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THE FAR-REACHING EFFECTS OF VISUAL DYSFUNCTION, THE NEED FOR INTERVENTION

Before embarking on any program of intervention, it is vital to know why that particular intervention is important. The visual system is all encompassing in its effect on behavior and daily function. The visual system is bimodal in its function, with central vision that points us to see details in figures, and ambient vision which maintains visual awareness of space, detects motion and provides the ground on which the figure (central) is defined and from which it derives meaning. In addition to this dual function the structure has dual aspects in terms of the nerve fibers that form it. The accommodation or focusing system is part of the autonomous nervous system, so the ciliary muscle fibers respond in an automatic way - the same as the heartbeat, respiration and other aspects of the autonomic system. The extra-ocular motor system, which moves the eye in the orbit, is part of the musculoskeletal system. It is under voluntary control and points the eyes to the place where they need to focus in order to see clearly.

This interaction of the focusing system with the aiming system is what makes possible the multiple functions of the visual system, permitting the eyes to work at close, change to work at far, and always maintain awareness of the periphery and a very refined organization in which space is a flame of reference. This organization is dependent on the physiological intactness of the system and makes function versatile through experiences of seeing and moving parts of the body or the whole body in space. A match of vision with proprioception and kinesis takes place giving as a final result the knowledge of "where I am in space" and "where objects and persons are in space," in relation to each other and to the observer.

With the eyes we "know" at close, but we also "know" in space and time so we can navigate without bumping into things or persons. It is this functional duality of the visual system that makes it dominant in the sighted person. In fact, in the first seven years of life vision is dominant over proprioception and then proprioception becomes dominant as it is the time in which there is a need to maintain the body balance in postures that give a stable base for the eyes to move freely with dissociation from the head over a small space and do intellectual work with books, notebooks, video monitors and other detail.

Visual skills are so completely integrated into the human experience and so automatic in their expression that they only come to our conscious awareness when something goes wrong. The structural representation of vision within the brain is often over-simplified in order to present it in a way that is more easily understood, but it has

connections to every major subsystem of the central nervous system. The functional aspects of vision are seldom appreciated fully due to their complexity and the fact that various professions have addressed particular aspects of visual perception and processing as areas of specialization. Psychological testing is heavily loaded with responses that necessitate basic visual skills, and often eye-hand coordination.

The visual system is engaged in the learning process that integrates it with other functional systems during development and is capable of some re-learning after most types of brain trauma. Vision plays a major role in the orientation of a child to the immediate environment. A process of perceptual matching aligns the visual impressions with those of other senses. The young infant literally "grasps" an object with the eyes before the hands have sufficient control to explore, hold or handle an object. Vision alerts the baby to interesting persons, forms and movement in the environment. It is an important adjunct to initial emotional bonding. Displacement of the body in space is motivated by vision and the baby moves toward interesting toys, objects and persons to learn about the environment.

When visual dysfunction occurs, there are problems of orienting to the surrounding space with its complex assortment of objects and forms. In order to move in a secure way a person must be able to localize another person or object in relation to his or her own body, but must also have an awareness of that person or object in relation to other persons or objects that make up the environment. This visual awareness of spatial relationships serves to build confidence in the motor planning so necessary for skillful performance.

Visual distortions can lead to severe emotional dysfunction, because behavioral judgments rely heavily on visual impressions and the expressed behavior, in turn, stimulates a social reaction to the individual. Corporal expression is often times interpreted by the observer as emotional and/or physical problems. However the true explanation lies in the subject's need to position the visual system for optimal function.

As the visual system has such a profound effect on so many areas of human function, the reader will experience many new insights while reviewing the information presented in this manual. It is hoped that the resolution of visual problems through this organized approach will result in improved function and a more satisfying life for those being helped. Attending to the functional duality of the visual system and providing the ground for integration with other sensory modalities is of paramount importance.

Fig. 13 Using a flashlight in reduced room light

2) In a room or an area with reduced light the flashlight may be used effectively to focus on the child's hand, and then on other parts of the body to establish visual awareness. This is particularly useful for young children who also have some motor impairment that has prevented motor learning and movement exploration from being matched with visual information during early development.

