Survey of Research on Child and Vision Development

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Research on Child and Vision Development

1. Vision: “It’s Development in Infant and Child” plus the optometric heritage
2. Latent Heliotropism
3. Visual and General Space World Problems by Preschoolers
4. Stereopsis Outweighs Gravity in the Control of the Eyes
5. The Brain’s Sense of Movement

Vision: It’s Development in Infant and Child
Arnold Gesell, M.D. et al., Available through OEPF

- Even though this book was first published in 1949 it is still current, and referred to in much newer research.
- The potential risk that newer data and observations might be contaminated from 50+ years of socio-biological change, stresses the need for existing reference to help maintaining a picture of a natural vision development.
The heritage

The works of D. B. Harmon, Lawrence W. Macdonald, G. N. Getman, Robert A. Kraskin, Furth and Wachs and many other pioneers are now to increasingly extent being reconfirmed by much of the current research on almost any vision related field.

As I was reading the material I came by preparing this presentation, it seemed to me like these pioneers put research to work that wasn’t even done in their own time.

This part of our heritage is more current than ever, and is compulsory reading if we are not to reinvent the wheel.

Heliotropism

M. C. Brodsky – Br. J. Ophthalmol. 2002;86;1327-1328

- Heliotropism - an orienting response to the sun (phototropism and phototaxis might bring additional relevant search results)
- Brodsky: “As summarised by Duke-Elder ... the control of the movements of living organisms, both plants and animals, by light is a fundamental function of great phylogenetic age, preceding the acquirement of vision and, indeed, leading directly to its development. The association of the functions of equilibration and orientation with the visual system of higher animals is in every sense basic.”
- Brodsky: “By redirecting our attention to the posture of our patients with congenital visual disorders, we can begin to deduce the role of vision in regulating human muscle tonus”
• For example, the torticollis that accompanies Congenital homonymous hemianopia may attest to the primitive role of vision in establishing baseline muscle tone.
• The head is turned away from the seeing field while fixation is maintained at the object of interest, the head turn seemingly serving no obvious compensatory function.

• This basic concept is seemingly unaccounted for in respect to human neurology. Or – at least, I have not been able to find the term in our own optometric literature.

Visual and General Space World Problems by Preschoolers
Raumlich-Konstruktive Störungen bei Grundschulkindern,
Wibke Bein-Wierzbinski
(Germany, Europäische Höchschulschriften ISBN 3-631-52288-6)
• A research done on the importance of the neuro motoric body righting process for the development of fine eye movements and spatial relationship as well as ways to enhance these through motor training.
• Eye movement
• Visual spatial relationships
• Primitive reflexes and motor programs

• Wibke Bein-Wierzbinskis work and research relates early development to the visual spatial problems often identified by optometrists. The references are numerous and counts among them Ayres, Babinski, Bender, Blythe, Gesell, Frostig, Goddard, Piaget and research on neurology and development, ranging from early 1934 up to 2002.
This study shows positive effect on almost all visual components of the training program.

Personal concern:
It seems as if treatments based mainly on motor and reflex stimulation lacks far behind in speed, compared to Vision Training incorporating general motor development programs. My bet is once you switch to visual guidance, vision will be your most effective learning channel.

Stereopsis Outweighs Gravity in the Control of the Eyes
Hubert Misslisch, 1 Douglas Tweed, 2 and Bernhard J. M. Hess 1

The eyes are controlled by multiple brain circuits, some phylogenetically old and some new, whose aims may conflict. Old otolith reflexes counterroll the eyes when the head tilts relative to gravity. Newer vergence mechanisms coordinate the eyes to aid stereoptic vision.
Counterroll hinders stereopsis, weakly when you look into the distance but strongly when you look at near.

- Since this study is *humor on* “monkey business” we may not infer the results directly on humans. Still we can think of this mechanism as a possible cause for reduced stereoacuity at near.
- In presence of a developmental problem in early childhood, convergence suppression of otolith reflexes might partly fail, leading to reduced stereoacuity or fragile binocularity.
- Should we test binocular tolerance to head tilt??

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The Brain’s Sense of Movement

- Alain Berthoz describes how human beings perceive and control body movement, how perception and cognition are inherently predictive, functioning to allow us to anticipate the consequences of current or potential actions.

- “To localize an object simply means to represent to oneself the movements necessary to reach it”

- “Two basketball teams, one team of children with normal vision and one of amblyopes(?) (both eyes) with less than 20/200 who read in Braille and do not attend normal school...”
"I was watching two basketball teams, one team of children with normal vision and one of amblyopes (?) (both eyes) with less than 20/200 who read in Braille and do not attend normal school... "I could not tell which was the handicapped team"

The faster the movement, the more the second group seemed to succeed..."

"...This experience convinced me that ophthalmological tests examine only a tiny fraction of visual function and, in any case, totally ignore perception of movement..."

"Although millions of people wear progressive lenses that modify the apparent velocity of visual motion in a nonlinear matter...no test worthy of the name examines dynamic vision, which is the most important for coordinating gestures and perceiving three-dimensional shapes, as research on the contribution of movement to perception of curves shows. We are working on this question in collaboration with lens manufacturers" (??Essilor France??)

"A baby first directs his gaze using his own body as reference point. He turns his head and eyes about the axis of his body, an egocentric frame of reference."
• Once he begins to walk, he must give up the fixed reference and develop a new strategy for keeping objects steady in space. Before 18 months he fixates a landmark to which he anchors his progression around the room.
• This is probably the first sign of him constructing object location and object relationships.
• If his anchor point is hidden he reverts to egocentric strategy.

• At 18 months he adopts his third type of functioning, and becomes able to mentally update his position in the room, while walking, using a mechanism of mental rotation and translation.

• Go where I'm looking”, not “Look where I'm going”
• From experiments it follows that we head towards where we are looking. We simulate our trajectory and compare the actual with the predicted movement.
• “When I direct my gaze towards a target, I'm trying at the same time to act on that target. Movement is an integral part of perception.”

Summary
• It is obvious that the early development of vision is strongly connected to that of movement.
• Likewise is motor development depending on vision (Heliotropism).
• Our present challenge: Revealing the developmental roots of vision problems with the intention of preventing and remediating them.