

Seeing the Spectrum: Optometry's Role in Autism

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**Abstract:**

Autism is defined as a group of developmental disorders characterized by difficulty in social environments, communication, sensory processing as well as repetitive, stereotyped behaviors. Autism has multiple categories and a spectrum of functionality, with no definite cause. Autism spectrum disorder (ASD) is generally diagnosed by common behaviors such as lack of eye contact, obsessive compulsive qualities, hyper attentive behavior, fixating on light patterns or windows, and looking from the corner of their eyes. All these behaviors have a visual component to them which result from a deficiency of integrating both focal and ambient pathways effecting overall visual perceptual skills. Vision therapy is a treatment plan that can integrate all sensory input and allow vision to help, not hinder, daily tasks. Yoked prism, when used appropriately, can improve a patient's visual organization of space by shifting their field of vision toward the prism apex. An appointment with developmental optometrist can help guide the appropriate diagnosis and treatment plan required.

Autism spectrum disorder (ASD) refers to a broad spectrum of developmentally delayed conditions generally characterized by social skills challenges and repetitive behaviors. Currently one out of 40 children are diagnosed with ASD, and four more times more likely in males than females.<sup>1-2</sup> Individuals on the spectrum are always unique and may have varying skill sets, even though they have the same diagnosis. There is no single cause of autism but research shows it has been linked to a combination of genetic and environmental factors. ASD diagnosis is mostly based on behavior, even though there are numerous diagnostic instruments such as: Autism Diagnostic Interview (ADI), Diagnostic Observation Schedule (ADOS), Developmental Dimensional and Diagnostic Interview (3Di), and the Diagnostic Interview for Social and Communication Disorders (DISCO).<sup>2</sup> Symptoms usually start before the age of three, but vary greatly. There are two main categories of Autism spectrum disorder: Pervasive developmental disorder- not otherwise specified (PDD-NOS) and Asperger's syndrome.<sup>2</sup>

Characteristics of autism are varying depending on individual basis, but generally ASD children have delays in both understanding and using language (receptive/expressive) including nonverbal communications, difficulty in social interactions, and restrictive patterns of behavior. Overall, children with ASD develop at various rates in areas of development such as motor, language, cognitive, social skills and visually.<sup>4</sup>

Many people would never really think of vision developmental delays being important. However in reality, many behavioral characteristics of ASD involve the visual system, such as poor eye contact, side viewing, excessively attentive to objects, repetitively lining up objects, and staring at lights or spinning objects.<sup>5</sup> ASD affects how one processes and responds to sensory information, and sensory input from our visual system is one of the largest sensory inputs. Most of the visual symptoms of autism can be explained by the inadequate integration

between the two visual processing pathways: focal and ambient. The focal visual pathway gives specific information on what is being seen or observed centrally, while the ambient pathway gives information on where an object is in relation to where we are in space.<sup>6</sup> Ambient pathway gives information on where an object is in relation to where we are in space visual field and integrating it with other sensory systems.<sup>6-7</sup>

In 1971, multiple doctors at UCLA first described the phenomenon of 'tunnel vision', which is found to be a relatively common symptoms in individuals with autism. Stimulus overselectivity is when a person focuses on only one aspect of the environment or an object while ignoring their surroundings.<sup>8</sup> For example, many parents of autistic children initially suspect their child of being deaf due to stimulus overselectivity. Such as a child playing with a toy for hours and not responding to his name or other children yelling/crying, but runs when they hear a parent opening their favorite candy wrapper. There are multiple theories as to why autistic individuals have this "tunnel vision". One theory states, processing the surroundings as a whole can become overwhelming and cause over arousal.<sup>8-9</sup>

Dr. Melvin Kaplan states "Eighty percent of the information we receive comes from the visual sensory system. When we cannot obtain visual information from the environment due to some kind of receptive problem, we then start to see changes in performance or behavior."<sup>10</sup> Binocular vision is generally not easy for children on the spectrum. ASD children sometimes tend to look at objects or others from the corners of their eyes, which is their way of self regulating due to the excessive amounts of local information and decreasing movement perception. Monocular vision is less confusing and less data to interpret than dysfunctional binocular vision. Also, they may find it hard to make eye contact when one is talking due to visual and auditory simultaneous overstimulation.<sup>7</sup>

