Light and Human Vision

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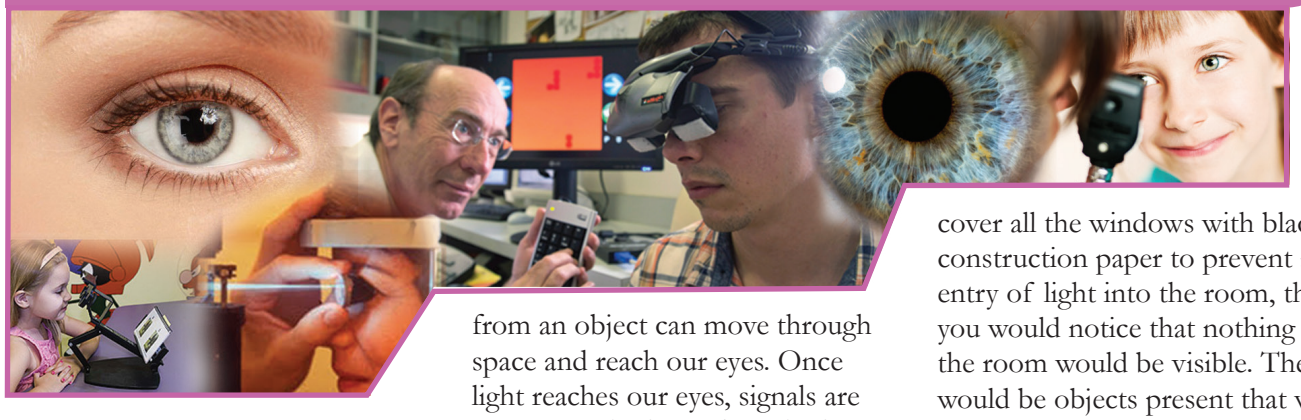


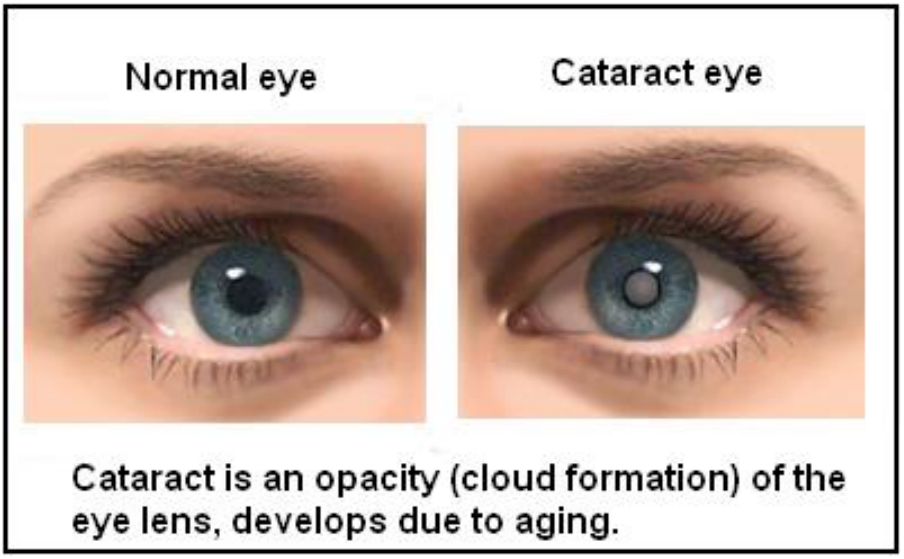
LIGHT AND VISION DEVELOPMENTS

We see things every day, from the moment we get up in the morning until we go to sleep at night. We look at everything around us using light. We appreciate the crayon drawings of children, fine oil paintings, swirling computer graphics, gorgeous sunsets, a blue sky, shooting stars and rainbows. We rely on mirrors to make ourselves presentable and sparkling gemstones to show affection. But did you ever stop to think that when we see any of these things, we are not directly connected to it? We are in fact, seeing light -- light that somehow left objects far or near and reached our eyes. Light is all our eyes can really see. In order to get a fuller understanding of why we see things as we do, it helps to learn a little about the physics of light. Light is after all, that which enters our eyes and causes us to see.

