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Petition for an Additional Vision Developmental Milestone

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Abstract: This petition is about two of the traditional three R's - reading, writing, and arithmetic; it concerns learning letter formation and learning to read, both of which require continuous interplay between the different perceptual attunements of central and paracentral areas of the retina. This interplay, managing the field of view between zooming-in for precise discrimination of detail and zooming-out to acknowledge properties of its context, is the substance for an additional vision developmental milestone. Inclusion of this milestone in vision assessment will contribute to improved teaching strategies by better defining the separation of visual perception from visual perception with the additional matter of prior learning attachments to it.

Key words: vision and hand writing, retinal function and reading, vision developmental milestones

1. Introduction

Rock climbing epitomizes managing one's field of view. Each climber searches the wall's jagged surface, jostling to preserve balance and continue the ascent as their eyes make the scanning movements of searching the surface for something to grasp hold of (Figure 1).

Scanning to find variances in the general rock face is cut short by sudden jerks of vision, saccades, to zoom in on, to fixate on a possible grasping point for hand or foot.

The potential grasping point must be analyzed for depth, hardness, and surface conditions before climbers' weight can be committed to it. On a moment to moment basis each climber concentrates maximum acuity, foveal vision, on a contact point; then reopens the search area by re-distributing visual data to less sensitive retinal areas, parafoveal vision — the alerting mechanism to redirect foveal vision to the next potential grasping point.

Varying levels of retinal sensitivity are needed as different types of visual data are sought and responded to.

Advocacy is for a vision milestone that measures mastery of dynamic visual field circumstances, the moment-to-moment prioritizing of attention to stimulation from varying parts of the retina — differing visual acuities — as the dimensions of the scene that needs to be observed vary.

An expanded visual field requires perceptual sensitivities to multiple types of visual information reflecting the progressively declining rod to cone ratios from the all cone fovea towards peripheral vision.

The current set of visual developmental milestones does not contain such a measurement. This affects both the recognition of visual impairment and the prescription of therapies and teaching strategies to be applied when students fail to make adequate progress.

Pediatricians and child development specialists use a standard chart of vision milestones to screen children s' visual development. This is a listing of 40 or so visual behaviors beginning at birth and extending to six years of

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age. Several of these milestones make general acknowledgment of the visual field, such as depth perception, but not in a manner requiring management of visual attention between competing visual stimuli. Example, examiners may use the milestone list of Dr. N. Barraga's "Diagnostic Assessment Procedure" to assess the first year visual skill, "Track moving object". The Barraga procedure requires visual attention be given to a penlight which is then moved in a prescribed manner. The focus of attention, the penlight, is singular and without competition. This makes the focus of foveal vision on it direct and easy. Tracking this moving penlight is very different from having to select out an item to visually pursue from a background of like items. Children watching race cars leave the starting line will have to transfer their attention back and forth between racing cars if they want to follow the progress of a favorite.

Figure 1 Climbing Wall

Competing visual behaviors shape the often split-second decision making of where to look and for how long. There is a balance between eye responses totiming cues (zooming in, fixating, to find the flea on the dog before it jumps away) and competing eye responses to estimation cues (zooming out, taking the brush to the dog's tangled hair to better see the flea) timing and estimation being submissive to the voluntary eye control of prior learning — gaze being captured by tiny, dark speckles till their total stillness or movement reveals identity, dirt or flea.

Proposed milestone identification: linking complementary visual events, a visual scene milestone, establishing itself in the 3–5 year range.

Samples of complementary visual events are hand rotation upwards so that the palm is ready to catch potato chips as they fall from a tilting dispenser, racers aligned at the "set" blocks leaning forward in anticipation of the fastest response to "go", aligned sets of concentric rings radiating outwards from the impacts of a rock skimming across the surface stability of water, children re-tracking each of their footprints in the snow and meeting where they had parted.

Give and take of dominant alertness between parafoveal and foveal acuities is determined by how the observer, the data collector, wants to act on the scene. If the observer's view is without a central focus — is large as with a Ferris wheel at an amusement park — parafoveal acuity will dominate and be sufficient to discriminate legs dangling from the wheel's buckets to know if there are riders in those seats. If the observer's view has a center to it the observer can hold a fixation, advantage is to foveal vision as in studying a crescent moon to determine which encroaching object is Venus and which is Jupiter.

