The Role of Vision in Autism Spectrum Disorders: More than Meets the Eye (Part 1)

By Patricia S. Lemer, M. Ed., NCC

Do you know someone who has "vision?" What do we mean when we say, "I see?" If we comment that someone is "myopic" are we referring to his glasses' prescription, his thinking or both?

For the past 20 years I have been fascinated by vision and its relationship to learning and behavior in individuals with special needs, especially autism. My training as a mental health professional did not satisfy my thirst for information about vision, so I turned to other disciplines for answers. I have combined my findings in the book, *EnVISIONing a Bright Future: Interventions that Work for Children and Adults with Autism Spectrum Disorders*, published in 2008 by the Optometric Extension Program (OEP). In this two-part article I present a "look" at some of the fascinating information I discovered.

What Is Vision?

Vision is the learned, developmental process of giving meaning to what is seen. It is far more than 20/20 eyesight. It incorporates all the other senses, eventually becoming the dominant sense in typically developing children. Vision is conceptual and perceptual. It allows us to attend to, organize, understand and interact with the world around us. It develops hierarchically, emerging from an integration of sensory input from the eyes, body and brain. Vision drives imagination and creativity, and even many types of intelligence.

Visual Symptoms in Autism

In individuals with autism, vision - not eyesight - is often deficient. Visual behaviors in autism that could signal visual dysfunction include:

- Has difficulty making eye contact
- Tilts head when observing closely
- Squints or closes an eye
- Is fascinated by lights, spinning objects, shadows or patterns
- Looks through hands
- Flaps hands, flicks objects in front of eyes
- Looks at objects sideways, very closely, or with quick glances
- Shows sensitivity to light (photophobia)
- Becomes confused at changes in flooring or on stairways
- Pushes or rubs eyes
- Widens eyes or squints when asked to look
- Bumps into objects or touches walls while moving through space

Sadly, visual issues are often overlooked and misunderstood as simply symptoms of autism. In 1999, the National PTA passed a resolution stating that vision problems are often missed as significant factors in learning problems, and that academic deficiencies are often mistakenly attributed to behavior or motivation.

Why Vision Issues in Autism are Misunderstood

Controversy surrounds the role of vision because several different models "view" vision according to widely diverse training. The *medical model* represented by MDs or ophthalmologists defines vision in terms of eye health and structural pathology. A *functional model* of vision is represented by optometrists or ODs, whose training emphasizes that vision operates in relationship to the rest of the body. These professionals look at the visual skills necessary for learning, including visual perception. The *educational model* defines vision as acuity, and offers "vision" services for students with "low vision" or eyesight problems. School-based occupational therapists (OTs), special educators and school psychologists can all evaluate visual perception and write IEP goals to enhance visual perception as it relates to academic achievement.

Every child is unique. Just as all children with autism differ in many ways, so do the visual issues in those with autism. To identify and treat underlying visual issues requires a complete vision evaluation. In an ideal world, evaluating and treating an individual demonstrating behavioral or learning issues such as autism should take all aspects of visual function, including eyesight, structural pathology, perception and eye health into account. Oh, what I would give for an ideal world!

What Causes Visual Issues in Autism?

Vision affects and is affected by both genetics and the environment. While it is difficult to separate nature from nurture, nearsightedness (myopia) and a turned eye (strabismus) are believed to run in families. Some contemporary societal practices that restrict babies' and young children's movements for safety reasons may also be responsible in part. Safety measures such as back sleeping (even when remediated by "tummy time"), car seats, backpacks, strollers, and baby exercisers can impede the emergence of important reflexes necessary for motor development. An increased early use of electronics, such as computers, TV and video games, that force visual focus at inappropriate distances and for extended periods of time, may also contribute in subtle ways.

