities for intervention while appreciating and respecting the total development and uniqueness of the individual personality.

Developmental Aspects of Functional Vision

The visual system evolves in its function together with the larger integrated developmental process of the child. In visual development we are able to identify the following areas that occur more or less in a sequence, although there is not a rigid pattern of one coming directly after the other. As in all developmental processes the components of each function help to form a base for the evolution of more advanced skills. Subsequent development builds on the experiential learning that has gone before. Some components from one functional area can be identified in another and there is a positive crossover effect of new learning. As higher levels of function are refining certain skills, other newer abilities are emerging. The child who is beginning to walk continues to refine extension of the trunk, balance and rotations in the sitting position. The child who can read continues to make saccades more efficient.

In the development of ocular motility the baby in a totally supported position can differentiate or dissociate the movement of the eyes from the head and follow an object that is moved across the visual field. However, when the baby achieves an independent anti-gravity sitting position the head initially moves with the eyes to follow an object. Only when the child is comfortable in controlling the higher postural alignments of sitting and standing are the eyes able to dissociate from the head movement in a wide variety of functional alignments. The visual system development parallels in many ways the motor development of the child. In normal development there is a constant interaction of the two systems, with one constantly supporting the other.

Sequential Areas of Visual and Sensory-Motor Development

1). General movement patterns - innate responses:

The blink response is elicited when something suddenly and rapidly approaches the eyes. The Moro reflex is a startle response to a loud sudden noise or a loss of support. There is an activation of the body with the arms opening and dosing again, and there is a wide opening of the eyes. The asymmetrical tonic neck reflex turns the face to orient the eyes to the outstretched hand in the normal baby. There is even a prenatal orientation to light during the last weeks of pregnancy.

As movement patterns modify and differentiate in a p roximal to distal orientation and follow a cervico-cephalo-cervico-caudal orientation, visual responses are evolving. In the first weeks of development the baby responds to changes of light, contrasts and forms.

Fig. 1: Asymmetrical Tonic Neck Reaction
One of the tonic reactions present in the first months of life. Among other things the ATNR provides the child with a facial orientation to the hand. Tonic reactions are not obligatory. They provide complete movement patterns that gradually become more organized and build postural stability.

The newborn baby is able to focus at a distance of 20 cms. or 8 inches, which serves to establish visual contact with the primary caregiver, an ability that is fundamental for bonding and the development of social relationships. During this developmental stage the baby is learning about his or her own body through self-initiated movement. Proprioceptive feedback aids the baby in relating body parts to the surrounding space and the immediate environment. Vision plays a strong role in orientation in space whether the baby is being moved or whether the movement is self-initiated. Motion of some type is an important part of learning about space and distances and sizes, and the baby begins to construct experiential memory that permits a response to the question "Where am I?"

Fig. 2: Establishing Visual Orientation
The newborn baby attends to mother's face and visually orients to familiar and novel shapes.

2). Refined movement patterns:

As an elaboration of previous development, increased dissociation in movement patterns helps the baby gain control over anti-gravity postural alignments. Sitting and pushing against the supporting surface puts the baby in a position to move around the environment and explore textures, sizes and shapes. As early as four months of age the baby has developed coordination of eye and hand movement. Touching the object seen serves to establish "matching" of information that is received from different sensory systems. Binocularity is present - permitting the baby to make distance judgments regarding the accessibility of toys or objects. The young infant will touch lightly as if to confirm the position of the object before clearly reaching toward an object with the intent to grasp. (Figs. 3 & 4)

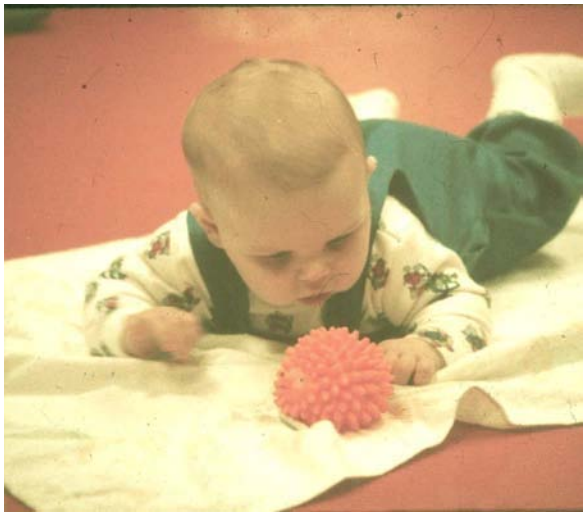


Fig. 3: Four Month Old Visual-Motor Behavior
Four month old examining a toy and making visual spatial judgments

Fig. 4: Four Month Old Visual-Motor Behavior
Four month old reaching for a toy after making visual-spatial judgments as seen in Fig. 3.

Early attempts to maintain fixation on an object are accompanied by postural stabilization. The baby accomplishes this in supine by pushing flexed arms against the supporting surface at the level of the shoulders. The face is most often in midline until greater control is available to the infant. At about four months there is a dramatic change in the support that the body is able to offer the visual system, and there emerges the possibility of moving and seeing at the same time. The baby can turn over completely and consequently change in a split second the entire visual environment. (Figs. 6 & 7)

Fig. 5: Stabilization In Supine
This infant shows an example postural stability that is gained in supine while maintaining the head in relative midline.

Fig. 6: Four Month Old In Supine Showing Visual Regard Of A Toy
This four month old infant is visually stimulated by the toy to her left. At this age the infant is capable of rolling toward the object of interest.