Like the scatter of billiard balls at break, actions distribute complementary events.

Our visual perceptions of these events flux between saccades favoring central vision (is it the stripped 15, or the solid color 5 ball), and pursuits attendant on ball trajectories and speed innervating the macula and peripheral retinal areas.

Complementary visual events become distributed visual perceptions that in the aggregate form a completion. They are a singular form of what perceptual psychologist J. J. Gibson described as "environmental properties".

"Acting successfully entails perceiving environmental properties in relation to one's self" (J. J. Gibson, 1979).

Corresponding environmental properties to one's self may also lead to unsuccessful actions. Balance between foveal and parafoveal vision is essential to successfully turning visual data into successful actions. A repeating observation of visual data being susceptible to a bias favoring narrowing of the field of attention occurs in "observe and copy" tasks. Example, a student displaying this myopic tendency is asked to make copies of two inch size letters from a sheet onto an unlined 8×11 inch dry erase board. The sheet features lines that guide letter formation. The dry erase board does not. She is first asked to make the letters smaller when copying them from paper to board. While miniaturizing the letters, she reproduces each of the letter forms correctly using appropriately proportioned lines. She is then asked to copy each of the same letters as large as possible. Without the eye-hand motor control size reduction provides, freedom of size estimation is poorly handled by the student. Being unskilled in shifting gaze to survey and correspond the size of the board's boundaries to the sheet's letters results in gross mis-estimation of both position and relative size of the lines drawn to reproduce the letters; this outcome is shown in the student's work below (Figure 2).

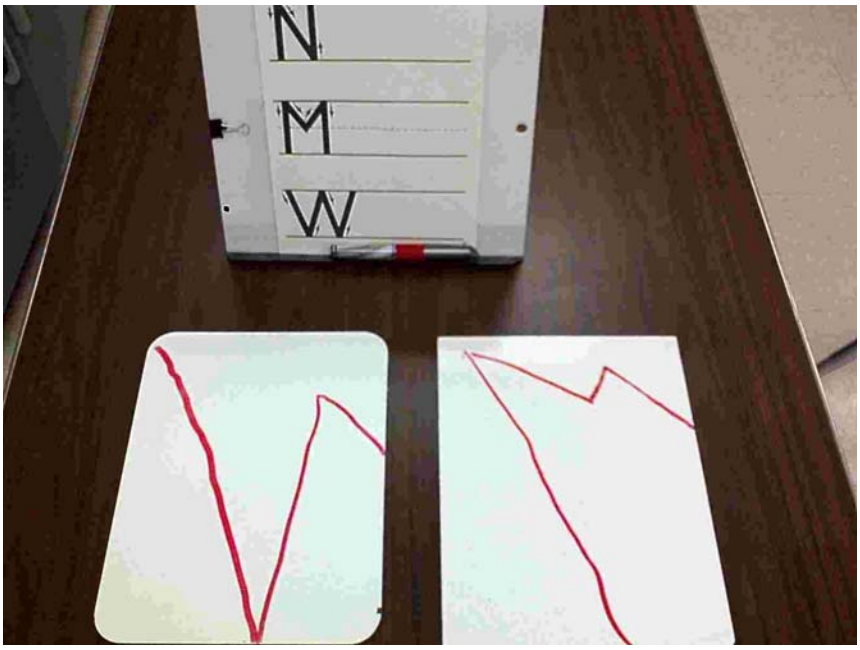

Figure 2 Observe and Copy

Shifting activities to a leisure moment of doodling this student then draws illustrations showing attention to detail, attention to and creation of boundaries — closure around figure details, alignment of picture elements — all within a telescoped area of the page, a restriction which allows her to engage a self-taught assist of holding her forearm stationary for additional bracing of her drawing hand.

