PAPER-I

IDENTIFICATION OF CHILDREN WITH VISUAL IMPAIRMENT
AND ASSESSMENT OF NEEDS (SES VI 01)

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IDENTIFICATION OF CHILDREN WITH VISUAL IMPAIRMENT AND ASSESSMENT OF NEEDS (SES VI 01)

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1.1 Introduction

During World War II, the United States Navy wanted its sailors to see infrared signal lights that were invisible to the enemy. Normally, we humans find it impossible to see infrared radiation because the receptors in our eyes are insensitive to infrared energy—as far as our eyes are concerned, infrared energy might as well not be there. To make infrared signals visible, Navy scientists had to come up with a way to modify the sailors’ night vision. These scientists knew that the eye’s receptors contained specialized lightsensitive molecules, and that a portion of each molecule was derived from vitamin A. Knowing that vitamin A comes in different forms, the Navy scientists wondered whether one of the alternative forms might encourage production of photosensitive molecules sensitive to infrared radiation.

To find out, they had human volunteers eat diets supplemented by an alternative form of vitamin A (extracted from the livers of walleyed pikes). Over several months, the volunteers’ vision changed remarkably, boosting their sensitivity to light extending into the infrared region. The experiment seemed to be working. At the same time, however, other scientists were successfully developing the snooperscope, an electronic device for seeing infrared radiation. This invention made it unnecessary to alter the eye itself, and the experiment was aborted (Rubin and Walls, 1969).

Still, the project dramatizes a truth that we’ll document throughout this chapter: the structure of the eye governs what we can, and cannot, see. Altering that structure would literally change your vision of the world.

The visual system of any vertebrate, humans included, consists of three major components: eyes, which capture light and convert it into neural messages; visual pathways, which modify and transmit those messages from the eye to the brain; and visual centers of the brain, which interpret the messages in ways useful for guiding behavior. All three components are crucially involved in seeing, so each component’s structure and function must be understood in order to comprehend how an organism sees. This chapter and the next one concentrate on the first of these components, the human eye; they discuss its anatomy (structure) and physiology (how it works). These chapters emphasize how the eye is built, how it captures light and how it turns that light into neural messages the brain can interpret. Chapter 4 will discuss the remaining two major sections of the mammalian visual system, the visual pathways to the brain and the brain’s visual centers.
Each of these three chapters has features that require special comment. First, we don’t spend time talking about anatomy simply because we are fascinated with structure per se. Structure is important because it influences how and what we can see. Second, although mainly interested in the human eye, we also consider the eyes of other animals, particularly animals whose environments and lifestyles differ from those of humans.

Understanding the diversity of vision—and the uniqueness of human vision—will heighten your appreciation of the processes involved in seeing.

Finally, we also consider how various defects impair vision. Besides being fascinating in their own right, visual defects illuminate the intimate connection between structure and function.

In writing these chapters we were very much influenced by Gordon Walls’s book *The Vertebrate Eye and Its Adaptive Radiations* (1942).

Walls wrote eloquently about the eye, as the following statement demonstrates:

“Everything in the vertebrate eye means something. Except for the brain, there is no other organ in the body of which that can be said. It does not matter in the least whether a liver has three lobes or four, or whether a hand has five fingers or six, or whether a kidney is long and narrow or short and wide. But if we should make comparable changes in the makeup of a vertebrate eye, we should quite destroy its usefulness.

Man can make optical instruments only from such materials as brass and glass. Nature has succeeded with only such things as leather and water and jelly; but the resulting instrument is so delicately balanced that it will tolerate no tampering.” (Walls, 1942, pp. iii–iv)

Walls’ credo underscores that we cannot understand vision without first understanding the eye’s structure. We’ll begin our actual discussion of the eye with general questions about the nature of vision—why vision took the form that it did.

The human eye is an organ that reacts to light and has several purposes. As a sense organ, the mammalian eye allows vision. Rod and cone cells in the retina allow conscious light perception and vision including color differentiation and the perception of depth. The human eye can distinguish about 10 million colors.[1]

Similar to the eyes of other mammals, the human eye’s non-image-forming photosensitive ganglion cells in the retina receive light signals which affect adjustment of the size of the pupil, regulation and suppression of the hormone melatonin and entrainment of the body clock.[2]

1 Structure
Blood vessels can be seen within the sclera, as well as a strong limbal ring around the iris.

1.2 The Structure Of The Human Eye

To understand the human eye, let’s start with an overview tour of the major features. We’ll ignore the details, however, until the second stage of our discussion, by which time you’ll have a good idea where those details fit into the eye’s grand scheme. In portraying these details, incidentally, people often draw an analogy between the eye and a camera. This analogy is apt, but only to a point. Certainly, both are optical devices designed to record visual images on lightsensitive material (film, in the case of the camera; photoreceptors, in the case of the eye). And the two do have components in common (mechanical, in the case of the camera; biological, in the case of the eye). So where appropriate, we will point out these commonalities. But don’t be misled. A camera merely records optical images on film. The eyes do much, much more. Besides recording images, the eyes recode those images, extract biologically meaningful
information from the recoded signals, and transmit that information to the brain for interpretation and reaction.

In this and the next few chapters, we’ll point out other instances where the analogy fails. For now, let’s start with an overview of the eye’s major features.

The human eye is very nearly spherical, with a diameter of approximately 24 millimeters (nearly one inch), or slightly smaller than a Ping-Pong ball. It consists of three concentric layers, each with its own characteristic appearance, structure and functions. From outermost to innermost, the three layers are the **fibrous tunic**, which protects the eyeball; the **vascular tunic**, which nourishes the eyeball; and the **retina**, which detects light and initiates neural messages bound for the brain.

Figure 2.9 illustrates this three-layered arrangement.

In this figure you can see that the eye is partitioned into two chambers, a small anterior chamber and a larger vitreous chamber. Thus the basic layout is three concentric layers and two chambers, plus the iris, pupil and lens.

**1.2.1 The Outermost, Fibrous Tunic**

When looking directly at someone’s eye, you see only about one-sixth of its outer surface. The rest is tucked into the bony orbit, hidden behind the lids and other protective structures. The “white” of the eye is part of the outermost, fibrous coat.

Since this white part is made of tough, dense material, it is called the **sclera**, from a Greek root meaning “hard.”*

The sclera averages about 1 millimeter in thickness, and microscopic inspection reveals that it’s made of tightly packed, interwoven fibers running parallel to the sclera’s surface. These densely
packed fibers give the sclera its toughness. Actually, the sclera needs to be tough because
pressure inside the eyeball is double that of the atmosphere. If the sclera were more elastic, that pressure differential could cause the eyeball to become deformed. As a result, the quality of one’s sight would be greatly diminished. We’ll return to the importance of the eyeball’s shape later, when we discuss the eye as an optical instrument.

At the very front of the eye, this outer coat loses its white coloring and becomes so transparent that its difficult to see it in the mirror. However, if you look at someone else’s eye from the side, you will notice a small bulge on the front of the eye. This bulge is called the cornea, from a root word meaning “like a horn.” (The cornea is composed of tissue comparable to that of an animal’s horn.) The cornea’s transparency is crucial for vision. It allows light to enter the eyeball unimpeded. The neat and orderly arrangement of the cornea’s fibers is the primary reason that the cornea is transparent. In addition, greater transparency is made possible because the cornea has no internal blood supply of its own. Since blood and the requisite vessels could reduce the passage of light, the cornea draws its nourishment from the clear fluid in the anterior chamber. The transparent cornea plays a crucial role in the formation of images on the back of the eye. Anything that disturbs the cornea’s transparency, therefore, will reduce the quality of these images and, hence, the quality of vision. For selfprotection, the cornea has extremely high sensitivity to touch. Foreign bodies, such as dust particles or a misguided finger, contacting the cornea trigger a sequence of protective responses, including lid closure and tear production. There’s one reflexive response, however, that should be avoided: as our mothers used to tell us, “Never rub your eye except with your elbow”—these words of wisdom mean leave your eyes alone, for most remedies simply do further damage.

1.2.2 The Middle, Vascular Tunic

For most of its course, the vascular tunic hugs the wall of the eyeball, and only toward the front of the eyeball does it pull away from the wall. We’ll begin by considering the rear two-thirds of this middle layer, the part that fits snugly against the wall of the eyeball. Most of the middle layer consists of a heavily pigmented, spongy structure called the choroid. The choroid averages about 0.2 millimeters in thickness and contains a network of blood vessels, including capillaries. Blood from these capillaries nourishes one particular class of cells in the
retina, the photoreceptors that turn light into neural signals. Without their nourishing blood supply, these vital photoreceptor cells would starve to death from lack of oxygen.

The choroid’s heavy pigmentation also reduces light scatter, the tendency for light to be reflected irregularly around inside the eyeball; light scatter would reduce the sharpness of images formed inside the eye. The choroid’s dark pigmentation reduces scatter by harmlessly absorbing light that isn’t captured by the photoreceptors.

Incidentally, this is the same reason the inside of a camera is painted flat black. The paint absorbs scattered light and protects the sharpness of images on the film.

1.2.3 The Anterior Chamber

Toward the front of the eye, this middle, choroidal layer curls away from wall of the eyeball and runs more or less parallel to the front surface of the eye. Over this part of its course, the middle layer forms a long slender structure called the ciliary body. This spongy network of tissue manufactures aqueous humor, the watery fluid that fills the smaller, anterior chamber of the eye located behind the cornea and in front of the lens. The aqueous humor serves a number of important maintenance functions. It transports oxygen and nutrients to several of the structures it bathes, and it carries away their waste products. The eye’s crucial optical components—the cornea and lens—rely on the aqueous humor as their source of nourishment.

The aqueous fluid also helps maintain the shape of the eyeball. If there were too little fluid in the anterior chamber, the eye would become deformed, like an underinflated soccerball. Constant pressure is maintained, however, because cells in the ciliary body are constantly producing new aqueous to keep the supply of nutrients from becoming exhausted. The creation of new fluid also prevents the buildup of high concentrations of waste products.

For pressure to remain constant, of course, a balance must be achieved between the rate at which aqueous fluid is created and the rate at which it is drained from the eye. Sometimes this balance cannot be maintained and too much aqueous accumulates in the eye, which elevates intraocular pressure. Excess aqueous accumulates either because of overproduction or because of improper drainage out of the anterior chamber.

Drainage can be blocked or slowed down if the outlets for aqueous (which lie at the junction of
The ciliary body and cornea) become squeezed shut or clogged. Pressure builds up within the eye, and if the pressure remains high for too long, vision can be impaired permanently. Increased intraocular pressure—the condition called **glaucoma**—is the single most common cause of blinding eye disease in North America. Fortunately, glaucoma can be treated if the condition is detected early enough. For this reason, eye doctors routinely measure the intraocular pressure in eye examinations these days.

### 1.2.4 The Iris, Pupil And Lens

**The Iris** As it curls inward, away from the wall of the eye, the ciliary body gives rise to the **iris**, that circular section of tissue that gives your eye its characteristic color: brown, blue, green, gray, and so forth. This variety of colors makes the name “iris” very appropriate because *iris* comes from the Greek word for “rainbow.”

The iris actually consists of two layers, an outer layer containing pigment, and an inner layer containing blood vessels. If the outer layer is heavily pigmented, the iris will appear brown. But if this outer layer is lightly pigmented, the inner layer becomes partially visible through the outer one. In this case, the iris will look more lightly colored. Thus, the color of one’s eyes results from a combination of the pigmentation of the outer layer and the color of the blood vessels in the inner layer. If the iris’s outer layer has no pigment, the inner layer becomes very noticeable, giving the eye a pinkish hue. This condition occurs in albino humans, who, because of a genetic defect, have greatly reduced pigmentation.

**The Pupil** Looking in a mirror at the center of your own iris, you’ll see a round black region, the **pupil**. The pupil is actually an opening, or gap, within two sets of muscles. The inner set runs circularly around the pupil. When this circular band of muscles contracts, the pupil gets smaller. Another set of muscles runs radially out from the edge of the circular muscles, away from the pupillary opening. When the radial muscles contract, the pupil widens, or dilates. These changes in pupil size regulate the amount of light reaching the back of the eye.

The size of the pupil at any given moment depends on several factors. First, it depends on the light level to which the eye is exposed: the size of the pupil decreases as the level of light increases.
In young adults, the pupil diameter varies from about 8 millimeters down to less than 2 millimeters, a fourfold variation in diameter. The amount of light passing through the pupil is proportional to the pupil’s area, which is itself proportional to the square of pupil’s diameter. Thus, as the pupil diameter varies over a range of 4 to 1, the amount of light passing through the pupil varies over a range of 16 to 1. The pupils of older adults change size in response to light in different proportions than their younger counterparts. In dim light, the pupil of an eighty-year-old person is only about half that of a twenty-year-old (see Figure 2.10). As a result, less light reaches the retinas of elderly people. This undoubtedly explains why older people frequently complain about the dim lighting in restaurants.

Besides light level, the size of the pupil also varies in response to events that stimulate the autonomic nervous system. Anything that induces excitement, fear, or sexual interest can change the size of the pupil. Some people, such as seasoned poker players, are quite adept at sensing an opponent’s excitement or dismay on the basis of their opponent’s pupil size. An opponent’s widened pupils are a dead giveaway that he or she has drawn a potentially winning card. Realizing the potential cue involuntarily provided by their eyes, clever poker players will wear dark glasses to hide their telltale pupils.

Although large pupils allow more light into the eye, smaller pupils can sometimes offer an advantage (Cornsweet, 1970). Suppose you are looking at an object located several meters in front of you. While you’re looking at that object, other objects—that much closer or much farther away—will tend to appear somewhat blurred.

The range of distances over which objects will appear sharply focused varies inversely with the size of the pupil. This range of sharp vision is called the **depth of field**. The easiest way to demonstrate depth of field is to substitute a camera for your eye. In taking the photographs shown in Figure 2.11, the photographer varied the size of the camera’s aperture to simulate the effects of changing pupil size. The photograph on the left was taken with a large aperture; the one on the right, with a small aperture. In both instances, the camera was focused on the object centered in the picture. Note that on the left, the picture taken with the large aperture, very few objects appear sharp. The photograph on the right was taken without changing the focus but with a smaller aperture. Now, more objects appear well focused—the range of distances over which objects appear in sharp focus has increased. This range defines depth of field. Whether we’re talking about cameras or about eyes, depth of field is determined by pupil (or aperture) diameter.
The Lens  One very important optical element of the eye, the crystalline lens, lies right behind the iris. The lens takes its name from its resemblance to a lentil, or bean. In adults, the lens is shaped like a very large aspirin tablet, about 9 millimeters in diameter and 4 millimeters in thickness. The lens consists of three distinct parts: an elastic covering, or capsule; an epithelial layer just inside the capsule; and the lens itself. As you might expect, each of these parts has its own job to do. In fact, the thin, elastic capsule around the lens has two jobs. First, it moderates the flow of aqueous humor into the lens, helping the lens retain its transparency to light. Second, the elastic capsule molds the shape of the lens—varying its flatness and, thereby, the lens’s optical power. This variation in optical power is called accommodation. The lens never stops growing. Throughout your life span, the outer, epithelial layer of your lens continues to produce protein fibers that are added to the surface of the lens. Consequently, those protein fibers nearest the center of the lens are the oldest (some were present at birth), whereas the fibers on the outside are the youngest. Between birth and age 90 years, the lens quadruples in thickness and attains a weight of 250 milligrams (Paterson, 1979). In the center of the lens, the old fibers become more densely packed, producing sclerosis, or hardening, of the lens. We’ll describe the significance of sclerosis later in this chapter. For good vision, the lens must be transparent—light must be able to pass through it easily, without loss or deviation. Like the cornea, this transparency depends on the material out of which the lens is made. Of all the body’s parts, the lens has the highest percentage of protein, and its protein fibers are lined up parallel to one another, maximizing the lens’s transparency to light. Anything that disturbs this alignment—such as excess fluid inside the lens—reduces transparency. An opacity (or reduced transparency) of the lens is called a cataract. While some cataracts are minor—barely reducing the transmission of light—others undermine vision to the point of blindness. In some cases, cataracts can be traced to cumulative exposure to ultraviolet radiation present in sunlight (Schein et al, 1994), which helps explain why cataracts are more common in elderly people. But not all young people are spared from cataracts. In fact, certain populations (Arabs and Sephardic Jews, for instance) have a very high incidence of congenital cataracts—lens opacities at birth. These opacities severely degrade the stimulation received by the eye, and this can be serious. At birth, the visual nervous system is immature, and its proper development
depends on normal stimulation of the eye. Deprived of that proper stimulation, the immature visual nervous system develops abnormally (Hubel, Wiesel, and LeVay, 1977). Realizing this consequence of visual deprivation, physicians now recommend removal of congenital cataracts as early in life as possible.