Fig. 7: Four Month Old Initiating Movement Toward A Toy Of interest
At four months the infant is able to take action toward a visual stimulus of interest by rolling in a total pattern from supine.

The eyes lead the head in an orientation response with respect to the environment. The ambient or peripheral visual system captures even subtle motion, which serves as a stimulus or target toward which the entire body orients. This close coordination of the two systems is very apparent in the infant of seven to nine months who is moving in a wide variety of ways along the surface and responding actively to all visual stimuli. At this age the baby is also able to sit independently and begins to refine hand manipulation skills that are largely visually directed. (Figs. 8,9,10,11)

Fig. 8: Seven Month Old Visual Regard of a Toy
This seven month old is able to regard a toy of visual interest while maintaining his stability and mobility in prone.

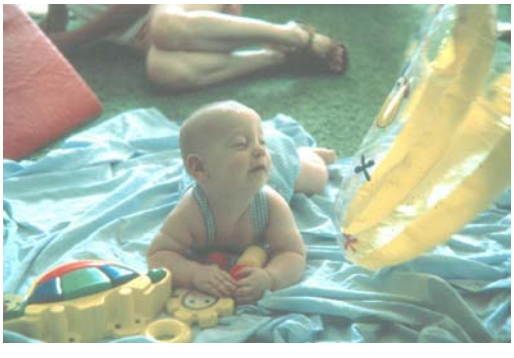


Fig. 9: Seven Month Old Visual Following Behavior
As another object is presented, the infant easily follows visually, adjusting his posture automatically.

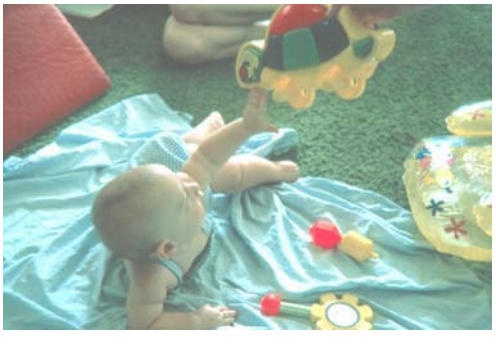


Fig. 10: Seven Month Old Visual Following Behavior.
As the infant visually fixates and reaches for the toy, there is automatic and anticipatory stabilization to allow the eye-hand-reaching activity.

Fig. 11: Early Sitting With Visual Regard
At this stage the infant sits without hands for support while locating an object visually. The infant combines reaching and trunk rotation with eye-hand aiming.

At six months of age the baby can focus on objects that are between-24 inches (60 cm.) and 36 inches (90 cm.). Visual and motor development proceeds until the child is able to achieve an upright or standing position. He begins to understand where things are in space and where they are in relationship to himself. There is integration of both sides of the body. Manipulation of objects is directed by vision and refined between nine and fifteen months of age. Binocularity is present and the baby has stereopsis or depth perception. Knowledge of objects and persons from different perspectives gives the child confidence for motor exploration. He recognizes things without having to touch them and the process of visualization is beginning. This is evidenced by knowing where a toy was placed out of sight.

Vision leads movement, and will continue to do so until about seven years of age, influencing balance and postural control. In the developmental process there is a constant matching and combining sensory information from different sources; proprioceptive with vestibular, kinesthetic, tactual, auditory, gustatory, olfactory, as well as visual. The integration of the multiple stimuli forms the basis of perception and learning. The child is able to form a mental image of what he hears, what he touches and what he sees. Very soon this imagery will be used to anticipate events in order to have an efficient response when gathering information. In the sighted person, the visual system is the dominant system in all environmental interaction. Because of the developmental-dominance of the visual system, a dysfunction will affect posture, movement and learning processes.

These are the verification exam questions to be answered when you click on Take Exam. For ease of completion select your answers prior to clicking on Take Exam.

Functional Vision and Its Impact on Learning and Motor Organization

CEU Verification Exam

1. People whose eyes deviate outward have difficulty focusing their attention on one thing and often don't finish what they begin.
a. True
b. False

2. In order to function adequately the eyes must have the possibility of stabilizing their position and fixating on a visual target. For this to happen, the eyes need a stable and well-oriented base with respect to the horizontal and vertical axes.
a. True
b. False

3. When a child has one eye that deviates inward, the child does not experience severely limited perception.
a. True
b. False

4. In order for a child to develop the skills of fixation, pursuits, and convergence, he must evenly develop good postural control and a proper dominion over his movement while working against gravity.
a. True
b. False

5. A child who has suppressed the vision in one eye lives in a two-dimensional world. His balance and equilibrium are affected, making the child appear clumsy and uncoordinated.
a. True
b. False

6. Only when the child is comfortable in controlling the higher postural alignments of sitting and standing are the eyes able to dissociate from head movement in a wide variety of functional alignments.
a. True
b. False

7. Dissociation in movement patterns does not help the baby gain control over anti-gravity postural alignments.
a. true
b. False

8. Early attempts to maintain fixation on an object are accompanied by postural stabilization. The baby accomplishes this in supine by pushing flexed arms against the supporting surface at the level of the shoulders.
a. True
b. False

9. The ambient or peripheral visual system captures even subtle motion, which serves as a stimulus or target toward which the entire body orients.
a. True
b. False

10. Vision leads movement, and will continue to do so until about seven years of age, influencing balance and postural control.
a. True
b. False