The Role of Light to Sight

The bottom line is: without light, there would be no sight. The visual ability of humans and other animals is the result of the complex interaction of light, eyes and brain. We are able to see because light from an object can move through space and reach our eyes. Once light reaches our eyes, signals are sent to our brain, and our brain deciphers the information in order to detect the appearance, location and movement of the objects we are sighting at. The whole process as complex as it is, would not be possible if it were not for the presence of light. Without light there would be no sight.

If you were to turn off the room lights for a moment and then cover all the windows with black construction paper to prevent any entry of light into the room, then you would notice that nothing in the room would be visible. There would be objects present that were capable of being seen. There would be eyes present which would be capable of detecting light from those objects. There would be a brain present which would be capable of deciphering the information sent to it. But if there was no light the room and everything in it would look black. The appearance of black is merely a sign of the absence of light. When a room full of objects (or a table, a



shirt or a sky) look black, then the objects are neither generating nor reflecting light to your eyes. And without light, there would be no sight.

That brings us to the question: What is Light? A very simplistic answer would be "Light is Energy". It is like saying that "Steve Waugh is a cricketer". So how do you define light?

As does light gives vision , over exposure during life span causes damage to the eye. However, in the "natural" environments with natural and man-made lights, the most offending portions of the EM spectrum are the UV-A (315 nm to 400 nm), UV-B (280 nm to 315 nm), and "blue-light" portion of the visible spectrum (380 nm to 500 nm). Our atmosphere generally protects us from UV radiation below 280 nm. Additionally, as the cornea and crystalline lens absorbs almost all natural UV radiation, UV radiation is thought to cause damage to the anterior eye, while short visible light ("blue-light") can cause damage to retinal structures. Also, as the damaging processes are thought to be at least partially photochemical in nature, the damaging effects can be cumulative in nature, which may compound across one's lifetime.

The blue-violet light that was discovered as part of this study is a 40 nm band of visible light that causes the maximum retinal cell death. Over time, our eyes are exposed to various sources that emit this blue-violet light (e.g., the sun, LED lighting, CFLs). Combining that with the use of tablets, TVs, computer screens and smart phones, enhances our exposure to blue-violet light. This cumulative and constant exposure to the blue-violet light is bound to increase over time and has the potential to cause damage to the retinal cells, which will gradually lead to retinal cell death, and in turn lead to AMD.

The level of light emitted by newer energy-saving lighting techniques (e.g., LED, CFLs) is very high. For example, CFLs, white LED light and even sunlight emit high levels of blue-violet light compared to the rest of the blue light spectrum. This underscores the need for us to protect our eyes from the harmful bands of blue-violet light.

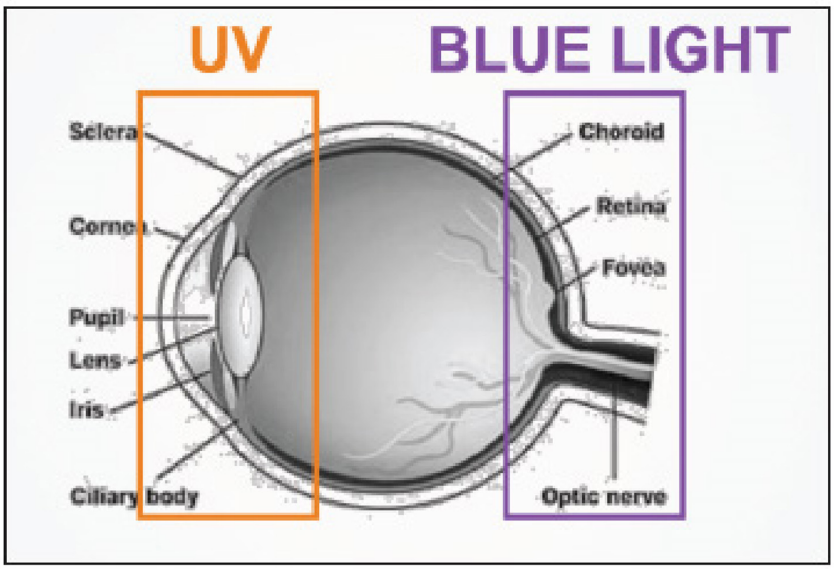
New Technologies that have improed Human Vision.