Surgical removal of a cataractous lens has become more or less routine today. Since the lens contributes to the total optical power of the eye, removal of the lens must be accompanied by some form of optical compensation. Powerful spectacles or contact lenses can be worn, or alternatively, a plastic lens can be surgically inserted into the eye, replacing the missing biological lens (Applegate et al., 1987). None of these alternatives, however, restores the ability to accommodate. People who have had such surgeries must use different glasses for near versus far vision.

1.2.5 The Vitreous Chamber

The vitreous chamber accounts for nearly two-thirds of the total volume of the eye. This larger of the eye’s two chambers is bounded by the lens in front and the retina on the sides and in the rear.

This chamber is filled with a transparent fluid called vitreous, a substance with the consistency of egg white. Encased in a thin membrane, the vitreous is anchored to the inner wall of the eyeball. Unlike the aqueous, the vitreous is not continuously renewed, which means that debris can accumulate within it. Sometimes you become aware of this debris, in the form of floaters, small opacities that float about in the vitreous (White and Levatin, 1962). If you look at a bright, uniform surface, floaters cast shadows on the back of the eye, producing little dark spots that dart about immediately in front of you. Thanks to gravity, floaters tend to settle to the bottom of the vitreous chamber, out of the line of sight. Although floaters are usually harmless, dense or persistent floaters may be a symptom of retinal detachment, a vision-threatening condition that requires treatment.

The Retina
The innermost of the eye’s three layers, the retina, resembles a very thin, fragile meshwork, which explains its name—rete is Latin for “fisherman’s net.” Although no thicker than a postage stamp, the retina has a complex, layered organization.

Figure 2.12 shows how a section of the retina would look if magnified greatly and viewed from the side. The arrows denote the direction taken by incoming light. From this perspective, you can see that the cells comprising the retina have a peculiar arrangement: light must pass through a complex network of neural elements before reaching the photoreceptors, ganwhich are actually responsible for converting light energy into neural signals. Moreover, the light-sensitive part of each photoreceptor, called the outer segment, actually faces away from the incoming light and toward the back of the eye.

This seemingly “backward” arrangement has one distinct advantage. Photoreceptor outer segments, which have high metabolic demands, end up snuggled into the choroid, which, as we’ve already learned, contains a rich blood supply.

The neural signals generated by the photoreceptors, in turn, pass through a network of cells—bipolar, amacrine and horizontal cells—that collect and recombine the photoreceptor signals. These collected, transformed signals are then passed on to the retinal ganglion cells, where biologically important information about the distribution of light over space and time is extracted and recoded. The recoded neural messages are then carried by the axons of the ganglion cells out of the eye and into the brain. As you can already begin to appreciate, crucial events underlying visual perception are inaugurated in this complex neural network, the retina.

To a large degree, the retina’s complexity reflects its origins. Embryologically, the retina arises from the same tissue that spawns the billions of cells comprising the brain. So the retina is actually a direct extension of the central nervous system. This affinity with the brain has one unfortunate aspect, though: damaged retinal cells, like damaged brain cells, cannot be repaired.

The visual consequences of damage are permanent, which is why it’s so important to protect the eyes from excessive light exposure (by wearing sunglasses), from trauma (by wearing goggles when playing sports), and from disease (by having a routine, periodic eye examination).

The eye is not just a window out, onto the outside world, it also is a window through which another person can look directly inside your body and view your nervous system. In fact, the eye is the only place where the nervous system and blood supply can be viewed directly, without surgery. If you were to look directly into another person’s pupil, however, you wouldn’t be able to
see anything except a dark hole because your head obstructs the light necessary for seeing the back of the eye. Essentially, you’re looking through a peephole into a dark chamber. Thanks to the nineteenth-century physicist, physician, mathematician and philosopher, Hermann von Helmholtz, it’s possible to illuminate the eye while at the same time looking into it (Figure 2.13). Helmholtz invented a simple, clever device called an ophthalmoscope,* which allows us to visualize the interior of the living human eye, including its retina and blood supply. Doctors use this instrument to examine millions of patients every year, usually employing a hand-held, battery-powered model that you’ve probably encountered during a routine vision exam.

1.2.6 Retinal Landmarks And Blood

Because the living retina is virtually transparent, the ophthalmoscope mainly reveals structures lying in front of the retina—such as the central retinal artery—and structures lying behind it—such as the choroid. Although not a complete view of the entire retina, this photograph does highlight several of the retina’s most significant features. Look first at the nearly circular area in the center. Measuring roughly 1.5 millimeters in diameter, this region is called the macula. When you look directly at objects such as the words on this page, the images of those objects are centered within the macula of each eye.

Vision is most acute in the center of the macula.

Consider another landmark shown in Figure 2.14, the optic disk. This is the region of the eye where optic nerve fibers (the axons of the ganglion cells) exit the retina, carrying information to the brain. Normally, the optic disk has a pinkish color because of small blood vessels on its surface; these blood vessels nourish part of the optic nerve. Loss of this pink color can signify the presence of a circulatory problem that could eventually starve the optic nerve and impair vision.

Fortunately, such changes in color can be detected quite easily with the ophthalmoscope.

The retina has the highest metabolic rate of any part of the body, so its access to blood—for oxygen and nutrition—is vital. To supply the entire retina with blood is a challenge because metabolically active cells need to be in extremely close contact with the capillaries that nourish them. To meet this challenge, the eye contains two blood supplies: one that primarily nourishes
the photoreceptors (the choroidal circulation system), and the other that nourishes the remaining cells of the retina (the retinal circulation system).

As you’ve already learned, the choroid and its blood supply are located behind the photoreceptors and, therefore, out of the path of light that stimulates the photoreceptors. This isn’t true, however, for the retinal circulatory system. Notice in Figure 2.14 the large blood vessels that run outward from the optic disk, which are arteries and veins. These vessels make up the retinal circulatory system. They fan out from the optic disk, dispersing into a fine network of capillaries spread throughout the inner part of the retina. Because they’re situated in front of the retina, these blood vessels lie directly in the path of incoming light. This arrangement may strike you as odd, but it’s the only way to get the blood vessels in close proximity to the outer portions of the retina that require nourishment.

The pigment epithelium also provides for waste disposal. Molecular garbage shed by the receptors is taken up and recycled within the pigment epithelium. If uncollected debris accumulates, it can eventually impede the transfer of nutrients.

So anything that keeps pigment epithelium cells from performing their tasks will cause photoreceptor starvation and, eventually, death.

One natural enemy of the pigment epithelium is aging. Age-related macular degeneration, a condition that causes a progressive loss of vision, is the leading cause of impaired vision in the Western world and accounts for about one-half the cases of blindness among the elderly. Macular degeneration can seriously impair a person’s ability to read, to drive an automobile and even to get around on foot (Hazel, et al., 2000). Currently, a minority of cases of age-related macular degeneration can be arrested, but not reversed, if treated early by means of laser surgery.

Diabetes is another common disease that can affect the retina’s blood supply. This disease is marked by disordered insulin metabolism that causes too much sugar to accumulate in the diabetic’s blood. For reasons not completely understood, the excess sugar can promote the development of a cataract in the eye’s crystalline lens.

Cataracts, as you’ve learned, can blur vision to the point of blindness. Besides cataracts, diabetes can have another serious consequence for vision. In some diabetics, the retina’s blood supply is severely reduced. Sensing that it is being starved for oxygen (carried in the blood), the retina generates a chemical that stimulates the growth of new, larger blood vessels. Growing new blood vessels may sound like an excellent solution to the problem, but this growth produces
devastation of its own. The thick new vessels grow out of control, blocking light and eventually causing blindness. In the last decade, lasers have been used very successfully to stop the growth of these new vessels.

1.3 The Eye As An Optical Instrument

Obviously, to see objects in the environment around you, your eyes must capture light reflected by those objects. But simply capturing the light itself isn’t sufficient. The pattern of light reaching the retina must mirror the distribution of light in the scene being viewed. This light distribution, or retinal image as it’s called, is the raw material on which the retina works. The fidelity of the retinal image depends on the ways that the patterns of light arriving at the eye interact with various ocular structures that influence the passage of that light to the back of the eye where the photoreceptors are located. To appreciate the workings of the eye’s retina, then, requires understanding something about the image it receives.

Light conveys to the eyes information about objects in the environment. But how does light acquire that information in the first place? Initially, light originates from a source such as the sun or a light bulb. This is called emitted light, and it’s certainly a necessary antecedent for vision: we cannot see in the dark. But emitted light per se isn’t the stimulus for vision. Rather, we are interested in seeing objects, and for that to happen our eyes must pick up and register light reflected off the surfaces of those objects. It is reflected light that conveys biologically important information about the appearance—and hence the identity—of objects.

How does this come about?

Surfaces absorb some, but not all, of the light shining on them; the portion of light not absorbed is reflected by the surface. Objects with high reflectance usually appear “light,” whereas objects with low reflectance appear “dark.” For example, this page has a reflectance of about 80 percent, while the print on this page has a reflectance of about 10 percent. Abrupt changes in reflectance usually signal discontinuities in a surface, such as the letters on this page or the edges and corners that demarcate an object’s boundaries (see the top drawing in Figure 2.15). More gradual changes inreflectance usually correspond to curved surfaces (see the middle drawing in Figure 2.15).
Surfaces can “sculpt” the patterns of reflected light in other ways, too. For example, some surfaces reflect light evenly in many different directions. Because such surfaces lack highlights, they appear dull or matte. Other surfaces reflect light strongly in one narrow range of directions, giving those surfaces highlights and making them appear smooth and glossy (Greenberg, 1989). (The differences between dull and glossy surfaces are depicted in the bottom drawings in Figure 2.15.)

So, reflected light is structured by objects in the environment, and this optical structure conveys potential information about those objects and their textured surfaces. But before that potential can be realized, three prerequisites must be satisfied. First, the light must be sufficiently intense to penetrate the eye, reaching the photosensitive material in the retina. In fact, about 50 percent of all light striking the cornea is reflected or absorbed before reaching the retina (Cornsweet, 1970, p. 24).

Second, the distribution of light imaged on the retina must be properly focused. Consider the sharp contours forming this pair of letters: GO.

To produce a sharp image of these letters, light reflected from that region of the page must form small, well-defined replicas of those contours on the retina. Blurred replicas would be created if each small, sharp contour were imaged as a larger, spread-out distribution of light on the retina. As a result, different parts of the retinal images of the contours would overlap, blurring one another’s boundaries and making it difficult to see separate, individual letters, in which case reading would be impossible. Some effects of blur are illustrated in Figure 2.16.

Third, the pattern of light falling on the retina must preserve the spatial structure of the object from which it is reflected. If that spatial structure is preserved, light arising from two adjacent regions in space—from neighboring parts of an object, for instance—will fall on adjacent parts of the retina. A distribution of light that preserves the spatial ordering of locations in space is called an image. If the light distribution on the retina were scrambled or spatially random, it would be useless as a source of information about the structure and layout of objects.
1.4 Image Formation In The Human Eye

The sharpness of images formed on the retina depends mainly on two factors. The first is the power of the cornea and crystalline lens (where “optical power” means ability to bend, or refract, light). The other factor controlling image sharpness is the size of the eyeball, particularly the eyeball’s length from front to back. In a camera, a good picture requires that the film be just the right distance from the lens. In the eye, the same thing holds true: the retina must be the right distance from the crystalline lens. Some eyes are too short, others are too long; either condition impairs vision.

The optical power of the eye is not constant, though. By changing its shape somewhat, the crystalline lens automatically changes its optical power. This automatic change, called accommodation, helps one see objects clearly, regardless of their distance from the eye. To appreciate how these components of the eye contribute to vision, we’ll have to consider the behavior of light and its interaction with these components. To simplify our analysis of image formation we’ll begin with a very small object: a single point in space that emits light. The same analysis works for other, more complex visual objects, since we can think of them as consisting
of a large set of points. But dealing with just one point will simplify our explanation of the rudiments of image formation.

In the eighteenth century, Thomas Young showed that light seemed to behave as though it consisted of waves. Upon dropping a pebble into a pond, you’ll see wavefronts spreading out from the place where the stone hit the water. The stone corresponds to our point of light, and radiating out from that point is a set of spherical wavefronts (see Figure 2.17). Light that spreads out in this way is said to be **divergent**. Divergent light cannot form a well-focused image—a point—unless something is done to reverse its divergence.

Let’s examine how the eye accomplishes this feat. Certain optical devices can counteract light’s tendency to diverge. One such device is a convex lens, which gets its name from its shape.

Once a diverging wavefront passes through a strong convex lens, the paths of neighboring points on the wavefront get progressively closer together and eventually converge to a single point. After passing through this point, light diverges once again. Figure 2.18 illustrates this effect of a convex lens.

Lenses differ in their ability, or power, to converge light. A highly convex lens converges light more strongly than does a mildly convex lens. As Figure 2.19 shows, rays that pass through a convex lens of lower power are focused at some distance farther from the lens, whereas rays that pass through a convex lens of high power are focused close to the lens. The distance at which a lens brings light to focus depends on both the power of the lens itself and the degree of light divergence striking the lens. To converge the light, a convex lens must overcome, or null, the light’s divergence.

This is demonstrated in Figure 2.20: a lens of constant power is shown converging light of three different degrees of divergence. The most strongly divergent light comes from the source positioned closest to the lens, while the most weakly divergent light comes from the source farthest from the lens. In addition, each object is focused at a different distance from the lens: the most divergent light is focused farthest from the lens, and the least divergent light is focused closest to the lens.

With these optical principles in mind, consider a human eye that is looking at an object sufficiently far away that light coming from that object has essentially zero divergence (in this case we say the object is located at “optical infinity”). To form a useful image, light from the object must be focused on the retina. Since cornea and crystalline lens both contribute to image
For the retinal image to be sharply focused, the optics’ power must match the length of the eyeball—specifically, the distance from the lens to the retina. This idea is illustrated in Figure 2.21. The top eyeball is just the right length, given the power of its optics. As a result, the distant object is brought to focus exactly on the retina. Such an eye is described as emmetropic (meaning “in the right measure or size”).

The middle panel shows an eye that is too long, given the strength of its optics. Although an image is formed, that image is formed in front of the retina, rather than on it. In fact, the rays have begun to diverge again by the time they reach the retina, so the image on the retina is blurred. Such an eye is described as myopic, or nearsighted, because near objects will be in best focus.

The bottom panel in Figure 2.21 shows an eye that is too short for its optics; an image is formed on the retina, but it, too, is not well focused and hence the image is blurred. Actually, for this eye the best-focused image would lie behind the retina—if light were able to pass through the retina. Such an eye is described as hyperopic, or farsighted, because far objects will be in best focus.

What are the perceptual consequences of a mismatch between an eye’s length and its optics? You’ve seen that in myopic or hyperopic eyes, light does reach the retina, but it is not sharply focused.

When an eye of the wrong size looks at a distant point, the resulting image on the retina will be a circular patch, not a point. Thus the point in space will appear blurred, or indistinct. The degree of blur depends on the extent to which the eye is too short, or too long: the greater the mismatch between the eye’s optics and its length, the worse the blur. The photographs in Figure 2.22 illustrate how the world might appear to a properly focused eye (panel A), to an eye that is only one-third of a millimeter too long (panel B), and to an eye that is 2 millimeters too long (panel C). Remember that when we describe an eye as “too long” or “too short,” we mean this in relative terms. “Too long” and “too short” are defined relative to the power of the eye’s optics.
The blur in panels B and C is so striking that it is hard to imagine that many people actually suffer unwittingly for years with that much blur or more. They go through their entire childhood and adolescence never realizing that their vision is defective. For reasons that are explained below, if their vision is blurred from myopia, they may have trouble seeing the blackboard clearly. If the blur comes from hyperopia, they may have trouble reading for prolonged periods. Unfortunately, the difficulties they experience in school may be mistakenly attributed to poor learning abilities rather than to poor vision. Since about half the human race is afflicted with these problems, it’s worth our time to consider hyperopia and myopia, and what steps can be taken to correct those problems.