Fig. 14 Using a light to attract visual attention

3) To present the stimulus in the clearest way, a darkened room is used for early visual stimulation. A small flashlight is used to attract the child's visual attention. The light may be directed to a reflecting surface in front of the child's eyes, and moved within a small range to help the peripheral vision system locate the stimulus. This may be done first at a monocular and then a binocular mode.

4) The flashlight may be turned on while simultaneously making a sound. The location of the light/sound stimulus is presented close to the individual initially and moved away as the ability to locate the stimulus emerges with more consistency.

Fig. 15 White gloves with fluorescent paint

5) A white glove may be placed on the child's hand, after spotting the glove with fluorescent paint designs. In the presence of a black light these painted areas become more prominent for easier identification. Movement of the hand (assisted when necessary) will help the child locate the visual stimulus. The child is observed carefully so that initial focus attempts can be confirmed with verbal praise. A child may enjoy having the fingernails painted with fluorescent colors to use under the black light.

Fig. 16 Using a bouquet of colored lights

6) A string of small Christmas lights may be used to form a "bouquet" to hold in front of the child's eyes in a dim light. When the child begins to respond the lights are moved slowly in a tracking pattern that the child can follow successfully.

Fig. 17 Using a circular tray with a ping pong ball

7) In full daylight a colored ping pong ball may be placed on a circular tray of a contrasting color. The ball is made to move around the rim of the tray, while calling the child's attention to the movement. The child is assisted as necessary to stop the ball with his or her hand and to take it.

Fig. 18 Using a lazy susan with white and black contrast design

8) A lazy susan tray (or any circular base on ball bearings) may be covered with an alternating black and white stripe design (stripes that are approximately 1 inch/2.5 cm. in width). Small toys or candies that are appealing to the child are placed on the tray. The tray is set in motion by the adult and the child is encouraged to stop it and remove the object. Assistance is given as necessary to offer the child a successful experience. An edible treat will serve to establish the "eye-hand-mouth" sequence that is part of early development.

FUNCTIONAL CATEGORY III:
BEGINNING TO PROCESS VISUAL INFORMATION PROFILE:

Functional Category III Profile:

In this group the child is at an age or at a functional level where he or she is in process of acquiring the prerequisites for academic work. Good basic visual skills are essential for activities that lead to reading and writing. Eye movement abilities, fixation pursuits in all directions, saccades and all the previous skills that were initiated must now become more efficient. Any areas of basic visual skills in the previous categories that are still deficient must be brought up to the general functional level and there are new, more specific skills to be acquired. The element of motion in space and the inherent rhythm of different movements contributes to visual skill and to the developmental integration of the visual and postural systems.

During his or her movement through space the child begins to keep in mind an ordered approach to a goal. This permits the child to experience success in movement that has a specific objective and prepares for more skilled games and play that are introduced. Performance must continually move to a higher level, with more complexity.

It must be kept in mind that the child who is in Functional Category III may still be significantly deficient in specific visual skills, but the necessity for preparation for basic academic work is predominant. Perceptual work is integrated into the vision therapy session, or sometimes is given to the child by a tutor working with him. By working with a wider variety of activities, the basic skills will often improve and the clinician has the advantage of keeping the child interested and motivated.

Functional Category III Objectives:

1) Ability to change focus from near to far, and back to near.
2) Ability to sustain work at near (18 inches/45 cm. or less).
3) Establishment of convergence/divergence abilities.
4) Initial perceptual abilities of:
    a) recognizing differences in figures,
    b) matching colors,
    c) sizes and position in space.
5) Ability to match according to different features of the object presented. Visual attention to detail.

6) Ability to remember the order of presentation of 2 to 3 objects, which is related to spatial relationships and a time order; with the addition of visual memory.
7) Ability to identify a total configuration or design (Gestalt) as well as the individual parts. This is essential for the skill of visual closure and the identification of figure from ground.
8) Basic visual skills are being perfected.
9) Visual judgments" knowing which is bigger or smaller, taller or shorter, farther or nearer.