There are many technological vision developments that are at research level for further advancements.

Bionic Eye

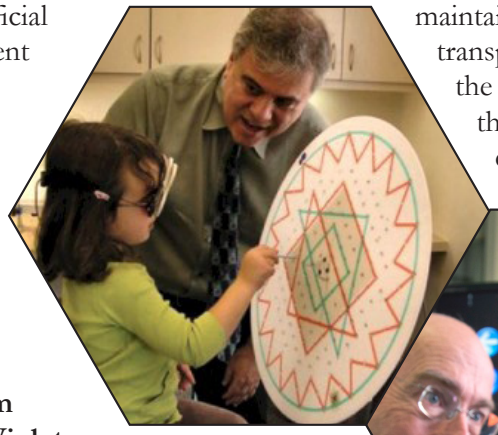
- Google Specs
- Retinal implants/Brain Implants to restore Vision.

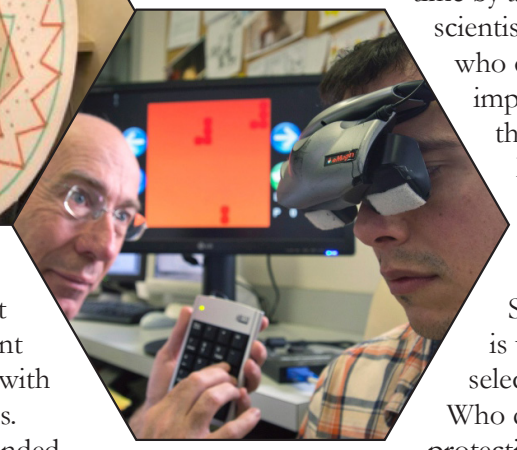
Apart from these there are



Dangers of light to the eye. UV light affects the front of the eye; blue light affects the back.

practically beneficial vision restorement plans executed world wide.
1).Vision Therapy.
2).Specialized lenses for ARMD and Cataract.