1.5 The Message And The Messenger:
Inverse Optics
As we progress through this discussion of vision, keep in mind that light is the carrier of visual information. It delivers messages from environmental objects to your eyes. But light itself is seldom the message of interest. It’s the objects we want to see. In a nutshell, the eye receives patterns of light energy reflected from the surfaces of objects in the environment. Those patterns of energy depend on a host of factors, including the surface properties of objects, the distance from the eye to those objects, and the source of light illuminating the objects. Whenever you change the angle of vision between yourself and an object, for example, you alter the pattern of light energy falling on your eyes (Figure 2.4). Whenever you view an object in natural sunlight and then move indoors to look at it under artificial lighting, you change the wavelength composition of light energy arriving at your eyes (artificial light isn’t identical to sunlight). In short, the same object can convey countless different optical messages to your eyes. So how do the eyes and brain figure out what produced some particular pattern of light energy?
That’s really what these next three chapters are all about. You will learn how the eye and brain are able to work backward, or inversely, starting with patterns of light and culminating in descriptions of objects in the world. This backward approach, which vision accomplishes automatically and effortlessly, is called inverse optics.
As you will learn, solving the inverse optics problem requires that the eye and brain make some assumptions about the objects and events we’re likely to encounter in our environments.
Fortunately, those assumptions are fairly safe ones because the physical nature of matter imposes certain constraints on the properties of objects.

For example, light cannot pass through opaque objects, which means that when one object partially occludes another, we automatically see the partially occluded one at a greater distance than the occluding object (this constraint is discussed in more detail in Chapter 8). In addition, those constraints don’t change over time.

**How the Eyes Move**

Every muscle in your body works by contracting and thereby pulling on the structure or structures to which the muscle is attached. In the case of the extraoculars, each muscle is connected at one end to an immovable structure, the eye socket of the skull, and at the other end to an object that is free to move, the eyeball. So when an extraocular muscle contracts, it pulls on the eyeball and moves it. The amount of movement depends on the strength of the muscle’s contraction and on the action of the other muscles. The direction of movement depends on the place at which the contracting muscle is attached to the eyeball and skull, and on what the other muscles are doing. Because each extraocular muscle is attached to the eyeball at a different position, contraction of any particular muscle turns the eyeball in a characteristic direction.

The following is a brief and simplified description of what the extraoculars do.

Each eye’s muscles can be divided into two groups, one with four muscles and one with two. The larger group, the **rectus muscles**, run straight back from the eyeball. Muscles in the other, smaller group run obliquely back from the eyeball. We can understand the general principles of the eye’s movements by looking just at the muscles in the larger group.

Each rectus muscle is attached to the eyeball at a different location, toward the front of the eyeball (see Figure 2.7). The other end of each rectus muscle is attached to the rear of the bony cavity holding the eyeball; this is the immovable end of the muscle. Whenever a rectus muscle contracts, it pulls the eyeball toward the place at which that muscle connects to the eyeball. When a rectus muscle relaxes, the eye turns back toward its original position.

One muscle, the **medial rectus**, attaches to the side of the eyeball closest to the nose. When it contracts, the medial rectus rotates the eye toward the nose. Another muscle, the **lateral rectus**, has exactly the opposite effect. It is connected to the side of the eyeball farthest from the nose, so its contraction turns the eyeball laterally, away from the nose. The **superior rectus** muscle
connects to the top of the eyeball, and its contraction elevates the eyeball, causing you to look upward.

The superior’s opposing muscle, the inferior rectus, is attached to the lower portion of the eyeball and its contraction lowers the eye, causing you to look down.

Now let’s consider how these muscles cooperate to move the eyes. Imagine that while looking straight ahead, you decide to glance leftward.

Both eyes must move to the same degree and in the same direction. In order for you to look to the left, the medial rectus of the right eye and the lateral rectus of the left eye must both contract, while both the lateral rectus of the right eye and the medial rectus of the left eye relax. You should be able to figure out for yourself what will happen if you now decide to glance rightward.

For the eye movements just described, both eyes have moved in the same direction—upward, leftward, and so on. Eye movements of this type are called conjunctive eye movements. But the eyes are capable of other types of movements as well. The eyes can move in opposite directions—both may turn inward or both may turn outward.

These are called vergence eye movements. For example, the left eye can turn rightward while the right eye turns leftward. As a result, both eyes turn inward, toward the nose. This movement aims the two eyes at a very close object straight ahead of you. This particular type of vergence movement is called a convergent eye movement. To accomplish it, the medial rectus muscles of both eyes contract, while the lateral rectus muscles of both eyes relax.

If you look at an object at arm’s length and then bring it closer to you, your eyes converge, tracking the object. When the object moves away from you, your eye muscles will engage in the opposite behavior, resulting in a divergent eye movement.

Much more can be said about eye movements and their role in vision, particularly in reading, and we’ll return to these roles in later chapters.

But for now, we want to stress that eye movements alone are insufficient to compensate for our limited field of view. To experience this for yourself, try a simple exercise. Hold your head very steady, close one eye and then look around in all directions by moving your open eye. Notice how limited this monocular field of vision really is. Repeat the exercise using your other eye.

When the famous Austrian scientist and philosopher
Ernst Mach (1838–1916) performed this exercise, he made a sketch of what he saw. Figure 2.8 shows you what Mach drew. Mach firmly believed that scientists should confine themselves to descriptions of phenomena that can be perceived by the senses. In this particular case, Mach’s senses revealed a seldom realized truth:
Because we’re accustomed to moving our eyes and heads, we seldom realize how limited our actual view of the world is at any given moment.
Our grasp on the whole of visual reality comes in bits and pieces assembled over time.

1.6 Summary And Preview

This chapter has laid out the basic design of the human eyeball, emphasizing the good fit between its structure and the job it must do. Because vision depends on an interaction between light and the eye, we also considered how light itself manages to capture information about the environment, information that is conveyed by light. This led us to a discussion of the eyeball’s optical characteristics and various common imperfections in those characteristics. The chapter ended with the capture of light by photopigment molecules and the first step toward seeing—photoreceptor responses that are communicated to other neurons in the retina and eventually to the brain. The next chapter follows these messages as they pass from one retinal neuron to the next. You already know that your vision mirrors the properties of your photoreceptors; the next chapter will show you how other elements in the retina also control what you see.

1.7 Check Your Progress

1. Explain The Outermost, Fibrous Tunic

2. Explain The Middle, Vascular Tunic

3. Explain The Anterior Chamber

4. Explain The Iris, Pupil And Lens

5. Explain The Vitreous Chamber

6. Explain The Retina
7. Explain Retinal Landmarks And Blood

8. Explain The Eye As An Optical Instrument

9. Explain Image Formation In The Human Eye

10. Explain The Message And The Messenger:

Check Your Progress
1. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.1.1. Points for discussion
Points for clarification
1.8 References


Suggestions for Early Interventionists. ERIC Digest. Retrieved from EBSCOhost.


Unit 2: Normal Vision Development And Process Of Seeing

2.1 Introduction

2.2 Early Intervention

2.3 Vision Stimulation Intervention

2.4 Vision Affects The Development Of Children

2.5 The Team Approach To Vision Care

1. The First Year

2. One To Two Years

3. Three To Five Years

4. Five To Eight Years

2.6 Developmental Low Vision Exam

2.7 Physiology Of Vision

2.8 Phototransduction

2.9 Processing And Transmission Of Visual Impulse

2.10 Dark Adaptation

2.11 Light Adaptation

2.11 Summary

2.12 Check Your Progress

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2.1 Introduction

The Children’s Program at The Center for the Partially Sighted is devoted exclusively to helping children who are partially sighted maximize their remaining sight, even if they are legally blind. We help these children use their sight to function successfully... in the home, in the classroom and on the playground.

The Center provides information, treatment and support to the families, teachers and therapists of children who are visually impaired.

2.2 Early Intervention

The purpose of this brochure is to provide parents, teachers and therapists with critical information to help the child who has a vision impairment. Children born with impaired sight do not know how they are supposed to see the world. Those who develop vision problems as young children may not have the language to communicate information that could help detect these problems. Early professional intervention can make a major difference in your child’s development.

Vision is…

Having 20/20 eye sight is not necessarily perfect vision. The standard eye chart used in the offices of doctors and school nurses measures how well a child can recognize a black letter from a distance of twenty feet with one eye. But this test detects less than 20% of children’s vision problems. It does not evaluate how well a child performs on reading distance, eye-hand coordination, tracking skills (following movement), eye teaming skills (how well both eyes work together) and visual processing skills. Vision is the ability to take in, process and understand visual information. It includes eyesight, eye movement skills, eye teaming, focusing, depth perception, color vision, peripheral vision, visual perception and processing, and the ability to integrate all of this information with our other senses.

…A Learned and Developed Skill

Your child’s vision is a learned and developed skill that requires stimulation and experience. Like learning to walk and talk, children must learn how to use their vision. The visual system involves much more than the eyes. The visual system interacts with the muscles of the body to
develop reaching, crawling, grabbing and walking. In fact, two thirds of the functions of the brain are associated with vision. Patterned targets are required to allow the visual cells of the brain to develop. Without patterned stimulation, these areas of the brain do not develop the ability to process visual information. Because vision requires stimulation, problems that occur in the eye or in the visual areas of the brain can affect your child’s vision. Examples of these problems include: eye diseases, such as congenital cataracts, retinopathy of prematurity, ocular albinism, optic nerve and retinal disease; and neurological abnormalities to the visual pathways and visual centers of the brain.

2.3 Vision Stimulation Intervention

Vision stimulation intervention activities can help children use their remaining vision more effectively. The theory is that by performing these activities, the visual areas of the brain are stimulated to maximize the development of vision. They are not exercises that strengthen eye muscles, or cure eye diseases or abnormalities to the brain. The activities presented in this brochure are to help stimulate the development of your child’s vision. Vision stimulation intervention should not be confused with vision therapy. Vision therapy is a program provided by eye doctors to treat specific eye conditions, such as strabismus or amblyopia. In contrast, vision stimulation is a program that can be performed by parents to maximally develop a child’s vision during the first 5 years of life.

2.4 Vision Affects The Development Of Children

Research has taught us that vision affects how children develop. Children with vision problems may not be able to use their vision to make eye contact, socially bond with family members, and also may have difficulty developing the sense of day versus night. Because vision also serves as a learning sense, children with visual impairment may not learn to perform many tasks as quickly as a child with full vision because they cannot learn by mimicking the behaviors of others. A child with impaired sight may be delayed in sitting, crawling, walking, talking, or learning to read and write. For these reasons, it is critical that you help to develop your child’s vision.
### 2.5 The Team Approach To Vision Care

Children with vision impairment benefit from a team of vision care professionals—ophthalmologists and optometrists. Each specializes in different areas of vision and has specific training that is unique to each profession.

The Developmental Low Vision Exam performed by a low vision optometrist evaluates how children use their remaining sight and determines if there are devices to help children reach their full visual potential. These two eye care professionals work together to insure that the child has the best care possible. Ophthalmologists are physicians who specialize in the medical and surgical treatment of eye diseases. When a child has an eye disease that requires surgery or a combination of surgery and medical treatment, an ophthalmologist is needed.

Optometrists specialize in the functional implications of vision problems and the non-surgical treatment of these problems. They have extensive training in the use of glasses, contact lenses, prisms, filters, and low vision aids. In California and 41 other states, optometrists prescribe medications and drugs for eye conditions. Both ophthalmologists and optometrists are required by law to diagnose eye diseases and vision problems.

### 5. The First Year

**Things To Do**

- **Stimulate your child’s vision by placing high contrast objects, such as black and white stuffed animals, just beyond her reach.**

- **Decorate the room to be visually stimulating by using high contrast mobiles, toys and fabrics.**

- **Use black and white or red and white patterns.**

- **Keep the room well lit. At night, leave on a small night light with a 25 watt bulb so that if your child wakes up the light will provide stimulation.**

- **Move the crib to different positions in the room so that she will experience different views of the room.**

- **Talk to your baby when you enter the room so she will know you are there.**

- **Remind family and friends to talk to her when they approach. If she doesn’t know you are there, your child may become startled if picked up too quickly.**

- **Position yourself in your child’s line of sight. Once she focuses, move your face so that she will follow your face with her eyes. This helps to develop eye tracking movement skills.**
»»Use brightly colored tape around your child’s bottle to create a high contrast target.

»»Move the bottle slowly from side to side to encourage her to track the bottle with her eyes. When she does follow the bottle, allow her to drink.

»»Using a “Mini Mag Lite” or variable beam flashlight from the American Printing House for the Blind, Inc. with colored lenses inserted on top of the light, shine the light on your child’s body from different angles. Move the light to encourage her to follow the light. This will promote eye tracking movement skills.

»»Use the Fisher Price Lite Box to project an evenly lit source of light to attract her visual interest. Use colorful, high contrast transparent patterns on the Lite Box and position it 16 inches away from your child’s eyes. You can also place toys and household objects on the Lite box to encourage your child to reach for and grab the object.

»»Use shimmering materials, such as pompoms or reflective mylar paper, to present visual stimuli in front of your child.

6. One To Two Years

Things to Do

»»Encourage reaching for toys and objects that your child enjoys, such as a pacifier, bottle or rattle.

»»Encourage the development of visual spatial relations skills by allowing her to play with blocks, such as Duplo blocks.

»»Continue to stimulate the visual areas of the brain with high contrast toys, pompoms, flashlights, and brightly colored fabrics.

»»Introduce toys that create a visual response after the child touches it, such as a Jack in the Box, or toys that have flashing lights or moving parts when a button is pushed.

»»Roll balls so that she can understand that by pushing the ball, it will go away and look smaller as it moves away.

»»Play card games that involve matching or putting cards in order.

»»Encourage your child to touch, hear and taste those objects that she sees.

»»Allow her to explore her surroundings. The ability to roam and move freely is a valuable experience for your child.
Introduce the names of objects that your child looks at and plays with. This is a time that the development of language occurs.

The iPad is one of the most versatile tools to stimulate a child’s vision. There are many applications that will help a child to focus on patterns and colors and also develop a child’s eyehand coordination skills. For a list of specific applications and techniques, please visit our website.

7. Three To Five Years

Things to Do

» Encourage top to bottom and left to right progressions by drawing lines on a chalkboard.
» Encourage visual recognition by playing with magnetic letters and numbers.
» Develop your child’s memory by playing card and word games.
» Teach him to move his eyes in a left to right reading pattern by placing your finger on each word as you read it. Later, place his finger on each word that you read.
» Use eye-hand coordination games such as pegboard or Lite Bright to teach eye tracking. Moving the game pieces in a left to right pattern teaches the tracking pattern needed for reading skills.
» Encourage your child to look at a picture and to name the object.
» Show him pictures and photographs to help develop the association of pictures with real objects.
» Allow him to run and develop eye-hand and eye-foot coordination. Allow him to kick a beach ball or tap a balloon from one place to another.
» Work on puzzles and blocks so that the child can see that parts will form a whole object. Consider using toys such as pegboards, matching card games, puzzles, dominoes, and Mega or Duplo blocks.

8. Five To Eight Years

Things To Do

» In the classroom, make sure that your child is positioned to make the most of his visual potential. Some children will do better near the front of the room while others may benefit from sitting on one side or in the back. The placement depends on his visual condition. A low vision specialist can make recommendations.
»»Lighting can make a big difference. Find out what level of light your child requires and provide the best type and level of lighting for him. Some children require low levels of fluorescent lighting while other children require high levels of halogen lighting for reading.

»»If your child has the visual skills to read, determine what type style, size and spacing he reads most easily. The type on this page is 12 point; most people with impaired vision need 16 point or 18 point type.

»»Provide your child with the most appropriate work station. Some children will require the use of a drafting table or slant desk while others require assistive technology, such as a Closed Circuit Television (CCTV), and/or specialized computer software.

»»Provide the student with the ideal low vision aids for seeing the chalkboard and reading.

»»Evaluate the effectiveness of specialized low vision aids, including closed circuit televisions, computer scanners, and voice-activated technology.

»»Make sure the child wears protective eye wear when playing outdoors. This will reduce the risk of trauma to the eyes during recess and play.

»»Your child may not require special visual aids or visual assistance during the first and second grades because the text that he learns from is relatively large. During this period, your child learns to read.

2.6 Developmental Low Vision Exam

A Developmental Low Vision Exam is performed by a low vision specialist to determine the extent of your child’s sight and how well the child is using that sight. A Developmental Low Vision Exam should check central and peripheral sight, scanning techniques, glare and contrast sensitivity, as well as a range of other visual skills. The following is a example of a report by the Center’s Pediatric Developmental Optometrist to use as a guide when your child is evaluated.