The eye is one of the most nutritionally demanding organs of the body, and is often the first place where disease appears, such as in diabetes. It is profoundly affected by vitamin and mineral deficiencies, toxins, and the foods we eat and drink. In the late 1990s, Mary Megson, MD discovered that a deficiency of vitamins A and D played a role in regressive autism, and saw great progress when supplementing the diets of her patients with cod liver oil, an excellent source of the deficient vitamins. Known excitotoxins, such as

MSG, aspartame and alcohol quickly affect vision. Many medications also have visual side effects, such as blurring, double vision or even blindness.

The Visual System Has Two Parts

Focal or *"central" vision* helps an individual determine "what is it?" Focal vision is primarily a conscious function, allowing one to see clearly, to recognize objects and to read. *Ambient* or *peripheral vision* answers "where am I?" or "where is it?" It is a subconscious function, and its role is to orient an individual and object in space.

An important reflex, the tendon guard, regulates how and where an individual focuses. If its "freeze" or "red-light" mode is overactive, vision is hyperfocused and behavior is compulsive or perseverative. In an overactive "fight or flight" or "green-light" mode, vision and behavior are chaotic and impulsive.

One of the most significant issues for individuals with autism is coordinating central and peripheral vision. Autistics tend to use one part of their vision, but not both simultaneously and efficiently. Without integration, the body is under stress. Some who are more "focal" may play with specks of dust, are obsessed with details or demonstrate savant abilities. Others are "ambient," fascinated by contrast, lights, shadows and shiny objects. This visual rigidity can make them appear very inflexible behaviorally. Reflex integration is often part of the treatment plan to restore a balance between central and peripheral vision.

Fundamental Visual Skills

In normal vision, the eyes move together as a team: up, down, in and out to coordinate their messages and send one distinct image to the brain. This is called *binocularity*. A person's two eyes should be able to move together to converge and diverge. Many students with autism spectrum disorders have *convergence insufficiency*, meaning they cannot cross their eyes and hold for more that a few seconds. The eyes should also be able to focus on the same object at the same time, no matter its distance, and shift their focus from near point to far point and back, a skill called *accommodation*. Table 1 lists essential visual skills.

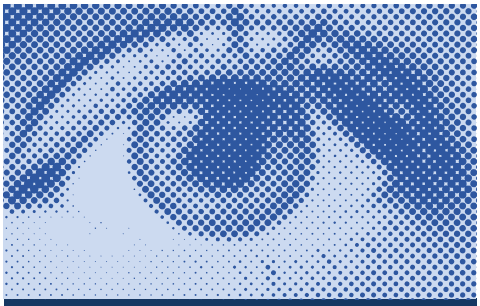


Table 1.
Essential Visual Skills

Acuity – Sharpness or clarity at both distance and reading distance

Focusing – Ability to maintain clarity while changing distances

Eye Tracking and Fixation – Ability to look at and accurately follow an object

Binocular Vision or Fusion – Ability to use both eyes together efficiently

Eye Teaming – Ability to aim, move and work the eyes as a coordinated team

Visual Motor Integration – Ability to combine visual input with input from the other senses and respond motorically

If the two eyes are working together properly, the brain takes in information, stores and uses it efficiently. If the eyes are not working together as a team or processing information inefficiently, such as in many people with autism, the brain must decide what to do with the partial information. Poor integration of ambient and focal vision, poor binocularity, inefficient and slow focusing, poor integration of vision with other senses and poor visualization come crashing together to manifest themselves as poor attention, memory, spatial awareness, visual-motor integration, perception or visualization: all symptoms of autism!

Strabismus: High Incidence in Autism

Research shows that about half of individuals with autism spectrum disorder diagnoses evidence an eye turn, called a "strabismus." This statistic is astounding when compared to only four percent of the population in general with this problem. A strabismus is sometimes seen after a traumatic birth, an infection, a high fever, surgery, heavy metal toxicity, sensory deprivation, or any assault on the growing nervous system.