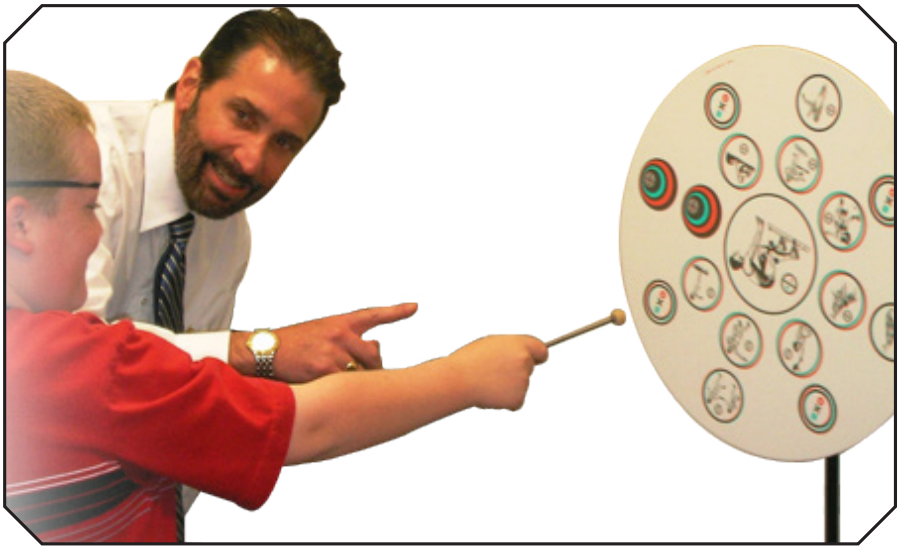




Protection from UV and Blue-Violet Light

How can we screen the harmful blue rays of light and allow the helpful blue rays of light to penetrate through and get into the eye? Essilor and the Paris Vision Institute established a goal of finding a selective light filter or a lens to block out UV as well as the harmful blue-violet light and yet allow the blue-turquoise light and the longer wavelengths of light to continue to penetrate through it. They did this with Light Scan, a patented, selective, no glare technology with three key features: 1) it selectively filters out harmful blue-violet and UV light, 2) it allows the beneficial visible light, including the blue-turquoise light, to pass through, and 3) it maintains an excellent transparency of the lens, so that there is no color distortion, and you get excellent clarity with the lens.
They ended up providing a lens with a front-side as well as a back-side protection. The front side of the lens deflects UV light as well as about 20% of the blue-violet light, thereby deflecting away the harmful rays. And the back side protects the patient from the reflective glare that comes off the back surface of the lens, mainly from UV light. Traditional blue blockers give pretty sunsets, but that is not what is requred. You do not want color distortion; you want your colors to be natural. The traditional blue blockers do not discriminate in the blue light spectrum. They just block all the blue light. This new lens technology is based on laboratory studies over a four-year period of time by an eminent group of scientists as well as clinicians, who came up with some very important data that allowed them to zoom in on the light that was needed to be blocked, and permit the light that was needed to get through. So this new lens design is very specific for more selective light.

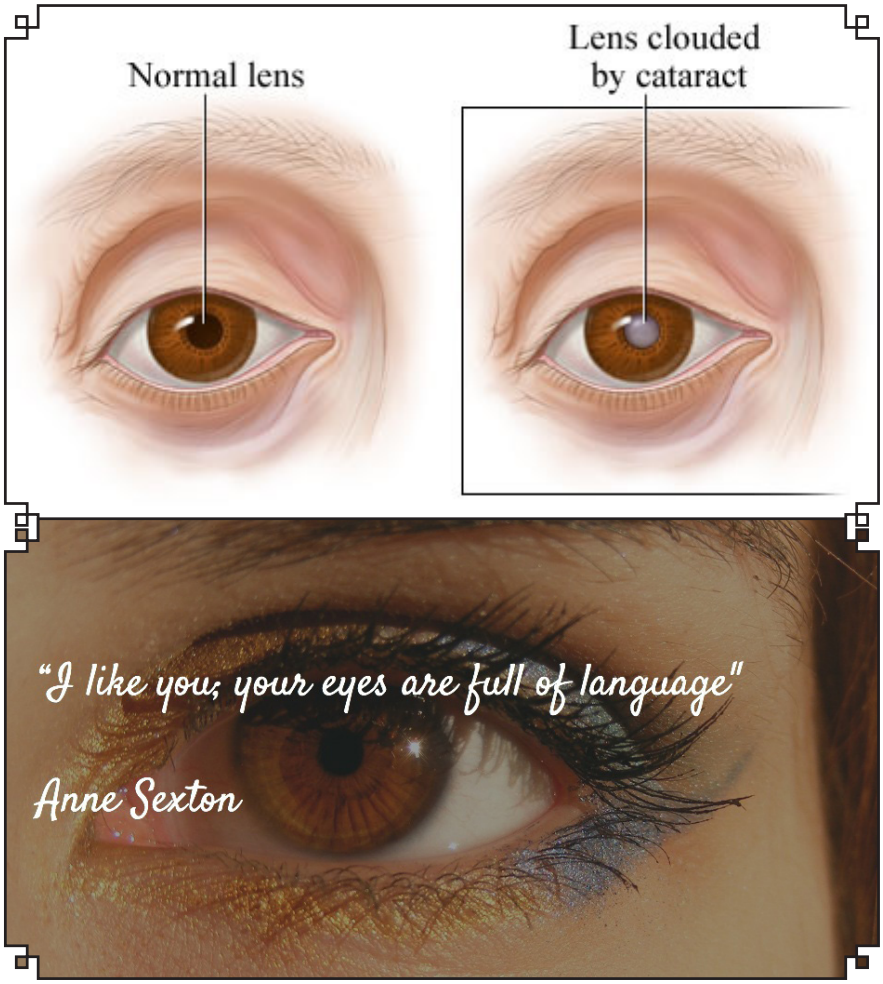
Who deserves the most protection? Those who experience high exposure to white LED or fluorescent light bulbs in offices and homes, frequent users of LED computer monitors, tablets, or smart phones, and those at risk for AMD, particularly those at high risk with family history, smokers, etc. Many companies are working on technology to look for harmful blue light, and ways to block these while allowing healthy blue light to remain.
Optical companies that currently offer blue-blocking technology include Nikon (SeeCoat Blue), Essilor (Crizal Prevencia), PFO Global (iBlu coat), HOYA (Recharge), VSP (UNITY BluTech) and Spy Optic Inc. (Happy Lens). We need to inquire from patients if they currently protect their eyes on a daily basis, if there is a family history of macular degeneration, and how much time they spend in front of a digital device or computer. We also need to find out if our patients are currently protecting their eyes against UV damage, which means that there is a lot of homework out there for us. These are the questions that are