Jaymie T. is a four-year-old girl, diagnosed with retinopathy of prematurity by her ophthalmologist. She weighed one pound and thirteen ounces at birth, 26 weeks into gestation. Jaymie also has cerebral palsy and receives speech, physical and occupational therapies. She takes Tegritol to control seizures and has not had a seizure in over two years. Her mother wanted to learn how well Jaymie uses her vision and whether she has the vision necessary for reading, writing and performing other academic tasks in her preschool.

Functional Vision
My examination confirmed the diagnosis of retinopathy of prematurity, a condition affecting the retina, the tissue inside the eye that collects visual information and sends it to the brain. The retina is not fully developed until 32 weeks of gestation but Jaymie was born prior to this period. Jaymie, however, has a very high degree of functional vision. She uses her vision to locate toys in our office and to find her way from one room to another. Jaymie did not use her hands to feel her way through the Center. She makes excellent eye contact and uses her vision to observe the behaviors of people around her.

**Distance Clarity of Sight**

Like many children with her condition, Jaymie has a high degree of nearsightedness which affects her ability to see distant objects clearly. At the present time, Jaymie’s distance sight measures 20/400 in each eye without glasses. This suggests that she can identify a symbol 7 inches high from a distance of twenty feet. I have prescribed glasses for Jaymie to wear for all distance activities, including walking, watching television, and playing outdoors. With the new prescription, her sight improves to 20/200, suggesting she can identify a letter 3.5 inches from a distance of twenty feet.

**Recommendations**

- Position Jaymie in the front portion of the classroom.
- Remind Jaymie to wear her glasses for outdoor activities.
- Use bold chalk when writing on the chalkboard.

**Reading Clarity of Sight**

Jaymie has excellent sight at distances closer than five feet. She can identify symbols as small as 10 point type size without glasses. I do not recommend glasses for Jaymie when she performs near work, such as reading, writing, crafts, or working on the computer.

**Recommendations**

- Allow Jaymie to hold reading material closer to her eyes.
- Remind her not to wear her glasses for reading or writing.
- Consider the use of larger print text, such as 18 point type.
- Use a telescoping computer monitor arm to place the screen eight inches from her eyes.

**Peripheral Vision**
Jaymie has some difficulty seeing objects in her upper field of vision. This may affect her ability to see objects like cabinets or branches that are at a level higher than her head. She may also have difficulty seeing her teacher when sitting on the floor during “circle time.”

**Recommendations**

» Present visual items in her lower field of gaze.
» Introduce scanning training so that Jaymie will learn to look above her head when she walks.
» Consult with an orientation and mobility specialist for training in the use of a cane.

**Eye Movement Skills**

Jaymie is able to move her eyes fully in all fields of gaze. However, her left eye crosses or turns inward when she reads with her distance glasses, a condition called esotropia. Without her glasses, her eye does not cross. Jaymie has an eye teaming problem that can affect her ability to track as she learns to read. It causes her to see double. I do not recommend surgery for Jaymie at this time. She is able to control her eye teaming problem very well when she does not wear her glasses. In the future, bifocal spectacles may be considered as her academic demands require more precise sight to copy from the chalkboard to her paper. At the present time, I am concerned that bifocals may affect her balance and mobility.

**Color Vision and Sensitivity to Glare**

Jaymie has a color deficiency that affects her ability to discriminate colors of similar hue, such as red from orange or pink. She is also sensitive to glare and bright light.

**Recommendations**

» Avoid color coding schemes involving pastels or colors of similar hue. Use primary colors.
» To avoid glare, position Jaymie so that her back faces windows and doors.
» Jaymie may benefit from wearing a hat or visor when outdoors. Her prescription glasses will automatically tint when she is outdoors.
» Try to use a chalkboard rather than dry eraser boards.
» When using a computer, select a dark background with lighter letters, such as a blue background with white or yellow letters.
2.7 Physiology Of Vision

Physiology of vision is a complex phenomenon which is still poorly understood. The main mechanisms involved in physiology of vision are:

- **Initiation of vision** (Phototransduction), a function of photoreceptors (rods and cones),
- **Processing and transmission of visual sensation**, a function of image processing cells of retina and visual pathway, and
- **Visual perception**, a function of visual cortex and related areas of cerebral cortex.

2.8 Phototransduction

The rods and cones serve as sensory nerve endings for visual sensation. Light falling upon the retina causes photochemical changes which in turn trigger a cascade of biochemical reactions that result in generation of electrical changes. Photochemical changes occurring in the rods and cones are essentially similar but the changes in rod pigment (rhodopsin or visual purple) have been studied in more detail. This whole phenomenon of conversion of light energy into nerve impulse is known as phototransduction.

**Photochemical changes**

The photochemical changes include: **Rhodopsin bleaching**. Rhodopsin refers to the visual pigment present in the rods – the receptors for night (scotopic) vision. Its maximum absorption spectrum is around 500 nm. Rhodopsin consists of a colourless protein called *opsin* coupled with a carotenoid called *retinine* (Vitamin A aldehyde or 11-**cis-retinal**). Light falling on the rods converts 11-**cis-retinal** component of rhodopsin into **all-trans-retinal** through various stages (Fig. 2.1). The all-trans-retinal so formed is soon separated from the opsin. This process of separation is called **photodecomposition** and the rhodopsin is said to be bleached by the action of light.

**Rhodopsin regeneration.** The 11-**cis-retinal** is regenerated from the all-trans-retinal separated from the opsin (as described above) and vitamin-A (retinal) supplied from the blood. The 11-**cis-retinal** then reunites with opsin in the rod outer segment to form the rhodopsin. This whole process is called **rhodopsin regeneration** (Fig. 2.1). Thus, the bleaching of the rhodopsin occurs
under the influence of light, whereas the regeneration process is independent of light, proceeding equally well in light and darkness. **Visual cycle.** In the retina of living animals, under constant light stimulation, a steady state must exist under which the rate at which the photochemicals are bleached is equal to the rate at which they are regenerated. This equilibrium between the photodecomposition and regeneration of visual pigments is referred to as **visual cycle** (Fig. 2.2).

**Electrical changes**

The activated rhodopsin, following exposure to light, triggers a cascade of complex biochemical reactions which ultimately result in the generation of **receptor potential** in the photoreceptors. In
this way, the light energy is converted into electrical energy which is further processed and transmitted via visual pathway.

### 2.9 Processing And Transmission Of Visual Impulse

The receptor potential generated in the photoreceptors is transmitted by electrotonic conduction (i.e., direct flow of electric current, and not as action potential) to other cells of the retina viz. horizontal cells, amacrine cells, and ganglion cells. However, the ganglion cells transmit the visual signals by means of action potential to the neurons of lateral geniculate body and the later to the primary visual cortex.

The phenomenon of processing of visual impulse is very complicated. It is now clear that visual image is deciphered and analyzed in both serial and parallel fashion. **Serial processing.** The successive cells in the visual pathway starting from the photoreceptors to the cells of lateral geniculate body are involved in increasingly complex analysis of image. This is called sequential or serial processing of visual information. **Parallel processing.** Two kinds of cells can be distinguished in the visual pathway starting from the ganglion cells of retina including neurons of the lateral geniculate body, striate cortex, and extrastriate cortex.

These are large cells (magno or M cells) and small cells (parvo or P cells). There are striking differences between the sensitivity of M and P cells to stimulus features (Table 2.1).

**Table 2.1.** Differences in the sensitivity of M and P cells to stimulus features

<table>
<thead>
<tr>
<th>Stimulus feature</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M cell</strong></td>
<td><strong>P cell</strong></td>
</tr>
<tr>
<td>Colour contrast</td>
<td>No</td>
</tr>
<tr>
<td>Luminance contrast</td>
<td>Higher</td>
</tr>
<tr>
<td>Spatial frequency</td>
<td>Lower</td>
</tr>
<tr>
<td>Temporal frequency</td>
<td>Higher</td>
</tr>
</tbody>
</table>

The visual pathway is now being considered to be made of two lanes: one made of the large cells is called **magnocellular pathway** and the other of small cells is called **parvocellular pathway.** These can be compared to two-lanes of a road. The M pathway and P pathway are involved in the **parallel process** of the image i.e., analysis of different features of the image.

**VISUAL PERCEPTION**
It is a complex integration of light sense, form sense, sense of contrast and colour sense. The receptive field organization of the retina and cortex are used to encode this information about a visual image.

2. The light sense

It is awareness of the light. The minimum brightness required to evoke a sensation of light is called the light minimum. It should be measured when the eye is dark adapted for at least 20-30 minutes.

The human eye in its ordinary use throughout the day is capable of functioning normally over an exceedingly wide range of illumination by a highly complex phenomenon termed as the visual adaptation.

The process of visual adaptation primarily involves:
- Dark adaptation (adjustment in dim illumination), and
- Light adaptation (adjustment to bright illumination).

2.10 Dark Adaptation

It is the ability of the eye to adapt itself to decreasing illumination. When one goes from bright sunshine into a dimly-lit room, one cannot perceive the objects in the room until some time has elapsed. During this period, eye is adapting to low illumination. The time taken to see in dim illumination is called ‘dark adaptation time’.

The rods are much more sensitive to low illumination than the cones. Therefore, rods are used more in dim light (scotopic vision) and cones in bright light (photopic vision).

**Dark adaptation curve** (Fig. 2.3) plotted with illumination of test object in vertical axis and duration of dark adaptation along the horizontal axis shows that visual threshold falls progressively in the darkened room for about half an hour until a relative constant value is reached. Further, the dark adaptation curve consists of two parts: the initial small curve represents the adaptation of cones and the remainder of the curve represents the adaptation of rods.
Fig. 2.3. Dark adaptation curve plotted with illumination of test object in vertical axis and duration of dark adaptation along the horizontal axis.

When fully dark adapted, the retina is about one lakh times more sensitive to light than when bleached.

Delayed dark adaptation occurs in diseases of rods e.g., retinitis pigmentosa and vitamin A deficiency.

2.11 Light Adaptation
When one passes suddenly from a dim to a brightly lighted environment, the light seems intensely and even uncomfortably bright until the eyes adapt to the increased illumination and the visual threshold rises. The process by means of which retina adapts itself to bright light is called light adaptation. Unlike dark adaptation, the process of light adaptation is very quick and occurs over a period of 5 minutes.

Strictly speaking, light adaptation is merely the disappearance of dark adaptation.

2. The form sense
It is the ability to discriminate between the shapes of the objects. Cones play a major role in this faculty.

Therefore, form sense is most acute at the fovea, where there are maximum number of cones and decreases very rapidly towards the periphery (Fig. 2.4). Visual acuity recorded by Snellen's test chart is a measure of the form sense.
Components of visual acuity. In clinical practice, measurement of the threshold of discrimination of two spatially separated targets (a function of the fovea centralis) is termed visual acuity. However, in theory, visual acuity is a highly complex function that consists of the following components:

Minimum visible. It is the ability to determine whether an object is present or not.

Resolution (ordinary visual acuity). Discrimination of two spatially separated targets is termed resolution.

2.11 Summary

The minimum separation between the two points, which can be discriminated as two, is known as minimum resolvable. Measurement of the threshold of discrimination is essentially an assessment of the function of the fovea centralis and is termed ordinary visual acuity. Histologically, the diameter of a cone in the foveal region is 0.004 mm and this, therefore, represents the smallest distance between two cones. It is reported that in order to produce an image of minimum size of 0.004 mm (resolving power of the eye) the object must subtend a visual angle of 1 minute at the nodal point of the eye. It is called the minimum angle of resolution (MAR).

The clinical tests determining visual acuity measure the form sense or reading ability of the eye. Thus, broadly, resolution refers to the ability to identify the spatial characteristics of a test figure. The test targets in these tests may either consist of letters (Snellen’s Summary chart) or broken
circle (Landolt’s ring). More complex targets include gratings and checker board patterns.

**Recognition.** It is that faculty by virtue of which an individual not only discriminates the spatial characteristics of the test pattern but also identifies the patterns with which he has had some experience.

Recognition is thus a task involving cognitive components in addition to spatial resolution. For recognition, the individual should be familiar with the set of test figures employed in addition to being able to resolve them. The most common example of recognition phenomenon is identification of faces.

The average adult can recognize thousands of faces.

Thus, the form sense is not purely a retinal function, as, the perception of its composite form (e.g., letters) is largely psychological.

**Minimum discriminable** refers to spatial distinction by an observer when the threshold is much lower than the ordinary acuity. The best example of minimum discriminable is vernier acuity, which refers to the ability to determine whether or not two parallel and straight lines are aligned in the frontal plane.

Because her distance clarity of sight measures 20/200 with her glasses, Jaymie is legally blind and eligible for those services and benefits for the legally blind. However, her level of functional vision is very high. Jaymie’s vision condition primarily affects her ability to see distant objects clearly. Her near vision is excellent and I believe she has the visual skills necessary to be able to read and write. She is an excellent candidate for optometric low vision aids. When she is five years old, specialized glasses to enhance her distance sight will help prepare her for the academic activities of the first grade. **It is important that Jaymie have yearly ophthalmological examinations to assure her eyes remain as healthy as possible.** I have noticed some difficulty with her balance and eye-hand/eye-foot coordination that I do not feel are related to her vision and believe that she would benefit from continued physical and occupational therapies. I would like to re-examine Jaymie in one year.

2.12 Check Your Progress

1. Explain Early Intervention

2. Explain Vision Stimulation Intervention
3. Explain Vision Affects The Development Of Children

4. Explain The Team Approach To Vision Care

5. Explain Developmental Low Vision Exam

6. Explain Physiology Of Vision

7. Explain Phototransduction

8. Explain Processing And Transmission Of Visual Impulse

9. Explain Dark Adaptation

10. Explain Light Adaptation

Check Your Progress
2. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.2.1. Points for discussion
Points for clarification
2.13 References


33. **Losada, Martinez, Ma Jose, Gonzalez-Benito, C. (2005):** Early Attention and Family Adjustment with Blind and/or Visually Impaired Children, ICEVI European Conference – Conference Report (str. 507-513), Sachsisches Forderzentrum Chemnitz, Chemnitz.


Unit 3: Principles Of Refraction And Refractive Errors

3.1 Introduction

3.2 Principle Of Refractive Errors

3.3 Refractive Errors

3.4 Types Of Refractive Errors

3.5 Assessing Refractive Error

3.6 Objective Tests

3.7 Subjective Techniques

3.8 Correcting Refractive Error

3.9 Summary

3.10 Check Your Progress

3.11 References
3.1 INTRODUCTION
At the receiving end of most optical devices is a human eye and chances are good that that eye suffers from refractive error. That refractive error and its correction can have important implications for optical designers: e.g., vertex separation due to spectacles can limit field through vignetting; instrument accommodation requires an allowance that will benefit younger users but blur presbyopes; Polaroid® sunglasses blot out a liquid crystal display; progressive addition bifocal wearers get stiff necks looking at a video display. Fifty years ago patients with refractive error had only glass spectacles that might have one of three or four bifocal designs and a choice of a handful of tints. Now they have a bewildering range of options, each with advantages and disadvantages that optical designers and vision care professionals need to bear in mind. At any given time, one or both eyes of the observer may not be optimally or fully corrected, and this issue needs consideration by the designer of optical instruments. Here, we detail some of the approaches and problems encountered.

3.2 Principle of REFRACTIVE ERRORS
The essence of REFRACTIVE ERRORS: analysis of the light reflex created in the pupil by light reflected back from the retina for the purpose of objectively determining the refractive error. This reflected light starts with a light shining off a plane mirror of the retinoscope and then passing through the pupil to eventually shine on the retina. The light reflected back off the retina is viewed in the pupil by the examiner “peeking” through a small aperture in the center of the retinoscope mirror. Before hand held electric instruments were available, the light source of the retinoscope came from a plane mirror illuminated by a candle. The modern retinoscope operates on a similar but updated principle. Some modern retinoscopes produce a “spot” rather than a streak. These spot retinoscopes are more difficult to use.

Control of Accommodation
In order to accomplish accurate measurement of the refractive error, the eye should be in the resting state. This simulates the condition when viewing an object at infinity or for practical purposes at a distance greater than 20 feet. Accommodation is suspended with a cycloplegic agent, usually Cyclopentolate ½ or 1% or atropine ½ or 1%. In some cases accommodation is suspended by “fogging”. This is done with a plus lens over the fellow eye that is fixing a distant
object. Fogging can be used in some instances instead of pharmacologic suspension of accommodation in a cooperative patient. If accommodation is not controlled, REFRACTIVE ERRORS will erroneously measure more myopia or less hyperopia especially in younger individuals with robust accommodation. In older individuals with absolute presbyopia or those who are aphakic or pseudophakic, REFRACTIVE ERRORS can be done without concern for accommodation which, of course, is absent in these individuals. In every case where REFRACTIVE ERRORS is done, the pupil must be large enough to allow the light reflex from the retina to be seen clearly. In addition, the corneal surface of the eye must be regular and the cornea itself clear to allow an undistorted reflex necessary to perform REFRACTIVE ERRORS.