- The tacit learning of preschoolers' play anchors them in the visual perception of complementary events: alignments, preschool anatomy as in donning a skeleton costume with visual attention on its adjacent bones — narrower at pelvis than at shoulder — all attaching to a cord that makes the complete ensemble be us;
- transpositions, tic-tac-toe or seeing the possibility of three of a kind to complete a row;
- transformations, completing the motions that stretch "magic face" springs distorting facial features and returning them to recognition, folding and unfolding origami, manipulating the "transformer" car into "transformer" robot;
- extensions, reiterating the micro extensions between dominoes as far as the playing surface allows, chaining cars between engine and caboose;
- substitutions, water play in which a bar soap's buoyancy allows it to be grouped into an "armada" of ships;
- mixing proportions, as in estimating how much chocolate syrup to spoon into the full glass of milk to make it taste just right.

These distributions set the stage to freely associate complementing elements throughout the visual field and provide freedom to associate elements that have no contiguous temporal or linear links to one another; gaps must be filled in. Such visual associations are one basis of what professor of animal science Temple Grandin writes of as "thinking by making visual associations". In a November 1997 article in "Western Horseman", Dr. Grandin wrote:

> I have no language-based thoughts at all. My thoughts are in pictures... When I recall something from memory I see only pictures. I used to think everybody thought this way until I started talking to people on how they thought. I learned that there is a whole continuum of thinking styles, from totally visual thinkers like me, to the totally verbal thinkers...

Dr. Grandin has autism.

In 1984 I recorded separate interviews on reading and visual learning materials with two colleagues, Marilyn De Witt, Director of the Center for Literacy in West Philadelphia, and Helen Simyiak, reading specialist and author of R.S.V.P.: Reading and Spelling Via Phonics subtitled Remedial Reading and Spelling: A Program for Teenagers and Adults.

Marilyn, it is my understanding that people who come to the Center for help typify the following characteristics. They are post high school in age and average or above average in intelligence; they are motivated, at least by a particular need such as reading work bulletins... Throughout their lives they have been frustrated when trying to learn to read, experiencing failure often enough that using the term "chronic" reading difficulty is appropriate.

Marilyn De Witt: In response to all the characteristics you've given I'll start with the last two you mention, chronic reading difficulties. This is true of the clients we work with here; chronic is a good description of the situation as a whole...

By the time they come to us the chronic nature of their reading difficulty has interfered with their ability to seek help. They've developed a whole series of ways to fake it and admitting they've got a problem is very difficult the longer they put it off. So the more chronic it is the more difficult it is for us to work with the client... Yes, it is true it's a rare person we deal with that is a chronic non-reader, or experiencing reading difficulties, who is not average or above or above average intelligence...

Helen, please comment on the general ability level of the students you work with.

Helen Simyiak: Brilliant. Some of the students are brilliant, particularly in mathematics. I have had students who were superior in math, but who could not read the simplest sentence. I can't tell why a student behaves this way. You'll meet another student who is disabled in both areas...

The type of student that I work with is the remedial student. The student who has not been able to learn with the methods available to him in the public school from the time he started. At present, I'm working with adults who still cannot make the type of associations basic to reading.

Marilyn, please comment on the predisposition of an individual toward behaviors and activities that shape a preference for selected types of perceptual reinforcement. Do you find that the solidification of such preferences makes for a core block of habits in directing attention, in learning to sequence responses which are very difficult to break through and restructure for the purpose of teaching reading skills.

Marilyn De Witt: That's definitely true. One of the biggest barriers to teaching reading (and we do it by phonics and word families for the most part) is that a person will rely on the shape of the word and will not, just will not, submit to recognizing a sound/symbol relationship.

Since the 1970's examination of the connection between vision and learning has resulted in optometric programs that phrase this as a separateness between "eyesight" which is the measurement of vision in a clinician's office, 20/20, etc.; and "learning to see" which is how we must move our eyes and fixate in order to select out useful data from a scene. "Intervention Strategies for Helping Children Overcome Deficits in Reading, Learning, and Comprehension" popularize this synergy between purposeful–voluntary–perceptual attention and oculomotor control.