In fact, in 1992, 34 autistic children were evaluated, from ages 2 to 11 years old, for eyesight, oculomotor skills and alignment and stereopsis. Results show compared to 3.7 percent for developmentally typical population, 21 percent of their children have strabismus and a high incidence of difficulty with pursuits.<sup>2</sup> Research also shows a significantly reduced near point of convergence in both low and high functioning ASD. Overall, research has shown poorer binocular and monocular visual acuity in the ASD population compared to neuro-typical children, even with refraction distribution being similar.<sup>11</sup>

Due to the lack of integration between the focal and ambient pathways, there are two main tools used to reinstruct an individual's 'organized space': yoked prism glasses and optometric vision therapy.<sup>7</sup>

### **Yoked Prism**

Yoked prism lenses tend to move the world in a certain direction- up, down, right, or left. By shifting the world in a specific direction disrupts the ambient system which encourages re-integration of the focal and ambient pathways.<sup>7</sup> Dr. Kaplan states "the use of lenses, which transform light, in combination with visual exercises designed to enable the patient to process visual stimuli in an organized, integrated fashion...can allow the patient to achieve harmony with his environment and reduce the panic responses to visual information that are symptomatic of autism"<sup>10</sup> Dr. Kaplan performed a study involving fourteen ASD children, with a mean age of 13 years old, to see how they react in terms of head tilt, body posture, facial expressions during visual pursuits, ball catching, and watching TV with one group wearing yoked prism and the other group wearing placebo lenses over four months. In conclusion of the study, individuals on the spectrum revealed a lower heart rate and increased electrodermal responses when viewing emotional videos through yoked prism lenses compared to the placebo lenses. The study also

indicated increased audio-visual stimuli, which in return increased attentiveness to affective content.<sup>6</sup>

### **Vision Therapy/Occupational Therapy**

Since no two children on the spectrum are alike, all therapies should be goal-oriented. Unfortunately, vision therapy is not usually one of the therapies mentioned when it comes to autism, unlike behavioral, speech, physical and occupational therapy. Select occupational therapist can perform visually enhanced therapy but are generally not equipped to use specific tools like prism and lenses. According to American Occupational Therapy Association, occupational therapist "help people across the lifespan participate in the things they want and need to do through the therapeutic use of everyday activities" whether it be for injury rehabilitation or helping children to participate fully in school and social situation.<sup>12</sup> Occupational therapy works on a lot of aspects, including gross and fine motor movements and bilateral integration which is essential in oculomotor development. The basis of using both eyes together is to use both sides of the body. Visually enhanced OT can be a great start to prepare for vision therapy, when appropriate.

According to American Optometric Association, vision therapy is defined as "a sequence of neurosensory and neuromuscular activities individually prescribed and monitored by the doctor to develop, rehabilitate and enhance visual skills and processing"<sup>13</sup> In oversimplified terms, it is therapy for the brain through the eyes, by using specific instruments, prism glasses, loose lenses, flippers, etc. The goal of vision therapy is unique for each individual depending on their goals. Due to the very wide spectrum of autism, patients can benefit in numerous ways. There are many success stories on how patients have spoken their first words in therapy or

increasing eye contact or decrease the need of their stimming by self-regulating their sensory system.

With any new environment, there may be some anxiety and confusion for children on the spectrum, especially if they are non-verbal and are unable to communicate how they are feeling. Therefore, consistency in people and scheduling may help the child adapt and adjust faster. Positive reinforcement, whether it be with food, toys, or words, will allow the trust to be built faster between the patient and the doctor. Initially, vision therapy activities should be programmed based of their individual capabilities and interest. For example, stick and straws is a great activity but it also requires adequate fine motor control that this population may have not acquired just yet. Thus, it could be of use to stick large straws in styrofoam can allow to limit the necessity of fine motor control and focus more on the eye hand coordination. Another example is using pictures/emojis instead of the letters hart chart to keep them more entertained.