3.3 REFRACTIVE ERRORS

The refractive elements of the eye are the cornea which provides about 2/3 of the eye’s optical power and the crystalline lens which provides the remainder. The shape of the crystalline lens may be changed in response to the action of the intraocular muscles in order to vary the eye’s optical power. This is called accommodation. These elements bring light to a focus on the retina (Fig. 1).1 Most eyes suffer from greater or lesser degrees of ametropia, the failure to accurately focus light from a remote object on the retina.2 The degree of ametropia or refractive error is quantified clinically by the optical power $F$ of the spectacle lens that corrects the focus of the eye. The dioptric power of a lens is the reciprocal of its focal length $f$, so $F \equiv 1/f$. The mks unit of optical power is the diopter, abbreviated D, which dimensionally is a reciprocal meter. Optical power is especially convenient in ophthalmic work since most ophthalmic lenses may be treated as thin lenses and the power of superimposed thin lenses is simply the algebraic sum of the powers of the individual lenses. Spectacle lenses are usually manufactured in quarter diopter steps. By ophthalmic convention, spectacle prescriptions are written with a plus or minus sign and two places beyond the decimal, e.g., 3.75 D.

3.4 Types of Refractive Errors
An unaccommodated eye which focuses collimated light perfectly is emmetropic and, of course, requires no spectacle correction to see distant objects (Fig. 1). A myopic or “near sighted” eye focuses light in front of the retina (Fig. 1). For the myope, remote objects are blurred, but closer objects are in focus. Myopia is corrected by lenses of negative power that diverge light.

A hyperopic or “far sighted” eye focuses light behind the retina (Fig. 1). By exercising the accommodation of the eye, the hyperope may be able to focus remote objects clearly on the retina, but the nearer the object, the greater the hyperopia and the less the accommodative ability of the eye and the more difficult this is to do. Hyperopia is corrected by lenses of positive power that converge light.

As the name implies, the astigmatic eye does not bring light to a point focus at all. Instead, the eye forms two line foci perpendicular to one another. Astigmats experience some blur at all object distances—the greater the astigmatism, the greater the blur. The effect of astigmatism on vision is far more serious when the two line foci are oriented obliquely instead of being more or less vertical and horizontal.

Astigmatism can be corrected with a sphero-cylinder lens (Fig. 2), a lens having a toric surface. Optically, a sphero-cylinder correcting lens acts like a cylinder lens that brings the two line foci of the eye together, superimposed on a spherical lens that moves the superimposed line foci to the retina. In clinical practice lens prescriptions are written in terms of sphere, cylinder, and axis. For example, the prescription \(-2.00/-1.00  \pm 015\) corresponds to a \(-2.00\) D spherical lens (sometimes designated \(-2.00\) DS) superimposed on a \(-1.00\) D cylindrical lens with its axis \(15\) (sometimes designated \(-1.00\) DC \(\pm 015\)). Cylinder axes are designated with respect to the usual trigonometric coordinate system superimposed on the eye as seen by the examiner.
i.e., with 0° to the examiner’s right and the patient’s left. Sometimes for clinical reasons astigmatism may be corrected by a spherical equivalent lens, a spherical lens that causes the lines foci to bracket the retina. For example, the spherical equivalent lens for the previous prescription would be \(-2.50\) D.

Refractive errors usually assume one of these three simple types because the curvatures of the various refractive surfaces of the eye vary slowly over the area of the entrance pupil.3,4 In various pathological conditions, however, irregular refraction may be encountered in which no simple spherical or toric lens, nor indeed any lens of any type, can produce sharp vision. Conditions in which this occurs include distortion of the cornea in keratoconus, a dystrophic deformity of the cornea, or subsequent to rigid contact lens wear; disruption of the optics of the crystalline lens by cataract; displacement of the crystalline lens; or tilting of the retina.5,6

A final refractive anomaly is presbyopia, an age-related reduction of the ability of the eye to accommodate due to sclerosing of the crystalline lens. While the crystalline lens becomes progressively more rigid throughout life, the effect of presbyopia only becomes clinically important in a patient’s early 40s.7 By the late 50s, the crystalline lens has become completely rigid and the patient experiences absolute presbyopia with no accommodation at all. Presbyopia almost always proceeds at the same rate in both eyes and at very similar rates among the population as a whole. Presbyopia is corrected by adding positive power to the distance prescription, either in the form of reading glasses or bifocals. Myopes may be able to compensate for presbyopia by simply removing their distance glasses.

3.5 ASSESSING REFRACTIVE ERROR

There are two basic problems in determining refractive error or ocular refraction:

1. It is not possible to measure the prescription parameters of sphere, cylinder, and axis separately and sequentially.

2. Clinical tests are typically accurate to within \(\pm 0.25\) D, roughly the depth of field of the eye,8 but the final results of a refraction must be accurate to within a somewhat smaller tolerance.
In practice, a refractionist employs a variety of testing procedures iteratively, repeating tests and refining results until a satisfactory end point is reached. Normally testing starts with *objective* tests in which the patient is passive, proceeding to the more sensitive *subjective* tests which require patient responses. Some of the most common procedures are discussed below.

### 3.6 Objective Tests

Objective tests require no judgment on the part of the patient, but with classic instrumentation require considerable skill on the part of the refractionist. In recent years, however, many of these tests have been adapted to automated equipment which simplifies the examiner’s task. Three common tests are keratometry, direct ophthalmoscopy, and *REFRACTIVE ERRORS*.

*Keratometry* measures the curvature of the front surface of the cornea by determining the magnification of the image of a bright object, the *keratometer mire*, reflected by the cornea. The total power of the cornea may be estimated from the curvature measurement. The astigmatism of the cornea may be used to predict the probable astigmatism of the whole eye. In an eye from which the crystalline lens has been removed, for example, corneal astigmatism is the total ocular astigmatism. Various rules of thumb have evolved for estimating total astigmatism from keratometric measurements in normal eyes, of which the best known is that of Javal and the simplest to use is that of Grosvenor.9 All these rules reflect the fact that large degrees of astigmatism are almost invariably due to the cornea.

The *direct ophthalmoscope* is used primarily to view the retina, but can also be used to estimate refractive error. The instrument sends light through the patient’s pupil to the retina which the examiner may view through the instrument. A variable lens in the ophthalmoscope enables the examiner to visualize the internal eye. The power of that lens which gives a clear view of the retina added algebraically to the examiner’s refractive error equals the patient’s refractive error. This is a rather crude estimate of refraction allowing at best a measurement of the equivalent sphere of the patient’s refractive error to within a diopter or so. Most doctors make little use of this method, but it can be of value with children and other noncommunicative patients.10

The most common objective measurement of refractive error is *REFRACTIVE ERRORS*. The optics of the retinoscope are somewhat like those of the direct ophthalmoscope, but the purpose of the
retinoscope is not to see the retina but the red reflex in the pupil due to the retina, the same red eye reflex which so often spoils flash photos.

In practice, the retinoscope is held at some known distance—the *working distance*—from the eye. The refractionist observes the red reflex while the retinoscope beam is moved across the patient’s eye. Because of vignetting of the patient’s pupil and the examiner’s pupil, the reflex will appear to move across the patient’s eye. The direction and speed of that motion depend on the patient’s refractive error.

In the most common configuration, collimated light is sent to the eye by a retinoscope held $\frac{2}{3}$ meter from the eye. If the reflex moves in the same direction as the retinoscope beam—*with motion*—the retina is conjugate to a point closer than the working distance. If the reflex moves in the opposite direction to the retinoscope beam—*against motion*—the retina is conjugate to a point farther than the working distance. The closer the conjugacy is to the working distance, the faster the motion. The examiner interposes lenses until an end point is reached when the reflex moves infinitely fast or when motion reverses. The patient’s refractive error is the value of the interposed lens minus 1.50 DS—the working distance correction.

A retinoscopist may judge the axis of astigmatism from the shape and motion of the reflex. The astigmatic refraction is then determined by examining each of the two principal meridians separately. This is facilitated by using a retinoscope with a streak-shaped beam.

REFRACTIVE ERRORS can provide a very good estimate of refractive error in a very short time, but requires a lot of skill. And even with great skill, there are a few patients whose retinoscopic findings vary considerably from their true refractive state.

Auto-refractors determine a patient’s refraction without the examiner’s skill and judgment. Instruments have been developed using a variety of optical principles, including those of the retinoscope and the direct ophthalmoscope.

3.7 Subjective Techniques
Subjective techniques provide the final refinement of refractive findings. Countless subjective techniques have been developed over the years, but in practice most refractionists rely on only two or three of them.

The most important tools for subjective refraction are an acuity chart and a set of lenses. An acuity chart consists of rows of progressively smaller letters or other symbols. The chart may simply be hung on the wall or, more commonly, projected onto a screen. The symbols on the chart are rated according to size. For example, a patient with a two minute minimum angle of resolution could just read a letter rated 12 meters or 40 feet when it is 6 meters or 20 feet away. In Snellen notation, the patient would have 6/12, or 20/40, visual acuity—the testing distance being at the top of the fraction, the letter rating at the bottom. A very rough estimate of the magnitude of refractive error may be obtained by dividing the denominator of the Snellen fraction in English units by one hundred. For example, a 20/50 patient would have about a \(0.50\) D refractive error.

Classically, refraction was carried out with a trial lens set, a box of labeled spherical and cylindrical lenses. These lenses could be held before the patient or placed in a special spectacle frame called a trial frame. Nowadays, most refractionists employ a phoropter, a device mounted before the patient which contains a range of spherical and cylindrical lenses and other optical devices designed to make rapid change of lenses possible.

Refractions can be carried out with or without cycloplegia with a pharmaceutical agent like Cyclopentolate which eliminates most accommodation. While cycloplegia may be important in certain patients, refractions without cycloplegia are generally preferable since they permit a more realistic assessment of lens acceptance as well as an evaluation of the patient’s accommodative and binocular status.

Refraction starts with an estimate determined from an objective technique, acuity rule of thumb, or the previous spectacle prescription. The usual first step in refraction is determination of the patient’s equivalent sphere by adding plus spherical power to the patient’s approximate prescription until the acuity chart is blurred (termed “fogging the patient”), then reducing plus spherical power (“unfogging the patient”) until the best possible acuity is just achieved. The end point may also be determined or confirmed using the red-green test in which the patient simultaneously views black letters on red and green backgrounds. Due to the eye’s chromatic
aberration, letters on the red and green side will appear equally sharp and clear with the right equivalent sphere in place.
The next step is to determine the patient’s astigmatism. One test for this is the astigmatic dial, a chart with radial lines arranged at 30° intervals (Fig. 3). With the approximate cylinder removed, the patient is fogged and asked to identify the line that seems clearest. That line corresponds to the line focus nearest the retina, from which the axis of astigmatism may be calculated. The magnitude of astigmatism may be determined by adding cylinder lenses at the axis of astigmatism until all the lines appear equally sharp and clear. Estimates of astigmatism are refined to a final prescription with the Jackson Cross cylinder, a spherocylinder lens with equal and opposite powers along its principal meridians, typically ≥ 0.25 D. The cross cylinder lens is designed to mechanically flip around one of its principal meridians to check astigmatism power and around an axis halfway between the principal meridians to check astigmatism orientation. The patient looks through the equivalent sphere noting changes in clarity of small letters on the acuity chart while the refractionist flips the cross cylinder lens, adjusting the power and orientation of the astigmatic portion of the prescription according to the patient’s opinion of which flip cylinder orientation is more clear. The final step in refraction is to increase the plus power or decrease the minus power of the refracting lens until the patient can just achieve best acuity.

3.8 CORRECTING REFRACTIVE ERROR
Philosophies of Correcting Refractive Error

In determining spectacle prescription the doctor must take into account the patient’s refraction and binocular status. Elaborate schemes have been developed for making these clinical decisions, but they come down to a few basic concepts. First, astigmatic corrections can cause adaptation problems due to spatial distortion, hence the minimum cylindrical correction consistent with clear vision and comfort is given. In some cases, that might just be the equivalent sphere. The distance prescription should allow patients to see remote objects clearly. For an absolute presbyope this means prescribing the exact results of the refraction. Young myopes often like to accommodate a bit through their spectacles, so they should receive at a minimum the full
refraction, possibly with a quarter or half diopter over correction. Young hyperopes are often blurred by their full prescription until they learn to more completely relax accommodation, so it is wise to give them less than a full prescription at first.

Likewise, the near prescription should provide clear, single vision for reading and other near tasks. For the presbyope this means bifocal lenses, reading glasses, or some other optical arrangement to supplement the eye’s accommodative power. Typically, the power of the near correction is chosen so that the patient uses about half the available accommodation for reading. Patients with an especially strong link between accommodation and convergence may also need bifocal lenses or reading glasses to prevent eyestrain and even double vision at near distances. Myopes with minimal astigmatism may be comfortable doing near work with no spectacle correction at all.

**Spectacle Correction**

**Spectacle Lens Optics.** Throughout this discussion, we’ve assumed that spectacle lenses can be treated as thin lenses and that their exact placement before the eyes is not critical. Fortunately, that is true for the spectacle lenses of that vast majority of patients whose refractive errors are of modest size, but for high refractive errors, we must deal with spectacle optics more precisely. First of all, the power specified for a spectacle lens is actually its *back vertex power*, the reciprocal of distance from the *ocular surface* of the lens (the surface next to the eye) to the secondary focal point of the lens. The back vertex power of the ocular refraction is read directly from the phoropter. The *lensometer* or *focimeter*, an instrument commonly used in determining spectacle power, actually measures back vertex power of a lens.21

The back vertex power of the correction depends on the *vertex distance* of the spectacle lens. The vertex distance is the distance between the ocular surface of the lens and the cornea, typically from 12 to 15 mm. If refraction at a given vertex distance gives a spectacle lens of back vertex power $F_V$, but the patient will actually wear the prescription at a vertex distance $x$ millimeters from the refraction’s spectacle plane (moving toward the eye corresponding to $x \leq 0$), the back vertex power of the spectacle prescription should be $F_x$.

$$F_x = \frac{1}{x} \quad (1)$$

From this equation it can be shown that changes of vertex of a millimeter or two aren’t significant until the magnitude of the prescription power exceeds eight diopters.22
The only significant degree of freedom available to the spectacle lens designer is the base curve of the lens, the reference curve of the lens form. The base curve is adjusted so that the eye encounters as nearly as possible the same spectacle prescription in all fields of gaze. In terms of the Seidel aberrations, this corresponds to minimizing unwanted marginal astigmatism and regulating curvature of field. A variety of designs, called corrected curve lens series, have evolved, each based on slightly different assumptions about vertex distance and the relative importance of the aberrations. In modern lens designs, the front surface of the lens is spherical, and the back surface toric, the so-called minus cylinder form. To achieve adequate performance in high powered lenses, especially positive powered lenses, it is necessary to use aspheric curves.

**Spectacle Lens Materials.** Ophthalmic lenses may be made of several kinds of glass or plastic. The final choice of material depends on lens weight, thickness, impact resistance, scratch resistance, and chromaticity. For most of this century, the preferred material has been glass, typically ophthalmic Crown glass of index 1.523, with higher index glasses used to reduce thickness in high powers. The introduction of impact resistance standards in North America in the early 1970’s, which required thicker lenses, and the trend to larger eye sizes in spectacle frames soon led to uncomfortably heavy glass lenses. Plastic lens materials which weigh about half as much as glass lenses have since become standard. The most common material is CR39 which has an index of 1.498. Another common material is polycarbonate, a very lightweight material of index 1.586 which is highly impact-resistant. Its toughness makes polycarbonate useful in safety lenses and in lenses for high refractive errors, but the material is very soft and suffers from considerable chromatic aberration.

**Presbyopic Corrections.** Presbyopia may be managed by using different spectacles for near and distance, but bifocal lenses are a more practical solution. The top part of the bifocal lens is for distance viewing, and an area of the lower part of the bifocal lens, the segment, is for near tasks. The add of a bifocal is the difference between segment and distance power. Adds typically range from 1.00 D to 2.50 D, the power increasing with age. Bifocal segments come in a variety of shapes, the most common being the straight top, Executive, and round styles illustrated in Fig. 4. Plastic bifocals are made in one piece. In
glassbifocals, Executive lenses are also one piece, but straight top and round lenses are made of a higher index glass, fused and countersunk into the distance lens. The choice of lens depends on the field of view the patient needs for near tasks and on cosmetic factors. Whatever the shape, bifocals are fit with the top of the segment at the margin of the patient’s lower lid.