Functional Category III Interventions:

1) **Pursuits combined with cognition**- following an object moving in space while answering simple questions. The questions should relate to information that the child knows well.

Fig. 27 Pursuits combined with verbal responses

Fig. 28 Using a near and far target to improve the focusing mechanism

2) **Change of focus between near and far** - use two charts" one with figures or shapes that are 3/4 inch (2 cm.) high, and the second with the same figures or shapes that are 1/8 inch (1/2 cm.) high. Letters, numbers or colored dots may also be used.

The child holds the near chart of the smaller figures and is positioned 10 feet away from the vertical surface where the larger chart is supported. He is to name one figure from the far chart and then one from the near chart, following the same sequence at far and at near. Assistance is given as necessary by pointing to the target figure so that the child locates it correctly. (A small "fiddlestick" or knitting needle is useful as a pointer.) It may also be necessary to block out part of the chart with a paper to help direct the child's attention to the desired target.

3) **Near/far focus with movement:** The child is asked to walk toward the far chart that is mounted on the wall or on a mirror while carrying out the visual task He or she then reverses direction and takes steps backward while continuing to read the far chart, as guided by the clinician. When this is accomplished the child can be positioned in standing on a balance board while the reading is done. The more advanced level would be to walk on the balance beam toward and away from the far chart while continuing to read the chart.

Another option for variation is changing the direction and the order of reading the figures or letters. The easier and more familiar direction is from left to fight. That can be changed to a fight to left sequence; then up to down, and down to up. Using the chart the child can be asked to read the first and the last symbol of the row, followed by the second and the next to the last, etc. The child is only progressed to a new challenge after experiencing success in a prior one.

Fig. 29 Using flipper lenses to promote accommodation

VISION CATEGORY LV:
TRAINING RESIDUAL VISION TO BE USEFUL IN DAILY LIFE

When visual acuity is reduced there is less perception of detail, but the individual visual impressions can differ greatly. As interpretation of any visual information is learned over time the infant and young child with compromised vision need both amplification of the stimulus and assistance with attaching meaning to the impression. Parents will play an important role in this regard and will benefit from the support and information that professionals can offer.

A common cause of low vision in very premature infants is retrolental fibrodysplasia that can occur from the concentration of oxygen used to save the premature infant. There may be a total loss of vision, moderate to severe field loss and/or severely reduced acuity. Another cause may be some congenital malformation of the eye that can occur in utero due to medication or other interference with the developmental process. Pre-term babies can have their vision affected by lights used in the newborn nursery to treat kernicterus. Some infectious disease processes will leave the individual with severely reduced vision, even after all efforts to correct acuity have been exhausted.

Later in life, magnification can be very important to persons with a stable low vision diagnosis. Fortunately, there are many developments in optics that permit maximal magnification with reduced weight of the lens, so that daily life is much easier and more independent for the adult. There are also compensatory prisms that direct attention to a visual field previously lost to the individual. The optometrist specialized in low vision is an excellent resource for this type of assistance.

A true diagnosis of low vision is reserved for the child who is old enough to respond in a reliable way to more formal testing, so we can expect that the visual status of the infant is subject to change. Some infants may fall into this category of low vision due to the general immaturity of the entire system. In some cases infants are given a diagnosis of "cortical blindness", with an intact peripheral eye structure. A certain percentage of these infants actually develop vision as the entire central nervous system matures over time. For this reason early stimulation of existing vision should be undertaken, even when there is only a slight possibility of getting a response that leads to good functional vision at a later age.

Low Vision Category LV Interventions:

The very young child is seldom able to use sophisticated adaptive devices, but this does not mean that intervention is not possible. It is important to offer experiences in tactual exploration coordinated with visual experiences to increase total learning from the environment. There is substantial individual variation in the effective use of the peripheral or ambient visual system. Some children become so adept at using their peripheral skills that a diagnosis of central vision loss is delayed, because they appear to "see" the stimulus.