### **Visual Spatial Skills:**

Visual spatial processing relates to one's internal map, meaning, one's body awareness and locating one's own body in space. Knowing where you are in space will allow you to spatially relate to other objects or people. The inability to process spatial information can be related to poor oculocentric, headcentric and bodycentric localization.<sup>15</sup> Higher order visual-spatial abilities translates into conservation of space, visual-logical reasoning, representational thought. Visual spatial skills can be seen in numerous ways from letter reversals to toe walking/duck walking. Letter reversals are a result of a lack of visual organization and visual orientation.<sup>15</sup> Toe walking is due to poor proprioception feedback, which is the ability to know where your body is in space, especially in the z axis.<sup>14-15</sup> This can also explain why children who are developmentally delayed, sometimes walk touching the wall in an open room. The wall is

stationary and is a guide of where they are in space compared to other objects. Overall, it would be difficult for anyone to function in a world where you can't tell where you are in space, yet alone where other people or objects are or where the world begins and where your body ends.<sup>15</sup>

### **Color perception and Photosensitivity**

Studies have shown ASD children demonstrate difference in color discrimination, color memory, and detection of color on achromatic backgrounds. Parents of children with autism often say their children will not eat any food of a specific color or will not play with a set of toys that are of a certain color. Clinicians can manage these color hypersensitive by colored lenses, colored overlays and syntonics. Color overlays have shown to increase reading speed in the autistic population compared to a control group. Clinicians have also reported certain light frequencies have improved physical and emotional functioning, but not a lot of research have been computed on light therapy.<sup>16</sup>

Photosensitivity is one of the common symptoms associated with autism. Research shows increased repetitive behavior for ASD children when in a room illuminates by fluorescent lightning versus a room with incandescent lightning.<sup>16</sup> Therefore, the simple act of changing the lightening can help to decrease any overwhelming visual sensory control.

### **Adaptations to exam:**

Children with autism can easily have sensory overflow especially in a new environment with unknown people and unknown plan as to what is going to be done. Often times children on the spectrum respond to fear and confusion by developing the symptoms such as rocking, hand-flapping, toe-walking, poor eye contact, social withdrawal, tantrums or hyperactivity.<sup>15</sup> In general, when working with this patient population, one should avoid strong smells, loud or high pitched sounds, bright lights, and glare. Allow them to walk and view the whole room before

starting the evaluation and having sensory support toys to allow the patient to cope with heighten sensory system, When giving instructions, use short concrete phrases and visual supports, such as pictures or gestures, can help the exam run smoother. Because of the sensory sensitivity, large portion of children on the spectrum hate anything close to them, especially their face. Therefore, occlusion of an eye with a cover paddle or putting on glasses or inserting eye drops can be difficult and frustrating for all parties involved. Some suggestions may be: occluding with a hand, whether it be their own hand, parents or the doctors; using glasses without temples or even let the child play around with a pair of sunglasses so they experience the feeling of glasses on their face. In reality there may be a need for shaping a behavior, which means developing a new behavior such as tolerating bright light, through successive reinforcement of attempts that are closer and closer to desired behavior. Such as using the transilluminator on their fingers and as well as the fingers of their relatives, so they can understand it will not hurt them in any way. During any difficult procedure or technique it may help by distracting them by counting or singing when completing the procedure.<sup>14</sup>

Overall, according to a pilot study involving 61 children ages 9 to 17 years old, patients on the spectrum can complete most vision and eyesight test within an examination protocol. In fact, only the intraocular pressure (IOP) testability was reduced, especially for nonverbal or minimally verbal patients.<sup>17</sup>

**Conclusion:**

According to Centers for Disease Control and Prevention (CDC), autism prevalence has increased by 15 percent nationally since 2012, with most children being diagnosis after the age four, even though research supports one can reliably diagnose autism as early as age two. Early diagnosis is essential because early intervention allows for the best opportunity for

developmental benefits across their lifespan.<sup>18</sup> Early intervention consists of multiple therapies such as speech therapy, occupational therapy, behavioral therapy physical therapy in early years of the child. Unfortunately, many people don't take in consideration how vision is affect in autism. Autism spectrum disorder individuals have common visual symptoms such as tunnel vision, visual hyper fixation, minimal or lack of eye contact, and spatial neglect.<sup>16</sup> A developmental optometrist can help to assess each individual unique case and figure out what would be most effective treatment. Due to the wide spectrum of autism, various adaptation may be needed to complete an exam to evaluate vision and eyesight. From there the developmental optometrist will determine if the child if glasses, vision therapy, or prism lenses. Vision therapy is generally the more permanent solution to enhance visual spatial, visual perceptual skills and integrate all sensory input to decrease the common visual symptoms seen in ASD population.

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