A Behavioral Approach To Vision and Autism

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Autism is a neurological disorder that affects an individual's ability to process information from the senses and multiple areas of the brain. Vision problems are very common in individuals with autism. Vision analysis testing should include ocular health, refractive status, binocularity, ocular motilities, accomodation, vision perception, and visual spatial awareness. Testing procedures include ophthalmoscopy, retinoscopy, photometry, eye movements, and performance tests used to evaluate the need for stress-reducing lenses, and yoked prisms. Treatment may include lenses that compensate for refractive status, plus lenses, yoked prisms in small amounts, and vision therapy. Vision therapy techniques begin with general visual arousal. These include activities where the patient wears red/green glasses, and interacts with moving white targets, and yoked prism activities. The prisms used are of the magnitude of 10 to 15 prism dioptors. Much later, the therapy activities change from stimulating the peripheral visual system to including central visual stimuli.
Key Words: *autism, vision, vision therapy, prisms, yoked prisms, ambient, focal, peripheral, central, performance testing, lenses, red/green glasses.*

INTRODUCTION

> To understand autism, or any other human condition you must observe the indivduals, not just the stereotypes. Our most talented teachers agree when they say, "To reach a child with autism, you must first learn to see the world through the student's eyes—Charles Hart[1]

In 1943, Dr. Leo Kanner[1] coined the term autism. He chose the word because he thought it described his patients' tendency to act "automated" or self-contained. Autism is a neurological disorder that affects an individual's ability to process information from the senses and multiple areas of the brain. The basis for this neurological problem probably begins before birth but often can't be recognized until several years later when the child shows problems developing skills common to others of the same age.

The visual symptoms of autism may include poor eye contact, difficulty attending visually, excessive visual searching, and generally unusual reaction to sight. Other symptoms include language delay and/or deficits, social problems, difficulty with relationships, unusual reaction to sound, taste, touch or smell, uneven developmental abilities, and scattered strengths and weaknesses. Symptoms appear over time as the child shows a

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pattern of developmental problems. Generally children are 2 to 3 years old before they have enough symptoms to be diagnosed.

Autism is considered a medical diagnosis[2] as opposed to a mental illness. The rate and pattern of development is a primary concern with autism. Challenges for people with autism include limitation in language, social development, and imagination. Researchers have noticed other common features of autism[1]:

A. Memory and sense of direction are often stronger than other skills.
B. Understanding time and the order of events is difficult.
C. Thinking is based more on association than reasoning.
D. There is a dependence on routines and a resistance to change.
E. Controlling emotion or excitement seems difficult.
F. Habits and interests are often unusual or eccentric and consumingly exclusive.

An estimated range of 4 to 20 of every 10,000 people have autism. It affects four times as many males as females and there are different types of autism. A study from the *American Journal of Psychiatry*[3] demonstrates that autism has a genetic, or hereditary factor. Studies with a larger cross-section of the public need to be conducted to prove this genetic factor. Autism is not caused by neglect, abuse, or tragedy, or cold, insensitive mothers as was once thought.

Dr. Margaret Creendon has found that children with autism cannot follow a moving object with their eyes as quickly as the typical child. Dr. Eric Courchesne[1] noted for his research with magnetic resonance imaging, believes people with autism have neurological problems that make it hard to regulate attention, to change their focus at will, or to respond to new stimuli.

A person with autism can often learn to succeed in many tasks. Habilitation teaches a person to adapt, substituting a strength for a weakness. The goal in working with people with autism is to habilitate, to make able.

VISION

People with autism use visual information inefficiently. They have problems coordinating their central and peripheral vision. When asked to follow an object with their eyes, they usually do not fixate on it centrally. They scan and/or look off to the side of the object. They say they are looking at the object. They seem to be "lost in space."

A tactually defensive person is overstimulated by tactile input.[4] They are always moving and wiggling. They avoid contact with texture. A visually defensive person avoids contact with specific visual input. Most people with autism have hypersensitive vision. They have difficulty with visually "holding still" and frequently rely on a constant scanning of visual information in an attempt to gain meaning. They have difficulty processing ambient information and thus have difficulty gaining access to focal information. As a result of poor integration they have difficulty processing information and gaining meaning. It should also be noted that once focal vision is gained, they shut down peripheral vision and remain fixated on a task for excessive periods.