An ophthalmologist (who looks at structure) typically recommends patching to treat a strabismus, and, when this intervention is unsuccessful, surgery to "straighten" the eye(s). While this approach possibly creates a cosmetically "straight" eye, binocularity is achieved in only about one in four cases. Optometrists view a strabismus not as a structural deficit of the eye but rather as a functional motor-sensory misalignment caused by an infant's unconscious adaptive response to neural dysfunction.

Motor & Vision Develop As a Team

Children learn to use their vision in the context of movement. The *motor system* develops incrementally from large to small, and from the midline out: head, neck, shoulders, arms, elbows, wrists, hands, fingers, and joints. *Vision* develops from the bottom up, and from whole body to lower, then upper body, trunk, neck, head and eyes. Each body part, including the eyes, eventually functions independently of the core, head and upper body.

At first the baby is simply a motor being; in its early years, the motor system drives vision. The baby moves from what Piaget called the Motor stage to the Motor-Visual stage, with the eyes going along for the ride. Reaching the next step, the Visual-Motor stage, where vision guides movement, is an enormous developmental jump. To manage this step successfully, the body must

know where it is in space and move automatically. Many with autism never get this far. They get stuck in Motor-Visual, and do not use their vision purposefully.

If a child does not know where HE is in space, it will be extremely difficult, even impossible, for him to know where objects, such as his backpack, homework, or letters on a page are in space. Kids with autism who have organizational difficulties are usually "lost in space" as a result of underlying visual dysfunction.

The final stage, Vision, requires moving concepts and ideas around in the mind's eye without actually moving the body in space. We call this organizing and conceptualizing. Many adults with attention deficits and learning disabilities and those with Asperger's Syndrome and high-functioning autism often lack this skill.

For a child to be academically "ready," the above steps take place in sequence, resulting in the development of a dominant eye and hand (not always on the same side) and the ability to use the two sides of the body together. Success at end-product skills such as holding down the paper with one hand and writing with the other, or using paper and scissors, are examples of bilateral tasks.

Vision's Role in Language and Social Skills

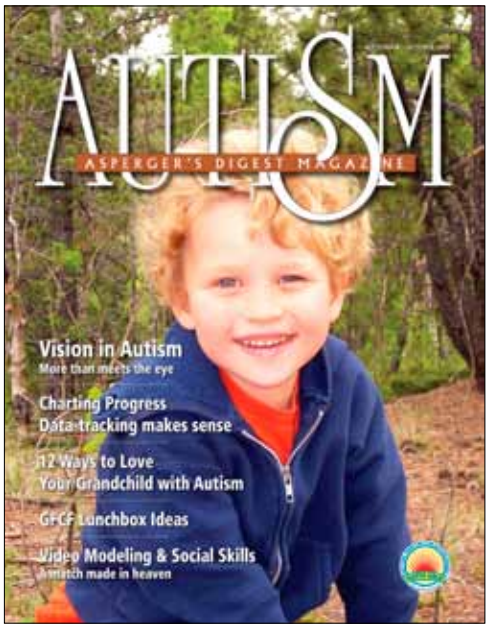
Pragmatic language and social skill development, two areas that are of great concern to parents of children with autism, are the most complex outcomes of tactile-motor-visual integration. Many years ago, I wrote an article entitled, "Say Hi to Patty." In it I elaborate upon how efficient vision allows a child to focus on someone who greets him, give the obligatory hand-shake, hug or kiss, and then listen to what the person is saying, even if seeing double, giving those words meaning and responding, all in a matter of seconds! To access this article, go to www.devdelay.org.

Change Behavior by Changing Vision

Individuals with autism can learn to use their vision more efficiently. Once their visual skills improve, so will their behaviors and learning. The best way to improve vision is through a program of vision therapy delivered by a behavioral optometrist.

Part 2 of this article will discuss Vision Therapy, the use of lenses and prisms, and offer ideas and strategies that address vision challenges within the classroom environment. Stay tuned!