As the patient progresses toward absolute presbyopia, a multifocal may be necessary to see adequately at all distances. In trifocals a band with power intermediate between the distance and near correction sits at the top of the bifocal segment. Trifocals are set somewhat higher than bifocals (usually at the lower margin of the patient’s pupil) to allow easy access of the intermediate and near portions of the segment.

An increasingly popular alternative to bifocals and trifocals is the *progressive addition lens* or *PAL*. In PALs an aspheric front surface allows power to vary continuously from the distance portion of the lens at the top to the near portion at the bottom. Distant and near portions are connected by a narrow optical channel (Fig. 5). Outside the channel and the wider segment, the optics of the bottom portion of the PAL provides only distorted and blurred vision. Dozens of PAL designs have been brought to market in recent years, each representing a different solution to the problem of designing the aspheric surface.26

PALs have been marketed principally as lineless bifocals that don’t betray the age of the wearer. But PALs’ transition corridors provide useful vision at intermediate distances, eliminating the need for trifocals. The chief disadvantages of PALs are expense, adaptation, and a reading area smaller than that of conventional bifocals. Nonetheless, most patients quickly learn to use these lenses and prefer them to conventional bifocals.27

A couple of specialty multifocals are worth mentioning. One is the *double segment bifocal* that has an intermediate segment above the eye in addition to the regular segment below. This configuration is useful for presbyopic mechanics, electricians, painters, plumbers, and others who need to see near objects overhead. The power of the upper segment can be chosen according to occupational needs.

Another is the computer lens. Regular bifocals are prescribed on the assumption that near tasks will be at a typical reading distance 40 cm from the eye. But computer users must see at arm’s length, typically about 70 cm from the eye. The intermediate corridor of a conventional PAL is too narrow for prolonged use, and a single vision lens prescribed for this working distance may leave the user with too narrow a range of clear vision. Some companies have
produced special progressive addition lenses for computer use which have a wide intermediate area with a small near zone at the bottom and distance zone at the top. Such lenses are also helpful with a number of occupations not connected with computers, for example musicians.

**Tints in Spectacle Lenses.** Tints are used in spectacle lenses for comfort, safety, and cosmesis. Color tints in glass lenses are produced by adding a compound to the glass as it is made or by coating the completed glass lens. Plastic lenses are tinted by dipping them into a dye. In ophthalmic practice, tints are classified numerically based on their light transmission. The most common application of spectacle tints is, of course, sunglasses. Optimal transmittance for comfort is about 10 percent, a #3 tint, which also helps preserve the eye’s capacity for dark adaptation. The most common sunglass tints are gray, brown, yellow, and green. Typical transmittance curves are shown in Fig. 6. Gray lenses block light without affecting color perception. Other tints can, potentially, alter color perception, but sunglasses following the ANSI Z80.3 Sunglass Standard should cause no difficulties, at least in the important task of recognizing traffic signals.

Photochromic lenses have become a popular alternative to conventional tinted lenses. In sunlight a clear photochromic lens darkens to about a #2 tint in five minutes or so. Darkened lenses will lighten to near transparency in about 10 minutes. Somewhat greater darkening occurs at lower temperatures. The darkest tint is inadequate for a true sunglass lens and photochromics are, accordingly, marketed as “comfort” lenses. The darkening is a response to ultraviolet (UV) light, so photochromic lenses work poorly in cars where the windows transmit little UV radiation. Photochromic lenses lighten in response to infrared (IR) radiation.

Photochromic lenses come in glass, ophthalmic plastic, and even polycarbonate. They can be had in single vision and bifocal formats, including progressive addition lenses. Polaroid® sunglasses are made with a layer of Polaroid material sandwiched within spectacle material. The axis of polarization is vertical to block glare from horizontally polarized light scattered from the road or water. Polaroid lenses can be tinted for extra density and can be made in most prescriptions, including bifocals and progressive addition lenses.
Antireflective (AR) coatings use thin film interference to diminish or eliminate reflections off spectacle surfaces. AR coatings improve lens cosmesis and can eliminate or at least minimize unwanted ghost images formed by lens reflection that some patients find distracting. IR and UV spectacle coatings block light at long and short wavelengths that have been associated with a variety of abiotic effects including keratitis and cataract. Because the crystalline lens is the site of most of the eye’s UV absorption, it is especially important to provide UV protection in visual corrections worn subsequent to cataract surgery.

Standards for spectacle prescriptions in the United States are spelled out in the ANSI Z80.1 standards. In North America all lenses are expected to have sufficient impact resistance to pass the drop ball test in which a half ounce steel ball of \( \frac{5}{8} \) in diameter is dropped from a height of 50 inches onto the lens. To satisfy this requirement, glass lenses must be hardened by thermal air tempering or chemical tempering. Plastic lenses require no special hardening treatment.

### 3.9 summary

Refraction is the term used for determining the refractive error in a person. It is just a part if the “big picture” of optics that includes: “bench” optics, physiologic optics, measuring refractive error prescribing, and dispensing. Moreover, clinical conditions including alignment, vision, fusion and binocularity, amblyopia, diplopia, and asthenopia can be influenced by refraction. The clinician should have some basic knowledge of optics, but most of the clinicians expertise deals with the clinical aspects of refractive errors, how to measure them, and when to prescribe glasses or other optical aids. It cannot be denied that the technician with appropriate training and supervision can measure the refractive error, but the far reaching implications of dealing with uncorrected or improperly corrected refractive error is the responsibility of the clinician. In most cases, when the proper refraction is found, changes throughout life tend to be an increase in myopia until the mid to late teens, some reduction in hyperopia, and the onset of presbyopia in the fifth decade. Trauma or surgery can also result in a change in refraction. The strabismologist frequently plays a continuing role in issues of refraction in cases of refractive and accommodative esotropia, as well the need to add prism, and supervise the placement of the bifocal in high AC/A. The pediatric ophthalmologist is the person most likely to find the refractive error in the very young child who may be seen initially for another reason.
reality today is that many sub-specialists in ophthalmology are likely to depend on auto refraction and technicians for determining refractive error for prescribing glasses. While ophthalmologists will continue to be expected to have an appreciation for all aspects of the refraction/optics process, this emphasis and enthusiasm will be likely to diminish as their abilities in the diagnosis and treatment of blinding diseases increases, more well trained technicians become available, and automated devices become more accurate and more widely available.

The pediatric ophthalmologist/strabismologist as well as any ophthalmologist who cares for young children or strabismus patients of any age should be an expert at refraction/retinoscopy, understand physiologic optics, be able to prescribe prism and bifocals, understand the aspects of vision and eye health screening, know when to prescribe, and appreciate a proper fit for spectacles.

3.10 check your progress

1. Explain Principle Of Refractive Errors
2. Explain Refractive Errors
3. Explain Types Of Refractive Errors
4. Explain Assessing Refractive Error
5. Explain Objective Tests
6. Explain Subjective Techniques
7. Explain Correcting Refractive Error

Check Your Progress
3. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others
1.3.1. Points for discussion

Points for clarification
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Unit 4: Concept And Definitions Of Blindness And Low Vision

4.1 Introduction

4.2 Indian Context

4.3 Case For Revision

(1) The Definition Of Visual Impairment Categories Based On “Best Corrected” Vision

(2) The Nomenclature

(3) The Categorization Of Blindness

(4) The Inconsistencies Within H 54 Subcategories

(5) The Ico Resolution On Revision Of Icd 10

4.4 Explanation Of Various Terms

4.5 Who Disability Sequence

4.6 Explanation Of Various Terms As Adopted By Who

4.7 Summary

4.8 Check You Progress

4.9 References
4.1 Introduction

The Convention of Rights of Persons with Disabilities (UNCRPWD: United Nation, 2006 w.e.f. 8 May 2008) and the Biwako Millennium Framework for Action and Biwako Plus Five (ESCAP 2003) reflect a shift from a medical to social model of disability. In the medical model, individuals with certain physical, intellectual, psychological and mental conditions (impairment) are regarded as pathologic or abnormal; it is simply the abnormality conditions themselves that are the cause of all restrictions of activities.

According to the medical model, disability lies in the individuals, as it is equated with those restrictions of activity. Faced with the line of thinking, individuals would feel pressured to work on ‘their’ restrictions, bearing the burden of adjusting to their environment through cures, treatment or rehabilitation.

In contrast, the social model shifts the focus to the society; undue restrictions on behaviour of persons with impairment are seen to be imposed by: a) dominant social, political, and economics ideologies; b) cultural and religious perceptions regarding persons with disabilities; c) paternalism in social welfare systems; d) discriminations by society; e) the inadequacy of the environment and information; and f) the lack of appropriate institutional and social arrangements. Thus in this model, disability does not lie in individuals, but in the interactions between individuals and society. In the social model, persons with disabilities are right holders, and are entitled to advocate for the removal of institutional, physical, informational and attitudinal barriers in society. Thus it is a concept based on the consequences of diseases/infirmity on functional capacity and/or social participation. It locates the definition of disability at the most basic level of activity/participation in core domains – defined as the ability or inability to carry out basic actions at the level of whole person (i.e. walking, climbing stairs, lifting packages, seeing a friend across the room etc.).

4.2 Indian Context

In India different definitions of disability conditions have been introduced for various purposes, essentially following the medical model and, as such, they have been based on various criteria of ascertainning abnormality or pathologic conditions of persons. In absence of a conceptual framework based on the social model in the Indian context, no standardisation for evaluating disability across methods has been achieved.
In common parlance, different terms such as disabled, handicapped, crippled, physically challenged, are used inter-changeably, indicating noticeably the emphasis on pathologic conditions.

**Persons with Disability Act, 1995:** Through the Act is built upon the premise of equal opportunity, protection of rights and full participation, it provides definitions of disabled person following the medical model. According to the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995, "Person with disability" means a person suffering from not less than forty per cent of any disability as certified by a medical authority (any hospital or institution, specified for the purposes of this Act by notification by the appropriate Government). As per the act "Disability" means -

(i) Blindness; (ii) Low vision; (iii) Leprosy-cured; (iv) Hearing impairment; (v) Loco motor disability; (vi) Mental retardation; (vii) Mental illness, which were defined as below.

- **"Blindness"** refers to a condition where a person suffers from any of the following conditions,
  (i) Total absence of sight.
  (ii) Visual acuity not exceeding 6/60 or 20/200 (snellen) in the better eye with correcting lenses;
  (iii) Limitation of the field of vision subtending an angle of 20 degree or worse;
- **"Person with low vision"** means a person with impairment of visual functioning even after treatment or standard refractive correction but who uses or is potentially capable of using vision for the planning or execution of a task with appropriate assistive device;
- **"Leprosy cured person"** means any person who has been cured of leprosy but is suffering from-
  (i) Loss of sensation in hands or feet as well as loss of sensation and paresis in the eye and eye-lid but with no manifest deformity;
  (ii) Manifest deformity and paresis; but having sufficient mobility in their hands and feet to enable them to engage in normal economic activity;
  (iii) Extreme physical deformity as well as advanced age which prevents him from undertaking any gainful occupation, and the expression "leprosy cured" shall be construed accordingly;
- **"Hearing impairment"** means loss of sixty decibels or more in the better ear in the conversational range of frequencies;
• "Loco motor disability" means disability of the bones, joints muscles leading to substantial restriction of the movement of the limbs or any form of cerebral palsy;
• "Mental retardation" means a condition of arrested or incomplete development of mind of a person which is specially characterized by sub normality of intelligence;
• "Mental illness" means any mental disorder other than mental retardation;
However, these definitions were not found to be useful even for enumerating the disabled population, particularly in Population Census process for a large population like that of India.

4.3 CASE FOR REVISION
There are five issues that dictate the need for consideration of a revision of the current definition and categorization. These are:
(1)The definition of visual impairment categories based on “best corrected” vision
(2)The nomenclature
(3)The categorization of BLINDNESS
(4)The inconsistencies within H 54 subcategories
(5)The ICO Resolution on Revision of ICD 10
Recommendations of WHO Consultation on “Development of Standards for Characterization of Vision Loss and visual functioning “

(1)Definition of Visual Impairment and Blindness
The currently used definition includes the term “best Corrected Vision” in the better eye.
The methodology followed for measuring visual acuity, particularly in population based studies, is to use a “pin hole” in patients whose “presenting“ vision is below a certain cut off point (currently 6/18). Many recent studies have shown that the use of “best corrected” vision overlooks a large proportion of persons with visual impairment, including blindness, due to uncorrected refractive error, a common occurrence in many parts of the world.
Uncorrected refractive error is now considered to be a major cause of visual impairment and estimations are under way to calculate the loss in terms of DALYs (disability-adjusted life years) resulting from this cause.
The correction of refractive error is a cost effective intervention and is one of the priorities under the disease control component of the Global Initiative for the Elimination of Avoidable Blindness (VISION 2020, the Right to Sight).

(2) Nomenclature
The current ICD uses the words “LOW VISION” for categories 1, 2 and 3 of Vision impairment. In the practice of eye care “LOW VISION” has a specific meaning as defined by WHO. This is as follows:

“A person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field of less than 10 degree from the point of fixation, but who uses, or is potentially able to use, vision for planning and/or execution of a task. “

Under this definition persons who would benefit from low vision care also exist among those who are currently categorized as blind. This has led to miscalculations in the estimation of persons requiring LOW VISION care.

(3) Definition of Blindness
The current definition does not make a distinction between those who have “irreversible” blindness (NO perception of light) and those that have light perception but are still less than 3/60 in the better eye.

The management of these two categories is different and categorization based on this would be useful.

(4) Inconsistencies in H54 subcategories
The sub categories of H54 have inconsistencies when describing “Monocular vision impairment” and “Monocular Blindness”; the fellow eye in these needs not necessarily to be “normal”. To add clarity to the sub-categories it is proposed to replace the current table (ICD - 10th Revision see below).

In India, the broad definition of visual impairment as adopted in the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995 as well as under the National Programme for Control of Blindness (NPCB) is given below:
1. **Blindness**: refers to a condition where a person suffers from any of the following conditions, namely:

_ Total absence of sight; or_
_ Visual acuity not exceeding 6/60 or 20/200 (Snellen) in the better eye even with correction lenses; or_
_ Limitation of the field of vision subtending an angle of 20 degree or worse._

For deciding the blindness, the visual acuity as well as field of vision have been considered.

2. **Low Vision**:

   The Persons with Disabilities Act, 1995 also recognizes low vision as a category of disability and defines it as follows:

   “*Person with low vision*” means a person with impairment of visual functioning even after treatment or standard refractive correction but who uses or is potentially capable of using vision for the planning or execution of a task with appropriate assistive device”.

   This definition is incomplete as it inadvertently omits quantification of the acuity as well as the field of vision as is done in the case of the WHO definition. It is desirable to modify this definition and the following quantification should be added: “*Low vision are those who suffer visual acuity between 20/200 to 70/200 (Snellen) or 6/18 to 6/60 in the better eye after the best possible correction or a Field of Vision between 20 to 30 degrees*”.

The WHO working definition of Low Vision (WHO, 1992) is as follows:

“A person with low vision is one who has impairment of visual functioning even after treatment, and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task”.

The points emphasized are that there is significantly reduced vision, visual performance is affected but that there still is vision that can be used. This last point is very important: if there is usable vision, training to use that vision might be possible. In addition, this person is not labelled blind.
The standard WHO definition is used in medical reports and publications and is solely based on visual acuity and does not take into account functional vision.

# The WHO working definition has been adopted since WHO Consultation in 1992. This working definition is solely used for reporting purposes and should not be used for eligibility of services.

The importance of the functional definition lies in the ‘label’ people are given. Someone with a visual acuity of 2/60 can have useful vision, for example, for mobility. However, he or she will be labelled blind person. The consequence is this person is than treated as if he/she is a blind. This ignores the usable vision. There should be a difference between legal blindness and functional blindness or low vision.

The WHO standard definition defines blindness as visual acuity of less than 3/60 in the better eye with the best possible correction as compared to that of 6/60 in India. The WHO functional definition, however, considers blindness starting at light perception or when a person has no usable vision. Similarly, a person with visual acuity better than 3/60 but equal or less than 6/60 is graded as “blind” in India, while WHO grades him as low vision.