Efficient visual functioning requires complimentary and reciprocal inhibitory cooperation of two pathways: ambient and focal.[5,6] The ambient visual system is designed for movement, "Where am I?" The focal visual system is attuned to details, "What is it?" If you are "lost" in the periphery, spatially unaware and unorganized, then there is great difficulty getting detailed central information.[7] For a person with autism, the visual system is highly ambient in function and may not be able to suspend peripheral visual information to organize focal vision processing.

The visual system relates to motor, cognitive, speech, and perceptual abilities. These areas may be affected when the visual processing system is interrupted. The goal with prisms, lenses, and vision therapy is to help organize space, and gain peripheral stability[8] so that a person can attend and appreciate central vision.[7]

Examination of these patients reveals a high incidence of exotropia and exophoria. (Esophoria and esotropia may also occur.) Rather than looking at this as a traditional muscle imbalance, the imbalance indicates there is a lack of organization of motor and sensory status for the individual. Yoked prisms can be a very effective tool in making changes in the oculomotor state, which

thereby affects sensory function. When yoked prism is introduced before an individual's eyes, the eyes re-orient to look at the image in a new position in space. The motor system readjusts, it sends information to the cortex, which states that the sensory component must readapt itself to this new position in space. This effect causes a reorientation of motor and sensory organization in the cortex. If the individual is successful in making a shift in motor orientation, it occurs not simply because the eye muscles change in alignment. The information is matched and reestablished between the sensory component of vision, the motor component of vision, the vestibular process, the kinesthetic and the proprioceptive inputs to the brain. When yoked prisms are used the visual system can begin establishing balances between these systems.[9,10]

VISION ANALYSIS

The developmental, emotional, and physical level of the person with autism varies greatly. Therefore the testing varies depending on the needs of that individual. After a thorough case history, as with any visual evaluation, many of the following testing procedures are attempted: visual acuities, rotations, fixations, stereopsis, color vision, bioptor screening, and near point of convergence; cover test, retinoscopies, refraction, phorias, vergences at distance and near; amplitude of accommodation, positive relative accommodation and negative relative accommodation, Worth 4 Dot, opthalmoscopy, IOP, biomicroscopy, keratometry, visual fields, and Van Orden Star.

PERFORMANCE TESTING

For patients with autism testing must proceed beyond the examination chair. The visual process needs to be examined as a dynamic process.

Performance testing utilizes 5 prism diopter yoked prisms.[9] The patient wears the yoked prisms in the following directions: base up, base down, base right, and base left. Testing may also be done with yoked prisms in oblique axis. Most common use is base up and base down yoked prisms. During performance testing, acute observational skills and specific documentation are required by the clinician. Observe postural adaptations and compensations while the patient is sitting, walking, and standing. Observe increase or decrease in visually directed movement and visual awareness.

Walking

Patients are asked to walk, with the habitual spectacles in place. Observe the quality of movement and posture. Have the patient put on the yoked prisms and walk. Observe the outcome. Is the quality of movement and posture the same, improved, or impaired? Note increased visually directed movement. Note change and/or improvement in visual awareness. Repeat changing the yoked prisms in all orientations.

Sitting Down

With the habitual spectacles in place, ask the patients to walk approximately 10 feet and then sit down in a chair. The chair is facing the patient so they must turn around to sit down. Repeat this activity having them wear the yoked prisms in each of the orientations. Observe the outcome.

Ball Catch

With the habitual spectacles in place, ask the patient to catch a Koosh or suspended ball. Then have the patient toss it back to you. Repeat this activity having the patients wear the yoked prisms in each of the orientations. Observe the outcome.

Miscellaneous Activities

Choose an activity that has been difficult for the patient, such as cutting with scissors. Repeat this activity having the patient wear the yoked prisms in each of the orientations. Observe the outcome.

TREATMENT

Lenses

Full distance refractive lenses may be difficult for the patients to handle, therefore near point retinoscopy should be used as a guide in ascertaining the prescription which will be acceptable to the patient.

