Visual Conditions and Functional Vision: Early Intervention Issues

Visual Capacity
Session 2
Objectives

After completing this session, participants will

1. discuss the importance of vision for typical development.

2. describe typical visual development prenatally, at birth, and during the first two years of life.

3. describe how prematurity and atypical development of particular ocular structures may result in visual disorders that may limit visual capacity and result in atypical visual development.

4. describe physiological and environmental variables that may affect the child’s visual function.
Vision as an Integrating Sense

• Enables infants to learn about people, objects, and events; encourages play behaviors, visual imitation of skills, and activities; facilitates social development and self-help activities

• Plays a critical role in attention and cognitive development

• Motivates infants and toddlers to stay awake, alert, and attentive to people, objects, and events
Vision and Nonverbal Communication

Vision drives early nonverbal communication.

The ability of infants to see their caregivers’ faces facilitates bonding and attachment and reciprocal interactions. Later, vision is used to establish joint attention.

Glass, 2002; Warren & Hatton, 2003
Vision and Development

• Vision provides the nervous system with cues necessary to prepare the body to respond to events.

• Visual-motor skills are evident around 4 to 6 months when infants begin to reach and grasp.

• Development of purposeful movement allows infants to move toward enticing people and objects in the environment.
Manipulation of Objects

Infants’ manipulation of objects refines their understanding of

- size constancy,
- shape constancy,
- depth cues, and
- figure-ground relationships.

Hyvärinen, 2000
Understanding the Progression of Visual Development

- Enables the ECVC to understand the visual capabilities of typical infants at various ages and provides insight into the visual world of the infant.

- Helps to identify infants who have atypical development that might result from visual or neurological impairments.
Understanding the Progression of Visual Development

Provides the ECVC with the ability to assess functional vision in young children with VI and make appropriate recommendations for strategies to enhance visual function.
Critical Periods for Vision

Early visual experiences are necessary for optimal development of the visual system.

Visual impairments should be detected as early as possible to facilitate visual experiences.
Prenatal Development

• Structural development typically proceeds in an orderly manner.

• Evidence of the developing eye is apparent by the 21st day of gestation.

Chandna & Noonan, 2000
Cook, Sulik, & Wright, 2002
Postnatal Development

• The visual system is immature but functional at birth.
• The eye continues to develop from infancy through childhood.
• Changes to key structures of the eye occur during the first year.
Development of Visual Abilities

Within the first 6 to 12 months, infants demonstrate
- visual awareness,
- improvement of visual acuity, and
- visual fixation.
Development of Visual Abilities

Within the first 6 to 12 months, infants demonstrate

• increased control of eye movements,
• improved ability to scan visually, and
• integration of information from vision and motor skills.
Newborn Infants

- Attend to form, objects, and faces
- Are sensitive to bright light
- Are visually responsive under low illumination
- Are usually farsighted

Erin, 1996
Glass, 2002
Hyvärinen, 2000
Infants

- Are unable to focus accurately on distant or close objects until approximately 3 months
- Make eye contact with caregivers at approximately 6 weeks
- Develop binocular vision by 3 to 4 months of age

Erin, 1996
Glass, 2002
Hyvärinen, 2000
Development of Visual Acuity

Forced-choice preferential looking

• 20/600 at birth
• 20/120 at 3 months of age
• 20/60 at 12 months of age
• 20/20 at 3 to 5 years of age

Visual evoked potential

• 20/400 at birth
• 20/20 at 6 to 7 months of age

Eustis & Guthrie, 2003
Contrast Sensitivity

- Ability to see subtle shades of gray is underdeveloped at birth
- Useful indicator of an infant’s ability to use vision in daily routines
- Infants 2.5 to 3 months can see shades of gray as well as most adults if the pattern size is large enough
- Improves as efficiency and density of the cones at the fovea of the eye mature

Atchley, 1997; Chanda & Noonan, 2000
Visual Fields

Visual field is difficult to measure in infants and toddlers due to

• variations in the type of assessment,
• maturity rates of visual fields,
• tests requiring cooperation, and
• the extent of visual fields in infants and toddlers.

Mohan & Dobson, 2000
Variation in Visual Maturation

• Visual development can be interrupted or modified by internal or external factors in the environment.

• Reflexes and skills may not appear within typical range during the first year; however, later observations may show the same abilities within normal range.
Congenital Abnormalities

- Optic nerve hypoplasia
- Microphthalmia
- Anophthalmia
- Colobomas
- Congenital cataracts
- Congenital glaucoma
- Developmental abnormalities of the anterior segment
Prematurity and Visual Function

Functional visual response of the preterm infant:

24 to 28 weeks
- Immature visual function present
- VER obtainable to bright light
- Lid tightening to bright light
- Infant is very nearsighted

30 to 34 weeks
- Pupillary reflex present
- Bright light causes lid closure
- Visual attention to high contrast under low illumination

Creger, 1989; Glass, 2002
Prematurity and Visual Function

Functional visual response of the preterm infant:

36 weeks

- VEP response like newborn
- Vertical and horizontal tracking to soft light
- Prefers to look at patterns
- No refractive error

Creger, 1989
Glass, 2002
Prematurity and Visual Development

Premature infants

- tend to be more myopic (nearsighted) at birth when ROP is present,
- have a smaller pupillary aperture and therefore response to light may vary depending on the degree of prematurity, and
- their visual skills may emerge at a slower rate or in a different order.

Creger, 1989
Eustis & Guthrie, 2003
Components of Visual Functioning

ECVCs who understand visual components and how they interact with each other can facilitate visual functioning in young children with visual impairments.

- Visual abilities
- Stored and available individuality
- Environmental cues

Corn, 1983, 1989
Components of Visual Functioning


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FPG Child Development Institute
University of North Carolina at Chapel Hill
June 1, 2004
Visual Abilities

• Visual acuity nearpoint, midpoint, distance

• Visual field central and peripheral, hemifields

Corn 1983, 1989
Visual Abilities

• **Movement of eyes**—alignment, stability, and coordination of eyes (all directions, crossing midline, and binocularly)

• **Brain functions**—physiological control of eyes and processing/interpretation

• **Light and color perception**—color, tolerance, light/dark adaptation

Corn, 1983, 1989
Child Individuality

Stored and available individuality includes

- **cognition**—intelligence, concept development, memory;
- **sensory integration**—hearing, touch, taste; and
- **perception**—part/whole, figure/ground.

*Corn, 1983, 1989*
Child Individuality

Stored and available individuality includes

• physical abilities--
  muscle tone, stamina, endurance; and

• psychological makeup--
  motivation, emotional regulation.

Corn, 1983, 1989
Environmental Cues: Definition

Environmental cues may help young children with visual impairment use their functional vision more effectively.

- Color
- Contrast
- Time
- Space/distance
- Illumination

Corn, 1983, 1989

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Environmental Cues

- May enable the child to see objects in the daily routine by increasing or decreasing intensity of the cue
- May motivate the child to participate in daily routines
Biological Factors That Influence Use of Vision

- **State regulation**—As the central nervous system develops, infants have more control over physiological states, and they may become more visually attentive and be able to use vision more effectively.

- **Temperament**—Activity level, willingness to approach new experiences, objects, people; persistence/attention span; distractibility; mood; adaptability; intensity; sensory threshold; and rhythmicity