In India a person with a VA < 6/60 is legally blind, which enables to receive certain services and financial benefits. However, a person who is legally blind can still have useful vision to do certain tasks, as can be seen in the working definition. This refers to the fact that they still have functional vision, which is the use of vision for a particular purpose.
For India or other developing countries, it is essential to maintain the legal definition of blindness at the level of visual acuity of 6/60 (20/200 Snellen) or less and field of vision of 20 degree or less. Already the travel concessions, scholarship and other benefits are very meagre, if “perception of light” to “no perception of light” is considered blindness, a large of persons who are at present availing these concessions would fall outside the eligibility criteria and thus remain bereft of these benefits.

Alternatively, if these concessions are extended to all the persons with low vision in the acuity range of 6/18 to “perception of light” as defined by WHO, the appropriate Government may not be able to meet the demand due to financial constraints. For India and other developing countries, it is desirable to maintain the definition of blindness as adopted in the Persons with Disability Act, 1995, i.e. visual acuity of 6/60 (20/200) or less and field of vision of 20 degree and less and to consider all the persons in the range of acuity of 6/18 to 6/60 (20/60 to 20/200) as persons with low vision.

Thus the recommended definition for low vision in Indian context should be “Low vision are those who suffer visual acuity between 20/200 to 70/200 (Snellen) or 6/18 to 6/60 in the better eye after the best possible correction.”

3. One-Eyed Person:

There is a controversy regarding the inclusion of one-eyed persons in the category of blindness. The definition of blindness adopted in India exclude people with impairment only in one eye from the purview of blindness.

Even in medical parlance, disability is synonymous to the physical impairment and the level of such impairment has been prescribed for certifying a person to be disabled. Generally, the impairment of 40 percent or more is considered a handicap. As percentage of impairment in the case of a one-eyed person is only 30 percent, according to the approved definition in medical parlance, a person with one good eye is not a blind person. In short, a person with visual impairment of 40 per cent or more is considered a blind person.

The Committee of the Ministry of Social Justice and Empowerment on Recommendation of Standard Definition of Disability recommended that one eye-eyed persons should be excluded from the other categories of visual impairment so that facilities and concessions available to severely and profoundly visually impaired persons are not eroded. The committee, however, felt
that loss of one eye would not be considered as a disqualification on medical grounds unless a particular post is of such a technical nature that it requires of a person to have the coordinated use of both eyes or three dimensional vision.

4. Persons with Deafblindness

Deaf blindness is a condition presenting other difficulties than those caused by deafness and blindness. It is an “umbrella” term which can include children and adults who may suffer from varying degrees of visual and hearing impairment, perhaps combined with learning difficulties and physical disabilities, which can cause: severe communication, developmental, and educational problems.

It includes children and adults who are: blind and profoundly deaf, blind and severely or partially hearing, partially sighted and profoundly deaf, partially sighted and severely or partially hearing (Source: Contact (1993) A Resource for Staff Working with Children who are Deaf and Blind, Edinburgh: Moray House)

4.4. Explanation of Various Terms

In defining visual impairment, three aspects of vision namely visual acuity, field of vision and visual functioning are considered simultaneously. In a broad sense, visual defects result into loss of clear vision, central vision or peripheral vision.

All these losses are considered by measuring visual acuity, field of vision and level of visual functioning.

Visual Acuity: It refers to the ability of the eye to see details. The visual acuity for distance is measured as the maximum distance at which person can see a certain object, divided by the maximum distance at which a person with normal eyesight can see the same object. Thus a visual acuity of 6/60 means that the person examined cannot see, at a distance of 6 meters, the object which a person with normal eyesight would be able to see at 60 meters. If vision is so impaired that to see the biggest E of the E-chart, the person has to come within 6 meters or even
nearer, he is considered blind. The simplest method of testing visual acuity is to see whether the person can count fingers at a distance of six meters.

Field of Vision: It refers to the field which both the eyes can easily see in the front. The normal field of vision is 180 degrees in front of eye. It is determined by the Confrontation Test in which mapping is done on a chart having concentric circles marked upon it. The simplest method of testing is to bring snapping finger from the side of the ear to the front, move it up and down, and mark the position where the person can see the finger.

Visual Functioning: It relates in part to the condition of the eye. It is determined by the experience, motivation, needs and expectation of each individual in relation to whatever visual capacity is available to satisfy curiosity and accomplishment activities for personal satisfaction. The visual functioning refers to the degree to which/ability of a person to use vision for all (daily) activities.

4.5. WHO Disability Sequence
Generally various terms like impairment, disability and handicap are used interchangeably and at random. WHO has adopted a sequence underlying illness-related phenomenon as:
**Disease ——> Impairment ——> Disability ——> Handicap**

The International Classification of Impairments, Disabilities & Handicaps (ICIDH-2) likely to be officially adopted in 2001 proposes a common language of functioning and disability.

The new terms proposed are “Activity Limitation” for “Disability”; and “Participation Restriction” for “Handicap”. “Disability” will be used as an umbrella term covering all three terms: Impairment, Activity Limitation and Participative Restriction.

In context of vision defects, a variety of terms viz. totally blind, stone blind, blind, partially blind, legally blind, economically blind, visually limited, low vision, partially sighted, visually handicapped, visually impaired etc. are being used.

### 4.6 Explanation of Various Terms as Adopted by WHO

**Condition Concerned with**

**Impairments** Abnormalities of body Disturbances at structure and appearances; organ level organs or system functioning

**Disabilities** Impairment in terms of Disturbances at functional performance personal level and activities

**Handicaps** Disadvantages resulted Interaction with from impairment and and adaptation disabilities to individual’s surroundings

*Source: WHO Classification of Impairments, Disabilities & Handicaps*

The visually impaired is an umbrella term, used widely and understood in an educational context. This term is used to describe the total group of persons whose vision is affected by impairments in seeing, irrespective of the nature or extent of these. The term refers to all the persons where vision disadvantage has resulted from impairment as well as disabilities.

In case of persons who are completely without vision, or who have light perception only, it is desirable to use the term “blind”.

In all other cases of visual defects falling in the definition, the term “visually impaired” should preferably be used. For the persons who do not fall in the category of blindness as defined in the Act and whose visual acuity falls between 6/18 and 6/60 in the better eye after the best possible correction, the term “low vision” should be used.
In addition, the following should be done:

a. Use the term “blind” (VA 6/60 or lower) only for legal reasons or to get benefits.

b. For educational and rehabilitation purposes, all persons with a visual acuity <6/18 to light perception, who still have useful vision, should be labeled “low vision, not blind” so as to encourage the use of vision.

4.7 Summary

Visual impairment can have a significant impact on the patient's quality of life. The presence of a visual impairment can affect the ability to read, watch television, drive, work, learn, perform simple activities of daily living, and, in many cases, to maintain independence in a safe manner. As the population ages, the number of patients who are visually impaired is increasing, as is the need for appropriate evaluation, management, and rehabilitation services for these patients. Optometrists are uniquely qualified to manage visually impaired patients in that they can assess ocular status, evaluate visual functioning, prescribe low vision devices (e.g., optical, non-optical, electronic), and provide therapeutic intervention or coordinate other forms of care to improve the functioning of the patient's impaired visual system. Comprehensive optometric low vision care can significantly improve the quality of life for visually impaired patients.

4.8 Check you progress

1. Explain Indian Context

2. Explain Case For Revision

3. Explain The Definition Of Visual Impairment Categories Based On “Best Corrected” Vision

4. Explain The Nomenclature

5. Explain The Categorization Of Blindness

6. Explain The Inconsistencies Within H 54 Subcategories
7. Explain The Ico Resolution On Revision Of Icd 10

8. Explain Explanation Of Various Terms

9. Explain Who Disability Sequence

10. Explain Explanation Of Various Terms As Adopted By Who

Check Your Progress
4. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.4.1. Points for discussion
Points for clarification
4.9 REFERENCES


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Unit 5: Concept Of Visual Acuity, Visual Field, Depth Perception And Contrast Sensitivity

5.1 Introduction

5.2 Vision And Balance

5.3 Vision And Falls And Fractures

5.4 Sense Of Contrast

5.5 Visual Interventions For Preventing Falls

5.6 Summary

5.7 Check Your Progress

5.8 References
5.1. INTRODUCTION

In 1988, the Transportation Research Board published Special Report 218, *Transportation in an Aging Society: Improving the Mobility and Safety of Older Persons*. This report is a landmark document as it has focused the interest and resources of both the public and private sectors upon the emerging needs of older drivers. Since the introduction of Special Report 218, research involving older driver issues has been increasing exponentially. The current report provides a review of the vision literature which has appeared since 1988, with a focus upon basic and applied research that has direct consequences for understanding age-related changes in driving behavior. Previous reviews of age-related visual changes can be found in Owsley and Sloane (1990) and Schieber (1992).

Impaired vision can have substantial adverse effects on the ability to read, enjoy recreational pastimes and undertake activities of daily living [1–3]. Several studies, published during the past 15 years, have also shown that impaired vision adversely affects postural stability and increases the risk of falling in older people. This article reviews this body of research that has examined (i) the role vision plays in maintaining balance, (ii) visual impairments that predispose older people to falls, (iii) the effects of inappropriate glasses on vision and falls and (iv) the efficacy of visual improvement interventions for preventing falls.

5.2 Vision and balance

Vision plays an important role in stabilising balance by providing the nervous system with continually updated information regarding the position and movements of body segments in relation to each other and the environment.

When people stand with their eyes closed, postural sway increases by 20–70% [4–7]. It has also been found that moving visual fields can induce a powerful sense of selfmotion, and misleading visual cues induce significant increases in sway [8]. We have found that poor performances in tests of distant contrast sensitivity and stereopsis (a measure of depth perception) were independent predictors of increased sway in older people [9]. This suggests that the accurate perception of visual stimuli and depth plays an important role in providing a visual reference frame for the
5.3 Vision and falls and fractures

Many studies of the risk of falls in older people have included measures of visual impairment as a possible risk factor. Standard tests of visual acuity have been most commonly used to measure vision; however, published findings have been inconsistent with regard to whether impaired visual acuity increases the risk of falls. On the one hand, there are several reports that indicate impaired distant visual acuity is a risk factor for falls in community-dwelling and institutionalised older people. However, other studies have not found this to be the case, particularly when confounding factors such as age are adjusted for. Large case-control and prospective studies have also assessed whether reduced visual acuity is a risk factor for hip fractures—a serious consequence of falls in older people. Three of these found a significant association, but the fourth did not.

Whereas visual acuity measures fine detail vision, contrast sensitivity tests assess a person’s ability to detect edges under low-contrast conditions and may more accurately reflect capacity to detect ground-level hazards. Thus, a loss of edge-contrast sensitivity may predispose older people to trips over obstacles within the home, and outdoor hazards such as steps, kerbs and pavement cracks and misalignments.

In a series of studies, we have found tests of edge-contrast sensitivity, rather than visual acuity, to be more strongly associated with falls. This was also the case in the Blue Mountains Eye Study, which compared the predictive power of a range of visual tests, including visual acuity and visual field size. Reduced contrast sensitivity has also been found to be an important risk factor for multiple falls and fractures in large prospective fracture epidemiology studies.

Reduced depth perception has also consistently been found to be a significant risk factor for falls and fractures. Nevitt et al. found that older persons who had poor stereoacuity were at significantly higher risk of suffering recurrent falls, and Cummings et al. and Ivers et al. have reported that poor depth perception was an important risk factor for hip fracture. We have recently found that of nine measures of vision, impaired depth perception was the strongest risk factor for multiple falls in 156 community-dwelling older people [24]. Furthermore, subjects with good vision in both eyes had the lowest rate of falls, whereas subjects with good vision in one
eye but only moderate or poor vision in the other had elevated falling rates—equivalent to those with moderate or poor vision in both eyes Figure 1.

This suggests that the ability to judge distances accurately and perceive spatial relationships is important for negotiating and avoiding obstacles and hazards in the environment.

Further support for impaired depth perception being a risk factor for falls also comes from a study by Felson et al., who found that older persons who had good vision in one eye, but only moderately good vision in the other, had an elevated hip fracture risk.

Ivers et al. [10] found that visual field loss, although not as important as contrast sensitivity and visual acuity, was an independent risk factor for falls. Klein et al. also reported that visual field loss was associated with both multiple falls and fractures in the Beaver Dam Eye Study. By contrast, Nevitt et al. reported no significant association between visual field loss and recurrent falls, and Glyn et al. found that visual field loss was only weakly associated with falls in patients attending a glaucoma clinic.

![Figure 1. Proportion of subjects who suffered multiple falls classified with respect to visual acuity in left and right eyes. Visual acuity classification expressed as Snellen fractions: good \( \leq 6/7.5 \); moderate 6/9–6/24; poor \( \geq 6/30 \) [21]. The depth perception scores relate to errors (measured in cm) subjects made when attempting to align two vertical rods equidistant using the Howard-Dohlman device [34]. Scores of \( \geq 22.4 \text{ cm} \) were associated with a 2.26 increased risk of falls (95% CI = 1.24–4.14) [24]. Frisby scores provide a measure of stereovisual acuity in seconds of arc [35]. Scores of \( \geq 215 \text{ sec} \text{ arc} \) were associated with a 1.99 increased risk of falls (95% CI = 1.11–3.59) [24].]

1. Acuity

Even when screened for good ocular health and optimal refractive status, older adults, as a group, demonstrate reduced levels of visual acuity (Frisen and Frisen, 1981; Pitts, 1982). Several investigations have also revealed that age differences are exacerbated when acuity is measured
under low luminance conditions. A recent study by Sturr, Kline, and Taub (1990) measured acuity as luminance was decreased from very high (245.5 cd/m²) to very low (0.2 cd/m²) levels in a sample of 60 young (ages 18 to 25) and 91 older (ages 60 to 87) healthy observers. Acuity differences between the groups increased as stimulus luminance level decreased. Sturr et al. calculated the percentage of each age group that surpassed the 20/140 acuity criterion (the typical cutoff used by state motor vehicle licensing administrations) at 2.45 cd/m². This luminance level was selected as representative of the brightness level of highway signs encountered while driving at night. Although 77% of the 60-64 year-olds "passed" this nighttime acuity screening, only 28% of the 65 to 74 year-olds and 4% of the 75+ group were able to demonstrate this minimal level of visual competence. Age differences in acuity are further exacerbated at low levels of luminance contrast.

Owsley, Sloane, Skalka and Jackson (1990) found that reductions of stimulus contrast had no demonstrable effects upon young observers; but older persons exhibited a 10 to 25% decline in acuity as letter contrast was decreased from 96% to 4% (i.e., Regan Low Contrast Acuity Charts).

Other investigators have also demonstrated that apparent good acuity among older adults can become significantly compromised under low contrast and low luminance viewing conditions. Adams, Wong, Wong, and Gould (1988) examined age differences in acuity over a wide range of stimulus luminance and contrast. All observers demonstrated 20/20 (1 minarc) acuity under typical high-luminance/high-contrast assessment conditions. At the lowest luminance-contrast condition (10% contrast at 5.4 cd/m²), acuity dropped to 20/150 (2.5 minarc) for the young group (under 30 years-old) and all the way down to 20/800 (4.0 minarc) for the older observers (50-72 years-old). Similar results have been reported by Taub and Sturr (1991).

2. Contrast Sensitivity

The capacity to visually detect and identify spatial form varies widely as a function of target size, contrast and spatial orientation. As a consequence, an assessment of visual acuity (i.e., the ability to resolve small, high-contrast targets) very often does not predict an individual's ability to detect objects of large size and/or diminished contrast. The contrast sensitivity function (CSF), however, yields information about an individual's ability to detect low-contrast targets over an extended
range of target size - complementing and extending our ability to assess functional visual capacity.

The CSF is determined by calculating the minimum amount of contrast needed to detect the presence of sine-wave grating targets. Sine-wave gratings possess useful research properties (e.g., contrast and luminance can be varied independently). Furthermore, researchers have discovered that early stages of visual processing are optimally sensitive to such targets. Contrast thresholds are typically collected using vertically oriented gratings which vary in spatial frequency from 0.5 cycles/degree (very wide) to 32 cycles/degree (very narrow). Because high levels of visual sensitivity are associated with low contrast thresholds, a reciprocal measure (1/\text{threshold}) termed the contrast sensitivity score is computed. These sensitivity scores are plotted across the range of spatial frequencies examined during the assessment procedure and constitute an individual's CSF.