Small amounts of yoked prism, in the direction which improved outcome during the performance testing, is added to the prescription.[11] Base down prisms are typically pre-

scribed in units of 0.5 to 3 prism diopters base down, whereas base up prisms vary between 0.5 to 2 prisms diopter base up. Additional plus lens may be helpful at near.

A visual progress evaluation is scheduled 3 to 5 weeks after the examination. Case history is repeated to ascertain subjective changes. Portions of the visual testing battery are repeated as needed. A consultation, is scheduled to discuss the benefits of vision therapy.

Vision Therapy

Vision therapy treatment begins with general visual arousal activities. While doing vision therapy activities it is important to understand that the level of visual attention varies significantly with these patients. Activities using Red/Green glasses with large white moving objects (see Table 1) are the first step in vision therapy because they stimulate the ambient visual system. Activities using yoked prisms (see Table 2) of large amounts (typically 10–15 prism diopters) cause disruption of the visual processing, which leads to increased attention and increased awareness.[9] Peripheral arousal activities significantly improve patients ability to visually direct themselves. The lenses cause arousal of the ambient visual system as well as arousal of the basic binocular visual system.

These activities are prescribed for 3 to 9 months. Significantly improved awareness of their peripheral visual world is necessary before using traditional vision therapy activities. In the therapy room, the patients are guided to experience the different activities. Many times these patients will gravitate to certain activities that are beneficial to them at that time. We guide the patient to participate in appropriate activities; however, their needs and desires frequently take precedence. Home therapy activities are prescribed. These activities usually involve the Red-Green glasses; however, at times yoked prisms are sent home for specific purposes.

Activities that are used in the early stages of stimulating the central visual system include vectograms, minus lenses, lens flippers, trampoline with letter charts, letter naming with the fixator, pegboard rotator, and computer activities. It is important to make this switch gradually. We continue to work on the arousal of the peripheral visual system as we work with the binocular system using activities.

TABLE 1. Red/Green Peripheral Arousal

- I. Red/green glasses and large white target
  - A. White suspended ball with red/green glasses
    1. Bump ball, tap with hand
  - B. White balloon with red/green glasses
    1. Plays volleyball, kick or bump with a white stick
  - C. White ball with red/green glasses: Nerf balls, beachball, soccer ball, wiffle balls, ping pong balls or a volleyball
  - D. White bean bags with red/green glasses
  - E. Wayne Rotating Projector with red/green glasses
    1. Follow motion or make finger shadows
  - F. Marker board with red/green glasses and writing with black pen
  - G. White race car with red/green glasses
  - H. Angels In The Snow with red/green glasses and looking at a light
    1. Hierarchy of motor movement: *Integrating The Mind, Brain and Body Through Movement, A Vision Aerobics Program*[12]
  - I. Flashlight Tag with red/green glasses
    1. Miner's light from Recreational Equipment Incorporated—with red/green glasses
  - J. Rice in play box with red/green glasses
  - K. Bowling with white Styrofoam cups and white ball with red/green glasses.
  - L. White spoon, handle in mouth. Carry cotton balls and drop in white Styrofoam cup while wearing red/green glasses
  - M. Lite Brite with red/green glasses
    1. Make pattern with clear pegs, follow pattern
    2. Use as a light board to write on which to write
  - N. Lebarge Electro Therapist with red/green glasses
  - O. Wayne Saccadic Fixator or Eye/Hand Coordinator with red/green glasses
  - P. Sports Rotator with red/green
  - Q. White pegboard and golf tees with red/green glasses

TABLE 2. Yoked Prisms—Visually Directed Movement

- A. Walking rail
- B. Suspended ball
- C. Tootie toss
- D. Pegboard rotator
- E. LeBarge Electro Therapist
- F. Wayne Fixator or Eye/Hand Coordinator
- G. Sports rotator
- H. Balloon
- I. Marching in the mirror: look at themselves
  1. Homolateral, tap knee
  2. Cross-lateral

Prescription lens changes frequently occur as a result of vision therapy.[9] The need for therapeutic yoked prisms is reduced as a result of improved functioning of the visual system. Some patients comfortably go from needing yoked prisms in their lenses to not needing them at all, while others need to have their prescription gradually reduced.