Patricia S. Lemer is Executive Director of Developmental Delay Resources (DDR). Visit DDR's website to purchase a copy of Patricia's book, read informative articles, or contact her with questions or comments. www.devdelay.org



The Role of Vision in Autism Spectrum Disorders: More than Meets the Eye (Part 2)

By Patricia S. Lemer, M. Ed., NCC

In Part 1 of this two-part article on vision, readers learned that visual dysfunction often interferes with many aspects of development in individuals with autism spectrum disorders (ASD). Among the concepts discussed were the difference between eyesight (clarity) and vision (giving meaning to what is seen), essential visual skills, such as binocularity and accommodation, and the importance of integrating focal (central) and peripheral (ambient) vision.

Vision is a developmental process, just as are language and motor skills. Because a vast majority of children with autism spectrum diagnoses have visual symptoms, such as flicking their fingers and poor eye contact, and their visual skills lag, they should have a complete evaluation by a behavioral optometrist. Specific visual interventions, delivered

through a program of individualized vision therapy, can be invaluable in treating underlying visual lags that impact a child's functioning and learning. Individuals with autism *can* learn to use their vision more efficiently, and thus think, act, learn and behave in more desirable ways.

Vision Therapy

Specially trained optometrists all over the world offer in-office and at-home vision therapy. Since children do not "outgrow" delays in visual development without intervention, vision therapy (VT) cannot start at too young an age. VT can sometimes be the important trigger that turns on attention and comprehension especially in nonverbal individuals and those with significant cognitive, language and social emotional challenges. For higher functioning students, it can make the difference between requiring full-time special education and a classroom assistant or being able to work independently in a mainstream setting.

Vision therapy typically takes place once or twice a week in a doctor's office, supplemented with 15-30 minutes per day of home therapy to reinforce skills. While improvement is often seen in a month or so, therapy frequently continues for an average of three to nine months, and sometimes for as long as a couple of years, depending on the child and the severity of the visual dysfunction, to stabilize and solidify learned skills.

At the heart of vision therapy are activities individually designed to teach a person's eyes to move, align, fixate and focus as a team. The brain learns to coordinate new messages from the eyes for improved perception and cognition. Vision therapy tools include lenses and prisms (sometimes colored or tinted), balance boards, walking rails, chalkboards, balls, beanbags, computers, metronomes, and paper and pencil, all used in the context of movement.

During vision therapy, learning to use the eyes together first requires a conscious effort. The ability to perform complex visual-motor activities - like skiing or writing - develops gradually. The ultimate goal is for patients to learn to use the two eyes together effectively, and to integrate vision with movement and the other senses effortlessly and automatically.

Lenses and Prisms

Ophthalmologists use compensatory lenses to improve eyesight; optometrists use them therapeutically to correct vision. All lenses displace light. Single lenses address focal vision and help us see "What is it?" Ambient prism lenses operate on the "Where is it?" function. They deflect the light rays differently through a thin edge at the top and a thick edge at the base, influencing how the brain interprets where the body is in space. Prisms can be powerful temporary tools for individuals with autism and other delays because they alter neural processing of the brain, creating an unconscious change in posture or attention. The immediate changes give the brain a preview of what is possible. However, motor experiences are necessary for consolidation and permanent changes in perception.

Eye doctors sometimes tint or color lenses to help patients deal with glare or visual sensitivities. They also frequently prescribe bifocal lenses, which can have an enormous impact on functioning. Bifocals allow the eyes and the brain to readjust and respond differently as they move together into a new

To find a behavioral or developmental optometrist, go to www.covd.org, www.oepf.org and www.optometrists.org, and enter a zip code. These organizations certify, educate and promote optometrists who work with individuals with ASD.

visual field (about every eight inches). Some children with autism thus wear bifocals for the convenience of having two lenses, one for near work and one for distance to accommodate different fields.

