All About Strabismus

by Dr. Jeffrey Cooper & Rachel Cooper (no relation).

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Development, Causes, Diagnosis, Types, and Treatments.

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Two Eyes to the Side

Nature has given animals the physical attributes necessary for survival. Lateral placement of the eyes is essential to the survival of hunted animals or herbivorous animals (e.g., horse, rabbit, cow) as it allows them to increase side or peripheral vision.

Side vision (increased by lateral placement) is a sensitive detector for motion or movement. Peripheral vision allows creatures to effectively scan for danger. The rabbit must be constantly aware of its natural enemies while it eats your garden greens. At the first sign of danger, peripheral vision, the motion detector system, alerts the rabbit that there is danger. The immediate reflexive response is for the rabbit to run.

Two Eyes in Front

Faster moving carnivorous hunters do not need as much peripheral vision as the hunted. It is more important for hunters to locate their prey and accurately determine the distance from themselves to that prey. Therefore, animals that hunt (carnivorous or meat eating animals, e.g. lion, cat) as well as humans have frontal placement of the two eyes in order to determine the exact location of their prey. The hunters sacrifice the large peripheral motion detection system afforded by side placement of the eyes in favor of the incredibly accurate depth perception system created by frontal placement of the eyes. To make up for the loss of peripheral vision, most carnivorous animals have also developed a sophisticated, pivoting system which extends the range of side vision...that is, the neck.

The Benefits of Two Eyes in Front

Frontal placement of the eyes allows for a remarkable visual phenomenon called stereopsis. Stereopsis is the 3D perception that occurs as a result of both eyes working together to create relative depth perception.

Many of you have experienced exaggerated demonstrations of stereoscopic depth by viewing I-Max 3D movies or old stereoscopes. Or, perhaps, you have seen photos of theatergoers in the 1950's wearing special Polaroid glasses in order to view 3D movies.

What is Stereopsis?

Stereopsis results from the combination of the two images received by the brain from each eye. Each eye views the world from a slightly different vantage point (See Fig 1).

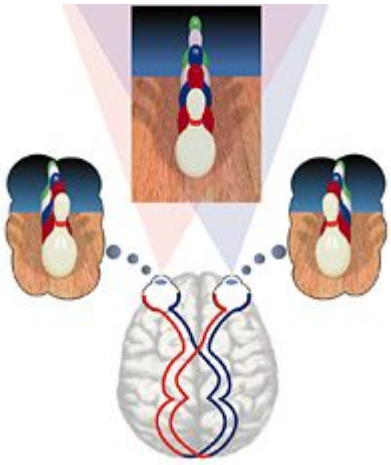

Figure 1

The fusion of these two slightly different pictures from our two "cameras" (the eyes) gives us the sensation of strong three-dimensionality or relative depth.

At near, there is a greater difference in what the two eyes view as compared to far. Thus, stereopsis is strongest and most important at near distances. **At near is where man uses accurate hand-eye coordination to make tools and other items!**

The Benefits of Stereopsis

Stereopsis has been very important in human development. Keen and accurate two-eyed depth perception has allowed man to develop tools and the manufacture of goods, a central aspect of modern civilization. Stereopsis plays a role in many other human activites, such as, catching a ball, parking a car, threading a needle, performing surgery, or any other activity that requires accurate depth perception at close distances.

Animals that have lateral position of the eyes and individuals who have **constant** strabismus (eye turn) lack stereopsis. This does not mean that they have absolutely no depth perception. There are many one-eyed (monocular) depth perception cues that allow us to make reasonably accurate depth judgements. These monocular depth perception cues may be familiar to you and include: perspective, overlay, shadowing, aerial perspective (color of the sky), relative motion, relative size, etc.