When the patient reaches a level at which the visual system seems to be functioning adequately, then it is recommended that the vision therapy be reduced slowly. Some of the patients make progress at a fairly rapid rate, whereas most make improvements in visual processing at a very slow pace. Completion of vision therapy program is gradually reduced. It is advised to first reduce the number of sessions in half. Continue to reduce their therapy sessions in this fashion so that they can make a smooth transition from good functioning visual system while in vision therapy, to a good functioning visual system without being in vision therapy.

CASE STUDIES

B.G.

Initial evaluation —August 1994.

History—B.G. was 29 years old when she was referred by an auditory integration therapist. She lived 200 miles from the office. Her mother reported that she was autistic with little expressive language, but that she comprehended quite well.

Visual symptoms—She did not read, but could pick out some letters; she was uncomfortable in a crowded area with a lot of movement, such as a shopping mall; eye/hand coordination sports were very difficult; she was hesitant with stairs; she placed a keyboard off to the right when using facilitated communication; and she had possible visual field problems.

Medical diagnosis—Autism, seizure.

Medication—Tegretal, Anaprox.

Work—Stuffing envelopes for the dietitians at Kaiser Hospital.

Visual findings.—Visual acuities at

	distance	near
OD	20/25	20/30
OS	20/20	20/30

Left side of the chart was more difficult to read than the right side.

Bernell Bioptor visual skills.—Distance: exo posture, fusion impaired; Near: exo posture, suppression with fusion demand.

Cover test.—Intermittent alternating exotropia.

Pursuits.—Impaired.

Near point of convergence.—6″/12″.

Randot Stereopsis Test.—Could not do.

Retinoscopy.—OD $-0.75 - 0.25 \times 79$

OS $+0.25 - 0.50 \times 78$

Visual field disc.—OD, temporal gaze 65°; OS, temporal gaze 20°.

Performance testing.—Yoked prism base down; fixations and tracing appeared easier.

Diagnosis.—1. convergence insufficiency; 2. reduced stereopsis; 3. intermittent exotropia at near; 4. left visual field neglect.

Plan.—1. Prescription: OD: plano 2 base up prism; OS: plano 2 base up prism. 2. Optometric vision therapy: Because of the distance from the office it was decided that it would be every other week in the office with 30 minutes of home vision therapy 4 days a week. Office therapy is once a month at times.

Significant outcomes:

9/93	Production at work is up 14%, seems more peaceful, decreased frustration, is able to say a complete sentence.
10/93	Able to look at people in the eye
2/94	Production at work is up 2%. New title: receptionist. More eye contact with people.
4/94	Pointed and followed in book all the words of the prayers and songs for an entire church service.
5/94	Working overtime. Is taking on co-workers' work. Gold medal in the Junior Olympics. She is now starting to work on computer.
5/94	Walking up to all signs and spelling in correct order, using her own finger as the pointer. At a large family gathering comments included: speaking more and more clearly, is more alert, participating, seems so much more comfortable, using sentences, didn't exhibit previous withdrawal behaviors; replied, "No my glass is half

full." Her response was quick, so appropriate and she has never used the "half" concept verbally.

7/94 B.G. was accepted in a new group home. She has "outgrown" her former home. Sentences are more and more frequent. New words are used. She is in T Ball and going to district finals.

8/94 B.G. caught one-handed: her idea and has about twice the accuracy.

Current optometric findings:

9/94 Visual Field increase of 60° temporally with the left eye.
Stereopsis increased to 140 arc seconds.
Cover test: alternating exotropia at near
Near point of convergence: 4"/4"
Exo posture with fusion impaired at distance and near

Current plan.—To continue with her present glasses for full-time use. To continue with optometric vision therapy as she is still having positive outcomes in daily living skills as well as optometric findings.

E.C.

Initial examination.—January 4, 1992.