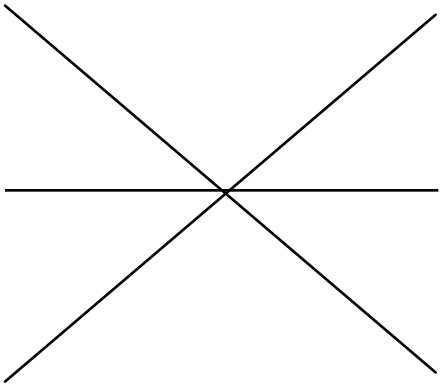
What Schools Can Do to Assure Efficient Vision

In its campaign to increase understanding of vision issues, the National PTA declared most schools and pediatric "vision" screenings inadequate. They urged that screenings look at binocular function, accommodation and convergence in addition to acuity. School nurses or teachers can be trained to use a machine called a Keystone Telebinocular to do such vision screenings.

Vision in the Classroom

Teachers can probably pick out those children with visual dysfunction just by observing their reading and writing postures, head and eye movements. Any student in first grade or above who still moves head or body along with the eyes requires intervention.

A simple vision readiness test teachers or parents can use is to have a child copy this design without seeing an adult draw it first:



The child should draw three intersecting lines moving from left to right and top to bottom. Any variation, such as six rays, Vs, or right to left drawing shows lack of readiness for reading and writing, and the need for intervention. Success copying this design is developmentally at about five-and-one-half years of age, or a beginning kindergarten level.

Classroom Modifications to Enhance Vision

- **Assure quality lighting**
- **Decrease visual "busyness" of room and written work**
- **Add touch and movement activitiest**
- **Offer seating, standing, and kneeling options for work**
- **Include movement breaks**
- **Add extras: grips, paper, fidgets, slantboards, cushions**
- **Consolt with an occupational therapist for individual needs**

Vision Activities Benefit Everyone

Teachers from pre-school through the elementary grades can incorporate enjoyable activities that will help vision develop, solidify visual skills and consolidate vision for everyone.

Visual Arousal Activities. For our youngest and lowest functioning children, activities that heighten use of vision in general are a good starting place. Balloons, bubbles, scarves and other items that move slowly work well. Hit balloons playfully, first with both hands, then alternating hands. Chase and catch huge bubbles blown from a giant wand. Throw and catch scarves, adding soft background music for calming. Play flashlight tag: An adult shines a light on the wall, and the child shines his/her light on top of it. Gradually move the light and have the child move in tandem. Take turns being the leader.

Chalkboard Activities. Remember those painting easels in pre-schools? Standing up and writing with the whole body engaged developmentally precedes sitting down and using only the hand. We can help young children develop stability of legs and trunk so they can later concentrate on eye-hand connection by allowing them to stand instead of sit. While erect, activities such as making circles with chalk on a blackboard (or with markers on paper taped to a wall) can strengthen the upper body. Alternate with both hands drawing circles clockwise, counterclockwise, and in opposite directions.

Lazy Eights. The figure eight lends itself to many activities to improve attention, eye movements, binocularity, crossing the midline and overall visual efficiency. Start with "walking eights," asking children with more challenges to walk around a path shaped like a large eight. Next, use the chalkboard for "standing eights," in the same manner as circles above. Next, seated, have a child follow an adult's thumb or "pencil topper" visually, while it moves in a "lazy eight" pattern. Finally, higher functioning children and adults can follow their own thumbs first on one hand and then on the other. The ultimate goal is to use eyes only, with head, trunk and body still.

Visual Thinking

Visual thinking, the ability to generate and use imagery, is the culmination of "sensory integration" and it begins when children are very young. In school it is important for reading comprehension, written language and understanding mathematics concepts. Temple Grandin is masterful at "seeing in pictures." However, many children with autism do not have that ability, and are attracted to video games, television and computers to fill the empty space in their minds' eye. Far better than electronic images are those that

come out of one's own sensory experiences of moving through space.