Binocular vision cues (from two eyes), such as stereopsis and parallax, are dependent on accurate alignment of the eyes and appropriate unification of the

two images by the brain. People with only monocular or one-eye depth perception skills can do fine in many situations. However, they are not allowed to fly a rocket ship, drive the trains in New York city subways, and they definitely should not be surgeons. They may have trouble catching a fly ball or becoming a NBA point guard. However, many jobs do not require stereopsis and thus the lack of stereopsis does not preclude a successful life.

Stereopsis does enhance quality of life and life choices, however! Some eye doctors might tell you that it is a luxury, but it is part and parcel of our evolution and human potential. 3D vision is a human skill we all want and deserve. Every attempt should be made to develop this visual-motor skill in a child [and it's not too late for many adults!]

What is the "critical period?"

In the early 1960's, two Nobel Prize winners from Harvard , Hubel and Weisel, did research on the development of vision. They studied monkeys and cats who have stereoscopic vision similar to humans. This led to conclusions regarding a "critical period" of development for stereopsis.

What is the "critical period" and what does it mean in regards to you or your child and your treatment options. Explore this controversial topic by reading the following two articles by Dr. Jeffrey Cooper and Dr. Paul Harris, two different experts on strabismus. Dr. Harris refers to the famous 1960s Hubel and Weisel study as well as later studies by Hubel and Weisel and others. Many of the more recent studies call into question the idea of a finite "critical period." Dr. Cooper explains the Hubel and Weisel study and its implications in detail.

The Myth of the Critical Period
by Dr. Paul Harris at http://www.strabismus.org/critical_period_myth.html

Development of Vision (Critical Periods)
by Dr. Jeffrey Cooper at http://www.strabismus.org/critical_period_Hubel.html

Why does my eye doctor say it is "too late?"

Whenever an eye doctor tells you that it is "too late" to treat your child's loss of binocular vision (or eye turn or "lazy eye"), he or she is probably referring to his or her earlier education regarding the "critical period." He or she might even be directly or indirectly referring to the aforementioned research dating from the 1960s.

Remember, a great deal has been learned about the human brain since the 1960s! For example, a new ground-breaking study on the brain's plasticity (its ability to change and grow) was released to broad media fanfare in the year 2000.

We recommend that you find a doctor (at http://www.optometrists.org/eye_doctors.html) who is more up-to-date on the latest in developmental vision and the brain (neuronal plasticity).

When is it too late to treat strabismus or lazy eye?

It is often asked at what age should treatment no longer be attempted. The answer is, everyone deserves a chance! Age should not be a deterrent, though treatment under age 6 (especially before 2) is ideal and allows better results than later treatment. After age 6, age is not important.

"... every attempt should be made to improve strabismus and lazy eye."

The best chance of success in eliminating the effects of the **most difficult conditions**, amblyopia or constant strabismus, occurs before the age of two. However, this does not preclude excellent success in many older patients and at least partial success in **most** patients older than 6 years of age. There are numerous studies that demonstrate that treatment after the age of 6 is very successful. One study compared treatment before age 6 to treatment after age 6. They found no statistical difference between the two groups. As a matter of fact, loss of an eye in patients over the age of 65 who were never treated for their amblyopia experienced a spontaneous improvement in vision in over one-third of

the cases.

Thus, every attempt should be made to improve strabismus and lazy eye, though treatment might not be as effective after the age of six, and definitely requires more work. Also, remember that if an eye turn occurs only some of the time (intermittent), the cells of the brains do not develop the changes associated with the more challenging cases of constant eye turns.

"It is never too late to try!!"

An analogy to understanding the relationship of age in regards to the treatment of eye muscle anomalies would be to consider the relationship of one's age in learning to speak a second language. During the period of neurological development, around the first year of life, language development is natural and spontaneous. Children raised in families that speak two languages from birth automatically learn both languages. However, if the second language is introduced in later school years, language development takes a longer time and is more arduous. Yet, remember, people learn languages well into their sixties and seventies. The very same is true of visual development. It is easier to develop normal vision during the critical period, but with work, many people can develop normal binocular vision in later years.

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