E.C. was 3.3 years old. He was seen for a comprehensive binocular vision evaluation. He was referred by an occupational therapist who was concerned that his visual system was interfering with his coordination. Autism had been diagnosed in E.C. at age 2.0 years. E.C. had delayed gross and fine motor skills and delayed speech (he only occasionally would speak a word). At age 15 months, E.C. had had a vocabulary of 20 to 30 words, but he had lost this development at the time of the examination. E.C.'s parents reported that he seemed to be totally unaware of what was happening around him. E.C. would frequently walk in front of a swing while another child was swinging, or tumble down a step and show no awareness of the step before falling. E.C. was unsafe in his environment. Other vision symptoms included excessive blinking, a short attention span, and an inability to stack three blocks. Other problematic areas included excessive head banging. Additional treatment in which E.C. was participating included extensive occupational therapy and speech therapy.

Medical diagnoses.—Autism, seizure disorder, manic depression.

Medications taken at the time of the initial examination.—Tegretol, antibiotics.

Visual findings.—Ophthalmoscopy: all structures were clear and healthy; visual acuity: no response. E.C.'s answers were unreliable to Snellen equivalent pictures and the Broken Wheel test. Attention to the task was too short to accept a response.

Cover test.—Distance: orthophoria; near: unreliable.

Hirschberg.—Orthophoria.

Pursuits.—Impaired, poor attention to Disney characters, Sesame Street Characters, or lights.

Near point of convergence.—6"/unresponsive: E.C. quit attending.

Randot stereopsis test.—Could not do.

Retinoscopy.—Distance: OD, +1.50 D; OS, +1.00 D. Near (stress point): OU, +0.50 D.

Performance testing.—Suspended ball: Attended for a few seconds with a +0.50 D prescription on; he did not attend at all without the prescription on; the yoked prisms showed no change in any direction. Blocks: Stacked four blocks with ease while wearing the glasses.

Diagnoses.—1. binocular fusion dysfunction; 2. ocular motor dysfunction; 3. fusion with defective stereopsis; 4. deficiency of smooth pursuits.

Plan.—1. Prescription: +0.50 D; 2. optometric vision therapy: one time weekly session in the office, with home therapy completed up to 30 minutes daily. The therapy program began March 22, 1993.

Significant outcomes.

4/94 He began watching the balloon for the first time.

6/93 He wore the yoked prisms 15 p.d. in all four primary directions.

10/93 Videotape comparison from the beginning of vision therapy to today showed significant improvement in E.C.'s awareness of where he is on

and off the walking rail. Without the videotape we would not have been aware of the dramatic change in his awareness of where he is in space. His mother then also reported that he was now climbing on a jungle gym and that she was able to back a little bit away while he was playing on the playground.

11/93 Has auditory training; at first this disorganized his visual system to before the use of his glasses, and the beginning of vision therapy; however, it soon returned with improved visual skills.

12/93 He showed awareness of depth with the stereo vectograms.

2/94 He used his eyes to find the handles on a piece of playground equipment.

3/94 Significantly increased echolalic speaking. Improvement was noted with his visual motor skills; he could now cut with scissors.

6/94 Prescribed new lenses: +0.50 D with 1 p.d. BU OU.
Performance testing showed significantly improved performance with the BU prism.

7/94 E.C.'s occupational therapist and speech therapist at a special week-long camp both noticed improved performance when E.C. wore his glasses. E.C. was saying many more words on his own.

8/94 E.C. was extremely sick, he had multiple seizures, and screaming sessions. The physicians were unable to diagnose the underlying problem. Progress has been slowed, but not stopped, as a result of him not feeling well.

Current findings.—Currently E.C. has at least 150 words. His visual motor skills, including cutting with scissors, are at age-appropriate levels. His mother feels that it is the combination of vision therapy and occupational therapy that have made such a tremendous change.

Visual acuity.—Broken Wheel test: forced choice. E.C. gave a positive response to 20/200, and a likely response to 20/60 cards.

Pursuits.—He is able to track any object which I use. Attention is much longer then previously, but is not yet at appropriate level.

Near point of convergence.—3"/6"; E.C.'s attention continues to be short.

Randot Stereopsis Test.—No response.

Retinoscopy.—OD +0.50 D; OS +0.50 D.

Current plan.—Continue with current prescription, continue with vision therapy.

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