expected to come to the forefront as this new technology continues to evolve.

Vision Therapy

Amblyopia, also known as lazy eye, is a common childhood condition, and is defined as defective vision in one or both eyes, which is present with no anatomical defect in the neuronal pathway of vision. This is not immediately resolved with wearing glasses. Amblyopia develops during early childhood (infancy to 12 years or older) due not to uncorrected vision needs. During this age it is usually reversible; however, if left untreated it will remain as a permanent visual defect unto adulthood. Factors commonly associated with amblyopia include squint, refraction errors between the two eyes, and stimulus deprivation such as cataract or ptosis. Unilateral refractive amblyopia may go unnoticed for years as the child usually has good visual acuity in the good eye , and poor vision in the bad eye. The condition may remain undiagnosed until school age. Bilateral refractive amblyopia can be detected sooner as the child may struggle with close work or complain of reduced or blurred vision. The best time to correct amblyopia is during infancy and early childhood , even though latest research show improvements till 40 years of age. The treatment aims at obtaining the best possible visual acuity in the amblyopic eye. The initial treatment is full time wear of appropriate eye power. This is usually followed by promoting the use of the amblyopic eye through limited use of the good eye . Thereon certain vision therapy techniques using computer directed instructions are conducted by a vision therapist. Treatment options included total occlusion, partial occlusion, use of cycloplegic drug of the good eye and other vision therapy techniques. Occlusion treatment was first described in 1772 and involves patching the non-amblyopic eye with an opaque patch. Another penalization was used for centuries and involves the instillation of atropine sulphate (a long acting topical cycloplegic agent) into the good eye to blur the near vision activities and force the amblyopic eye to be used. There are different opinions on the number of hours of patching per day as well as the number of days that atropine penalization should be prescribed.



The only center in Sri Lanka starting Vision Therapy is the Wickramarachchi Company, which has a mission with a vision to eliminate the reversible blindness from childhood.

Last but not the least , protect your eyes. Wear proper UV protected sunglasses , and not be hesitant do wear the correct eye glasses to correct any eye power. Your eyes are your actual wealth, and that you will realize when your eyes are closed temporarily.

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