Simple activities can enhance and improve visual thinking. Dr. Lynn Hellerstein, a Colorado optometrist recommends asking your child to take a Hot Air Balloon ride each night before going to sleep. Ask the child to describe her day by looking down on it from above. Prompt less verbal children as needed, with questions about temperature, colors, sizes and shapes.

As children get older, introduce parquetry blocks, starting with forming simple patterns and eventually making constructions from "my point of view." Taking another's point of view is an abstract concept that starts concretely and develops with practice. A wonderful book containing visual thinking activities is *Thinking Goes to School* by Furth and Wachs. I recommend it highly for teachers of all ages.

Rhythm and Balance

Adding rhythm and balance to visual activities removes conscious thought from the visual component and helps vision solidify. Teachers, parents and therapists can make all the activities above more difficult by doing them to a metronome and/or while on a balance beam. Once an individual can throw and catch beanbags while walking six inches above the floor on a narrow beam, you can add a cognitive component to the activity, such as saying the alphabet backwards or doing simple arithmetic calculations.

Vision and Reading

Students spend much time reading books and on the computer, yet many school screenings measure visual acuity only at distance. Young students are naturally far-sighted, the reason primary print is large. By third grade print size diminishes and many students show reading difficulty. "Learning lenses" which magnify print can be helpful for removing eye stress and strain for young learners, just as they do for their aging grandparents.

Research documents that not the clarity of the print, but rather the inability to track and sustain focus is a problem in some students. As eyes learn to work as a team, reading fluency often improves spontaneously. Comprehension is related to the ability to run images in the mind's eye, another visual skill. Again, as students with autism learn to visualize, their reading comprehension improves.

Reading words is different than reading with understanding. Some children with autism who have well-developed central vision are "hyperlexic" – read very early and have strong word decoding skills. While their parents may be proud of this skill, it is a sign that both aspects of vision are not integrating.

Vision and Writing

Putting thoughts down on paper is the most complex form of language expression. It includes formation, spacing and placement of letters, words, sentences and punctuation, as well as composing content. Students with autism generally have difficulty with all aspects of writing. Some "focal" learners excel at spelling. As with hyperlexia, this may be both an asset and a liability.

Writing descriptive well-formed sentences depends on strong visualization skills. Sometimes parents and teachers need to be patient; writing skills, like social skills, are one of the last areas to develop.

Take Home Points

- **Vision problems often interfere with learning and behavior in autism.**
- **Anyone with visual symptoms deserves a FULL vision evaluation that includes more than eye health and acuity.**
- **Vision is learned and vision problems can be remediated with proper intervention.**
- **Vision therapy can be an integral part of an educational therapy program.**

Vision and Math

More than any other academic subject, skills with mathematics are based in strong visual spatial understanding. People who are adept at math can tell you they visualize numbers in their minds' eyes. They can estimate time, money, distance and answers to problems easily. To help those with autism excel in number concepts, parents and teachers can offer frequent real-life experiences such as measuring, cooking and woodworking.

Have Vision!

Vision issues in autism *are* more than meets the eye. Individuals with autism spectrum disorders *can* learn to use their vision more effectively. For much more information, read my book *EnVISIONing a Bright Future: Interventions that Work for Children and Adults on the Autism Spectrum.*

Patricia S. Lemer is Executive Director of Developmental Delay Resources (DDR). Visit DDR's website to read informative articles, or contact her with questions or comments. www.devdelay.org

Vision Resources

Cheatum, BA, Hammond, AA. *Physical Activities for Improving Children's Learning and Behavior*
Furth & Wachs. *Thinking Goes to School*
Getman, G. *How to Enhance your Child's Intelligence*
Kaplan, M. *Seeing with New Eyes*
Lane, K. *Developing your Child for Success*
Remick. *Classroom Vision Activities*
Wendelberg, D. *Begin Where They Are*
Wendelberg, D. *Vision 0-3, Vision 4-5, Vision in the Classroom.*

(All available at www.devdelay.org)