IEP teams, Individual Education Plan teams, are composed of classroom teachers, occupational therapists, physical therapists, school psychologists, reading specialists, special education teachers, and family members. A recurring challenge teams face is determining why students who demonstrate a slight misalignment of the eyes during a cover test, this combining with an odd scattering of high and low proficiencies on visual-perceptual skills such as the Test of Visual-Perceptual Skills (TVPS), face seemingly insurmountable academic challenges. These students are described by team members as a being good classroom participants and the adjective "creative" is often used on their behalf; yet, the education team relates complete frustration with their inability to help these students make progress learning to read.

Teams review TVPS scores and recommendations for a regime of optometric "Intervention Strategies" in an effort to determine if insufficient voluntary eye control is this the stumbling block to our efforts to teach reading skills to this youngster?"

When attempting to negotiate the visual differences between the bottom-to-top perceptual learning of childhood where ninety degree corners invariably give form to a square, and the exclusively top-to-bottom perceptual demands of reading where form is secondary to context, the axes of our visual fields need to become reflexive enough to accommodate sustaining full perceptual attention of foveal vision on a single, narrow line of print.

Is it the eye teaming challenge of focusing visual attention in this restrictive manner that is the root cause of the challenge reading presents to so many learners, or is it the compounding of this compression with print's strategies of repeat usage of the same symbols in order for a limited set of characters, 26 letter characters in English, to express all of the sound/symbol relationships of a language?

To decode meaning the observer, reader, has to pass all of the line of print's visual data through a filter of prior learning — this filter is the learned strategies of repeat character usage languages need to represent sounds; the lynchpin of which is phonics.

To mitigate the interference of prior learning in measuring vision skills maximum effort should be made to exclude academic learning from the means of assessment. The observer should be able to demonstrate mastery of voluntary eye control on scenes of any size, and apply precise or relative visual discrimination to those scenes based upon age appropriate general knowledge. Therefore, a reading book would not be a good assessment tool for measuring voluntary ocular motor control because it also requires sound/symbol decoding skills, not an intrinsic part of the general knowledge of childhood.

A preferred assessment tool for measuring mastery of voluntary ocular motor control should present visual data that has a high degree of freedom in its display: freedom of orientation — unlike the rigid orientation requirements of print, general knowledge data is recognizable from multiple viewpoints; freedom of spacing — groupings are randomly distributed and occur in response to local conditions such as eddies of water in a stream; freedom of size — varying size elements can cluster in dense or sparse groupings, there is no mandated ordinal arrangement by size; freedom to reduce or simplify — visual data can be robust or degraded so long as key invariant bits retain their complementary relationship to one another; this is contrast sensitivity — the responsiveness of the retina across areas.

A clinical example of one of these freedoms, freedom of size, and its relationship to prior learning is found in the low vision clinic prescription for use of closed circuit cameras connected with large flat screen monitors for great magnification of print size. When vision is diminished to the degree that corrective lenses are insufficient to allow a person to continue to read print electronic magnification can change the game by enhancing font size to 48pt. size, 78 pt. size font, and larger-instantly. Beginning readers presented with a closed circuit format for learning to read may have a different experience with the device than experienced readers. Beginning readers may get repeatedly "stuck" inside the limited number of letters they capture within a single fixation of foveal vision — saccade — by not being able to identify the whole word from the chunk of its letters their vision captures and can identify. Decoding of words composed of more than three letters becomes more laborious **-** more eye movements are needed to repeat the attempt and the outcome is uncertain. At ultra-high magnification (beyond 48pt. print font) both beginning and experienced readers must predict, must "see" the possible relationships between the letters and the context of what has come before in order to string together combinations that are not occurring on the foveal area of the retina. The freedom to present reading materials in large font sizes needs to be approached with caution for beginning readers as success with sight words and short words does not guarantee continued success with larger words. An experienced reader can gain this magnification advantage and experience greater success reading in extreme font sizes because of prior learning: knowledge of word structures, syntax, word meanings, comprehending the importance of left for word beginnings, use of context. Prior learning "bandages" the missing visual data; that is, they can fill in for not being able to see in one fixation enough letters to recognize and then identify the word part or whole word.