In most toy stores mobiles and infant toys in contrasting black and white designs are readily available. The infant will also benefit from many of the ideas that have been suggested for Functional Category I. Working in a dim room the clinician can show the parent or caregiver how to present the flashlight or a cluster of small holiday lights as a light stimulus. One family used very large wooden letters painted black to write the child's name on the light colored wall of his room.

Observe carefully the response of the child as the overhead light is turned off and on, as well as interest in the window during the day. The contrast may help the child to orient and to attend, as the central nervous system alerts to the changing stimulus. It may be necessary to bring the light source close to the child's face (while taking the proper precautions for safety), and gradually move away. A lighted bulb may be a more effective stimulus than a flashlight for these activities. Orientation to a light source is an extremely useful tool for mobility in the general environment.

Some children will respond more to movement of the light in the peripheral visual field, where the movement serves as an additional stimulus for processing by the visual system. It is not so important to isolate the exact input to which the young child responds, as it is to obtain some consistency in orientation to the light when it is presented. Observation of the child at home, and in any familiar environment is very helpful to better understand the distribution of the child's strengths and individual therapy needs.

Sessions of stimulation should be short, but carded out several times per day if possible. Remember that the visual system is an important alerting system for the central nervous system. After the brief session of stimulation with the light in a dim room, the child can be given a toy to handle. There are musical toys that have large lighted buttons

so that the child begins to learn that he or she can create an effect on the environment. This is important to motivate further exploration and learning.

While presenting materials of any kind, it is beneficial to use a particular order of presentation so that the child begins to learn this organized way of knowing objects or anything in the environment. The starting point should be up and to the left, and then moving to the fight in an up to down direction. This is an indirect preparation for the use of magnification devices as the child reaches an age where that is appropriate.

High contrast is important for any level of low vision. The infant and young child will need dark objects on a light surface or vice versa. The white surface crossed with black bands, that is used in Functional Category I, is useful for placing toy objects for localization. Parents need to be aware of the visual impression given by plates and cups used for feeding. Solid colors that contrast with the tray or table mat are preferable to small busy designs that fascinate the child who has normal vision.

Direct illumination of a particular toy or object by a spotlight is useful to orient the child. This spotlighting technique may be used for hands and feet as well as objects. Direct feedback from the self-generated movement that occurs spontaneously in the limbs opens another avenue of learning, as it begins to match the fragmented visual impression with the joint proprioception and kinesthetic information that is generated.

Every opportunity should be taken to introduce the child with low vision to different textures :and shapes. These are cues that have great value for general orientation as the child matures. Exploration through touch should be encouraged, as it is another avenue of information for learning. Some young children have even been taught the principles of Braille at an early age - in the same way a young child may be exposed to a second language. This is usually reserved for those children who are at risk of losing vision in the future.

The child with low vision may need the **services of both an ophthalmologist and an optometrist** who has specialized in low vision. In some cases working with low vision children with ocular motility skills is important for later use of telescopic lenses, magnification devices and electronic instruments used for magnification. Another very important skill to develop is scanning, as well as knowledge of the position of presentation. With some low vision individuals it is possible to identify a position of presentation that gives them the possibility of seeing, which has to do with the residual vision in the visual field. It is important that regular visits with the optometrist insure documentation of any change and consequent adjustment of therapy and school programs. Smaller classes and a self-contained classroom for the younger child is recommended. In this way the child can develop security in knowing the environment.

Independence in daily living is an important objective, so the child with low vision may need some adaptations to clothing for identification purposes. Choices of dishes, cups and cutlery should be made with the thought of the size of the child's hand, possible coordination problems and the weight of the items. Color contrasts will prevent spills and build the child's confidence. To encourage mobility within the home environment, furniture placement should be changed as little as possible, with attention to colors and lighting. A thick line of contrasting color may be painted along doorways to frame the opening. Light switch plates can be painted in a contrasting color if they are within the child's reach. As much as possible the child should be encouraged to be independent in keeping with his or her age - even though some assistance and/or preparation is necessary for the child to have a successful experience.