One form of suggested visual data for assessing management of field of view, the petitioned for milestone, is animal "footprints". Footprints are visual data to which all of the above criteria [freedom of orientation, freedom of spacing, freedom of size, freedom to simplify...] may be applied in a manner accessible to children three years and older. A duck's webbed feet uniquely identify this bird in whatever orientation they are seen. Its beak, eyes, tail feathers, and wings associate with these prints. They are distinct from the three toed footprints of birds. The five toed footprints of frogs and the six minute pads of insects allow for invariant recognition and identification. Each print is identifiable at speed; each associates with an invariant body form. Unlike letters in a word, each retains its individuality so that a string of prints represents a group of animals once present in the space the footprints now appear in. The associations are visual, not academic.

Animal footprints may be presented in a format for linking visual events by presenting the prints in a habitat. Pictured below is a pond habitat (Figure 3).

Figure 3 Pond Habitat

The surface stability of water is the habitat attribute that immediately links complementary habitat areas together as a whole. Recognizing and identifying water's surface does not require precise visual acuity and the grid's expanse (2 feet x 4 feet) can be easily observed as a whole of complementing parts. Stability of pond's water is the same stability of water infants experience in their baths, in the splashing that pushes their water toys randomly about. The habitat is structured as a grid and it is non-foveal vision that recognizes grid panel similarities and differences, defining relations and separations between areas in a non-verbal manner. Areas are defined by column in this habitat: a column of logs floating on water, a sailboat column, a water lily column, and so on. Within each panel 3D animal characters may visit, may leave their prints, and appear in different areas of the pond via flying, swimming, jumping, or hitching a ride.

Footprints are shown as singular prints to familiarize observers with them, then freely grouped using varying sizes, orientations, and in strings of prints as illustrated in Figure 5.

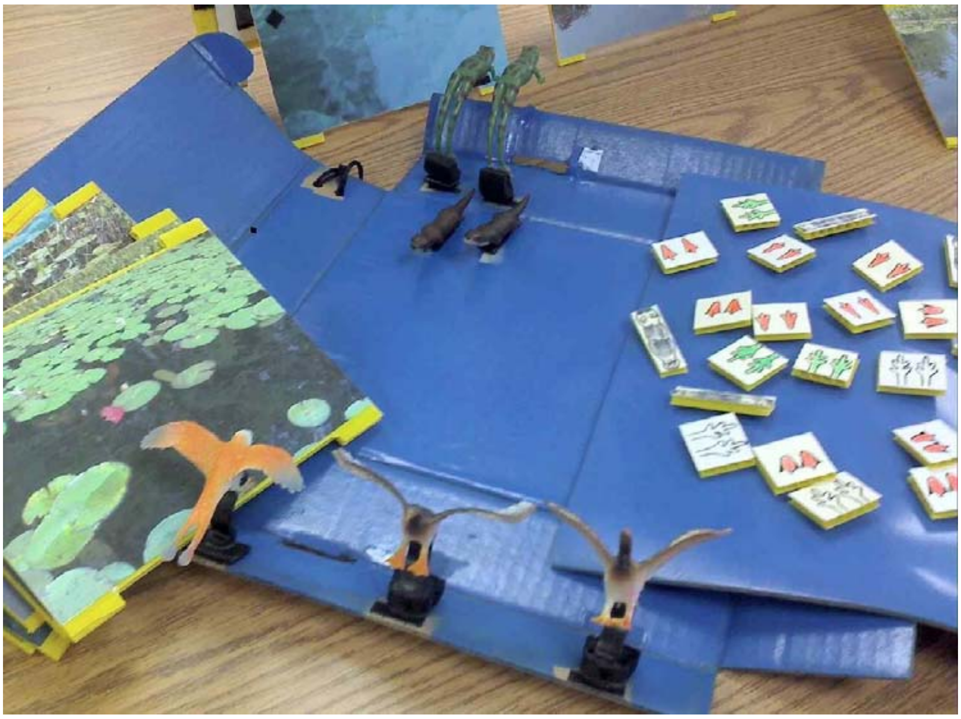

Figure 4 Habitat Elements

Figure 5 Distributed Prints

Sizing and density of a panel's footprints and those on adjacent panels can test visual discrimination and eye teaming abilities: sample question, "Which pond creatures left these prints? Immediate answer, "Birds" as by visual discrimination observers recognize and identify all prints as being three toed prints and therefore belonging to only one species of pond inhabitant.

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