NEUROMOTOR CATEGORY N:
VISUAL GUIDING OF BODY MOVEMENT

Neuromotor dysfunction can include conditions that have existed since birth, sequellae of central infections or trauma induced problems. We have already recognized the intimate functional relationship of the visual and postural systems - and both are affected by neuromotor dysfunction that affects both sensory and motor aspects of the central nervous system. Our experience has been that the interaction process of these two systems is also affected adversely in the majority of cases.

Brain dysfunction suggests that a central control is missing for the coordination of different subsystems. When postural control is inadequate, the child is unable to move in a coordinated way. The body is not sustained against gravity and head movement is not synchronized with the postural adaptation of the body. A child with a severe neuromotor problem may have difficulty in keeping the head erect and in tolerating a seated position for any significant length of time. Those with less of a problem will walk, with or without aids, but are likely to have difficulty balancing or even standing completely erect. There are often particular problems with any postural adjustment or movement that requires fine adaptations over the vertical midline.

Postural tone refers to the physiological readiness to move against gravity with ease. This implies that the physical distribution of tone in any given posture is sufficient to maintain the body against gravity, but low enough to permit movement without restriction. Children with cerebral palsy tend to have problems of tone distribution. Their postural tone may be extremely low so that the initiation of any movement is a difficult task. The postural tone may be consistently high so that there is resistance to intended movement, which reduces the child's interest or motivation for movement. In some cases the postural tone is described as fluctuating or changeable, which results in a lack of postural stability with excessive uncontrolled movement. This type of child generally has poor head control and an unstable trunk. With any intent to move the limbs or the body, the postural tone may suddenly increase so that the child loses control. Such children perform better when they concentrate less rather than more on the task presented to them.

Illnesses such as meningitis and encephalitis directly affect the central nervous system and cause inflammation of the meninges or protective coverings of the central system. There is often injury to the brain and spinal cord by the infectious processes as well as by the internal pressure of swelling within a closed space (intracranial pressure). The soft tissues of the neck and sometimes in the body in general lose their elasticity, making it much more difficult for the child to initiate movement or changes of position.

These central infections also may affect directly the sensory systems of vision and audition.

Developmental Interferences in Neuromotor Dysfunction:

The earlier that an injury or interference occurs, the greater the influence on the immature brain. Any restriction of movement and postural control during the first year has an effect on the developmental patterns that proceed with such rapidity and intensity during the first two years. With an inability to repeat postural adaptations in a predictable way, the infant lacks the stability to maintain the head in space so that the eyes move freely. The child may be able to move the eyes when the head is supported, but there has not always been the opportunity to move to the next level of competence. Coordination of hand and eye movement is also limited.

The child with severe physical limitations - for whatever reason - is dependent on adults to change his or her position. Questions about the position of the child's bed in the room and the changes of seating during the day may be appropriate to understand better the opportunities the child may have had to respond to the visual environment. When there are older children in the house it is more likely that the vision of the disabled child has been stimulated in a natural way.

Changes in tonus may have the effect of creating rapid changes in the visual environment for the infant. This means that each experience tends to be a new experience, and it is difficult for the child to learn to anticipate the effect of an action. Partial glimpses of the action are more likely to be his or her experience. Infants with high tone, also known as spasticity, have great difficulty in initiating movement, so there may be some visual interest and even appreciation of the environment, but the hand is not able to confirm tactually the visual impression. The head does not turn easily, so the peripheral information is not acted upon. When these children are seen in therapy or in a school setting, it will be noted that they seldom have correspondence between their visual response and manual activity. This awareness can be developed - even in the older child - when the clinician is addressing the needs of the visual system while supporting and assisting the accompanying movement. This child is often helped by prism experiences to awaken the potential of the visual system. It may be necessary to start at the level of Category I to gain visual awareness of the hand with a "spotlight" on the hand in a dim room.

Children with physical insecurity in their postural control need to be seated well for vision work. The feet should rest on the floor if possible and a table surface or wheelchair tray may help to steady the upper body. Postural stability and a feeling of