Advancing adult age is associated with moderate contrast sensitivity losses at intermediate spatial frequencies with progressively greater losses emerging as target spatial frequency is increased. These age differences persist even when observers have been optimally refracted to the test viewing distance (e.g., Crassini, Brown and Bowman, 1988; Elliot, 1987; Elliot, Whitaker and MacVeigh, 1990; Scialfa, Tyrrell, Garvey, Deering, Leibowitz, and Goebel, 1988). Owsley, Sekuler, and Seimsen (1983) found that age-differences in contrast sensitivity were not eliminated when young subjects viewed the stimulus gratings under conditions of simulated ocular aging (viz., markedly reduced retinal illumination and induced refractive error). Similarly, neither the elimination of age differences in pupil size (Sloane, Owsley, and Alvarez, 1988) nor the replacement of cataracts with transparent interocular lens implants (Owsley, Gardner, Sekuler, and Lieberman, 1985) succeeded in eliminating the age-related loss of contrast sensitivity for intermediate- and high-spatial-frequency targets. These results suggest that the residual age difference in contrast sensitivity represented an age-related change in the neural, rather than optical, characteristics of the visual system. When laser interferometry is used to "bypass" the effects of age differences in the optics of the eye, substantial age differences in contrast sensitivity at intermediate and high spatial frequencies persist (e.g., Morrison and McGrath, 1985; Elliot, 1987 - but see Burton, Owsley and Sloane, 1993 for a dissenting opinion), Owsley and Sloane (1990) reanalyzed the monocular versus binocular contrast
sensitivity data of Ross, Clarke, and Bron (1985) and found that the binocular summation process appeared to be less efficient in older observers who demonstrated a mere 11 to 27% binocular increase in contrast sensitivity as compared with young observers who demonstrated a 41 to 129% binocular enhancement effect.

This pattern is consistent with a neural mechanism of age-related decline in contrast sensitivity. Other findings also strongly indicate that much of the age-related change in contrast sensitivity results from neural differences in visual processing (Elliot, Whitaker, and MacVeigh, 1990).

Pelli, Robson, and Witkins (1988) have developed an improved procedure for assessing contrast sensitivity at intermediate spatial frequencies. The Pelli-Robson Chart consists of 48 Sloan letters arranged in groups of 3 letters each. Instead of varying the size of the optotypes as in an acuity chart, letter size stays constant while letter contrast decreases. The first group of 3 letters has a contrast of 90%. The contrast of each succeeding letter-triplet is decreased by 0.15 log units until a terminal value of 0.5% contrast is reached. The procedure is fast, reliable, and provides important information about functional status not necessarily revealed by a traditional high-contrast acuity assessment. Owsley, Ball, Sloane, Roenker, and Bruni (1991) found that Pelli-Robson contrast sensitivity was significantly decreased in older observers ($r = -0.36$). In addition, reduced Pelli-Robson contrast sensitivity was found to be significantly associated with increases in automobile accident frequency among a sample of older adults. These findings have been replicated by two large-scale followup investigations, which will be discussed in a subsequent section of this report (see Ball, Owsley, Sloane, Roenker, and Bruni, 1993; Brown, Geaney, Mitchel, and Lee, 1993).

The additional information provided by the CSF - over and above the simple measure of visual acuity - would be expected to yield an improved ability to predict age differences in realworld visual performance. Numerous studies have provided evidence to support this expectation. Owsley and Sloane (1987) found that age-related problems with the detection and identification of human faces - which could not be accounted for by differences in acuity - were associated with contrast sensitivity losses at intermediate spatial frequencies. Similar findings with other classes of "real world" stimuli have been reported by other investigators (see Evans and Ginsburg, 1985; Kline, Ghali, Kline, and Brown (1990).
3. Dynamic Visual Acuity and Contrast Sensitivity

Dynamic visual acuity (OVA) is a measure of one's ability to resolve spatial detail in moving targets. DVA performance declines as target velocity increases; and, persons with identical static visual acuities may demonstrate markedly different dynamic acuities. The limits placed upon DVA apparently result from errors in stimulus capture by the pursuit eye movement system which result in a "smearing" of the retinal image. Since oculomotor accuracy appears to decline somewhat with advancing age one would expect to observe a concomitant age-related change in DVA (Morrison 1980). Burg (1967) examined static and dynamic acuity in 17,000+ California drivers between the ages of 16 and 92. The ability to resolve fine detail in a moving target was found to decline more dramatically with age than traditional static acuity measures. Burg's DVA measure was also found to be significantly related to traffic accident frequency in older drivers. (Thus, the fascination with DVA which pervaded the traffic engineering community during the 1970's.) However, the effect observed in the Burg (1967) study was very small - DVA accounting for only around 3% of the accident variance.

Age-related declines in DVA performance may involve mechanisms other than oculomotor pursuit. For example, Long and Crarnbert (1990) recently reported large age differences in DVA even when stimulus exposure times were too brief to engage pursuit eye movements (i.e., 200 msec). Once more, Long and Crarnbert found that the DVA performance of their young (ages 17 to 23) and old (60 to 75) groups did not differ when the presumed age-related reduction in retinal illuminance was experimentally eliminated. It should be noted, however, that their compensatory increment in retinal illuminance was also accompanied by a confounded increment in target contrast. Hence, interpretation of their results becomes less straightforward.

Scialfa, Gamey, Tyrrell and Leibowitz (1992) examined age differences in static vs. dynamic contrast sensitivity. Dynamic sensitivity was assessed by projecting small sine-wave gratings along a circular path on a viewing screen. Gratings ranged in spatial frequency from 1.5 to 18 cycles/degree and moved at a rate of 0.5, 10, or 15 degrees/sec. Older adults demonstrated the classic pattern of contrast sensitivity loss for the stationary patterns; viz., moderate decline at intermediate frequencies with progressively greater loss at the higher spatial frequencies. The sensitivity reducing effects of stimulus motion emerged at lower target velocities for the older
(mean age: 69) subjects relative to their young (mean age: 24) counterparts. These results were interpreted as representing an age-related deficit in the gain of pursuit eye-movement mechanisms and/or a reduction in the efficiency of spatiotemporal integration (Elliot, et al., 1990).

4. Peripheral Vision

Most research regarding human visual functioning deals with *foveal* vision; that is, sensitivity for fine spatial detail and color which *are* both mediated by the central region of the retina. However, mounting evidence reveals that some of the most profound age-related changes in visual functioning may involve peripheral, rather than central, visual processing. Because of its critical role in diagnosing ophthalmic disorders, *static visual perimetry* is one of the most widely studied area of aging and visual function (Garzia and Trick, 1992). This procedure measures one's ability to detect small spots of light superimposed upon a constantly illuminated background (i.e., increment threshold) at locations throughout the visual field. The result is a map which depicts the sensitivity of the peripheral as well as central retina. Jaffe, Avarado, and Juster (1986) found age-related decrements in sensitivity across the entire visual field. This loss appears to accrue gradually across middle-age, but then begins to accelerate beyond age 60 (Collin, Han and Khor, 1988).

These age-related changes *are* not due to optical factors, and, hence, appear to reflect age-related neural losses (see Owsley and Sloane, 1990). Finally, since age-related sensitivity losses in the visual field (e.g., due to stroke) below the horizontal midline appear to be more relevant to driving than field losses above the midline, Parisi, Bell, and Yassein (1991) recommend that horizontal field assessments for driver screening be performed at 10 degrees below the midline rather than directly upon the midline as currently practiced.

Spatial resolution has long been known to decline markedly as targets move away from central vision into the parafoveal and far peripheral retina. Acuity for letters will fall to half its maximal level before targets reach a retinal eccentricity of 1 degree (Ludvigh, 1941). As target eccentricity increases from 1 to 25 degrees, acuity continues to decline (but at a slower rate). Anstis (1974) has demonstrated that letter size must be incremented by a factor of 0.046 per degree across this range. Recent evidence suggests that the rate of loss in visual sensitivity
associated with retinal eccentricity becomes accelerated in older observers. For example, Collins, Brown, and Bowman (1989) examined peripheral visual acuity in young and old observers with 20/20 (or better) central acuity. A high-contrast acuity target with a critical detail of 2.4 minarc (larger than that needed to achieve 20/140 central acuity) was moved away from the central fixation point until observers could no longer reliably determine its orientation. Young observers could discriminate the critical detail up to 61.6 deg of eccentricity while older observers could do so only through 45.7 deg, representing a 23 percent age-related reduction in the "useful field of acuity." The magnitude of the observed age difference in peripheral acuity was reduced when a larger (i.e., 4.8 minarc) target was employed. Similar accelerated losses in visual sensitivity with retinal eccentricity in the aged have been noted for measurements of contrast sensitivity (Crassini, Brown, and Bowman, 1988). Again, the analyses performed by these investigators suggest that age-related peripheral losses stem from neural rather than optical aging mechanisms. However, opportunities for optical contributions to such effects remain. Although the relative magnitude of peripheral refractive error does not appear to increase as a function of age (Scialfa, Leibowitz, and Gish, 1989), there are several ways in which age differences in peripheral refractive error could be introduced into the results of an experiment. For example, most older participants in a study would be expected to wear eyeglasses. Unfortunately, these eyeglasses, which correct refractive error in the central area, tend to introduce astigmatic error in the periphery. Studies of age differences in peripheral vision could be confounded by such effects.

Age-related losses in extrafoveal visual perception have also been noted using complex visual search paradigms. Cerella (1985) demonstrated that age differences in letter recognition times increased with the retinal eccentricity of the target. Others have found that older adults suffer from a restricted "useful field of view" in visual search tasks (Sekuler and Ball, 1986). Such agerelated decrements in the ability to process parafoveal targets appear to depend heavily upon competition for "attentional resources" imposed by the concurrent presentation of "distractor" stimuli rather than upon limits imposed by the sensory/perceptual systems (Ball, Beard, Roenker, Miller, and Griggs, 1988; Scialfa, Kline and Lyman, 1987). The cognitive/attentional aspects of visual search are detailed elsewhere in this report.

5. Depth and Distance Perception
There are many classical studies that have purported to examine age differences in stereopsis (i.e., binocular depth perception based purely upon retinal disparity information). However, no clear consensus has emerged about the magnitude of the age difference (see Owsley and Sloane, 1990, for an excellent review). Most of the studies that have failed to demonstrate age differences in stereopsis have used relatively insensitive clinical screening tools or random-dot stereogram tests which load upon a variety of visual mechanisms beyond the level of stereopsis (see Greene and Madden, 1987; Yekta, Pickwell, and Jenkins, 1989). This pattern of results suggests that age differences in stereopsis, if they exist as a general rule, appear to be small in magnitude.

Very little work has been done to investigate the possible effects of aging upon higher order depth perception that is based upon cues other than stereopsis (e.g., ocular vergence effects, spatial and motion parallax, spatiotemporal texture gradients, etc). Recent evidence suggests that space/distance judgments may become "distorted" at luminance levels representative of nighttime driving due to "vergence insufficiency" (Bourdy, Cottin, and Monot, 1991). Such processes may be exacerbated in the elderly driver due to a breakdown in the accommodation-vergence feedback loop (expected to result due to the onset of presbyopia). Lack of information in this area is unfortunate, especially since recent experimental work suggests that older drivers may be more heavily dependent upon distance (as opposed to velocity) cues in their execution of critical driving maneuvers (see work by Staplin, Lococo, and Sim, 1993, which is discussed below).

6. Glare and Glare Recovery Time

Disability glare occurs when the introduction of a stray light source reduces one's ability to resolve spatial detail. Advancing adult age is known to be associated with significant increases in susceptibility to the deleterious effects of glare (see Schieber, Fozard, Gordon-Salant, and Weiffenbach, 1991). Pulling, et al. (1980) measured the tolerance for disability glare in a sample ranging from 5 to 91 years of age. They found that glare tolerance declined exponentially with advancing age - the rate of decline becoming markedly accelerated beyond age 40. Schieber, et al. (reported in Dewar, Kline, Schieber, and Swanson, 1994) found that the introduction of a glare source (designed to mimic the headlights of an approaching car at a distance of 100 ft)
yielded a small but significant reduction in the contrast sensitivity of healthy older adults (ages 65-80). No measurable reduction in contrast sensitivity was observed for their young or middle aged (ages 40-55) subjects. It should be noted, however, that similar glare levels can yield nearly a complete loss of contrast sensitivity (i.e., functional blindness) in older persons with advanced cataract, even if they maintain reasonably good level of visual acuity (Nadler, Miller, and Nadler, 1990).

Most models of disability glare attribute its effects to intraocular scatter of light (Schieber, et al., 1991; Schieber, 1992). Such off-axis scattering of light within the eye covers the retina with a "veiling luminance," which effectively reduces the contrast of the images formed upon it. For this reason, Schieber (1988) has proposed that low contrast optotypes are better suited for the quantification of disability glare effects than high contrast optotypes which have been traditionally employed in glare assessment procedures. Newly developed glare tests, such as the Berkeley Glare Tester, now incorporate such low contrast optotypes in their design (Bailey and Bullimore, 1991).

One aspect of disability glare which remains poorly understood is the time required to recover visual sensitivity following exposure to a transient glare source (e.g., oncoming headlights while driving at night). There is ample clinical evidence that the time needed to recover from glare increases with age. However, little systematic work has been done to substantiate this claim (see Olson and Sivak (1984) for an exception). Schieber (1994) carefully estimated glare recovery time in young (ages 18-24), middle-aged (ages 40-55) and older (ages 65-74) adults with good acuity and contrast sensitivity. The time needed to identify two large, low-contrast letters after the onset of a very bright peripheral glare source (78 lux) was measured. The mean glare recovery time for the old group (2142 msec) was significantly slower than that obtained for the middle-aged subjects (1189 msec); who, in turn, took significantly longer to recover from the effects of "veiling" glare than the young group (790 msec). Finally, there is evidence that older adults suffering from diseases that effect the retina (e.g., diabetes, hypertension, macular degeneration, etc.) require even greater durations to recover from the deleterious effects of brief glare exposures (see Collins (1989) for a review).

5.4 Sense of contrast
It is the ability of the eye to perceive slight changes in the luminance between regions which are not separated by definite borders. Loss of contrast sensitivity results in mild fogginess of the vision.

Contrast sensitivity is affected by various factors like age, refractive errors, glaucoma, amblyopia, diabetes, optic nerve diseases and lenticular changes.

Further, contrast sensitivity may be impaired even in the presence of normal visual acuity.

**Measurement of contrast sensitivity:** In clinical practice the contrast sensitivity can be measured by using any of the following charts with letters or stripes represented in various shades of gray:

- Arden gratings,
- Cambridge low-contrast gratings,
- Pelli-Robson contrast sensitivity chart which consists of low contrast letters with same size (Fig. 2.5),
- The Visitach chart, and
- Functional acuity contrast test (FACT).

Many older people who wear glasses with outdated prescriptions or no glasses at all would benefit from wearing new glasses with correct prescriptions [3, 27, 28]. This indicates that older people are not aware of their declining vision and/or do not perceive the benefits of regular vision assessments and updated glasses outweigh risks to safety and lifestyle. Reduced access to eye care may also comprise an important barrier for some frail older people.

Irrespective of the correction for distance vision, multifocal (bifocal, trifocal or progressive lens) glasses may pose a significant risk of falling for older people. These glasses have benefits for activities that require changes in focal length, including everyday tasks of driving, shopping and cooking.

However, multifocal glasses may predispose older people to falls because viewing the environment through their lower lenses impairs the important visual capabilities (contrast sensitivity and depth perception) for detecting environmental hazards, particularly in unfamiliar environments. When walking, people view the environment at distances approximating two steps ahead [29]. For multifocal wearers, the lower lenses of their glasses (with focal lengths of 0.6 m) blur their lower visual fields, impairing vision at the critical focal distances required for detecting and discriminating floor-level objects (~1.5–2 m).
We recently examined the effects of multifocal glasses on vision and falls in older people [30]. In this prospective cohort study of 156 participants aged 63–90 years, 56% were regular wearers of multifocal glasses. These participants performed significantly worse in distant depth perception and edge-contrast sensitivity tests in conditions which forced them to view test stimuli through the lower segments of their glasses (Figure 2). Multifocal glasses wearers had significantly greater odds of falling in the 1-year follow-up period than non-multifocal glasses wearers (OR = 2.27, 95% CI = 1.04–4.97), when adjusting for age and known physiological risk factors for falls. Multifocal glasses wearers were also more likely to fall when outside their homes (OR = 2.54, 95% CI = 1.19–5.77), and when walking up- or downstairs (P<0.001).

5.5 Visual interventions for preventing falls

As visual loss is often correctable in older people, simple intervention strategies such as regular eye examinations, use of correct prescription glasses, cataract surgery and the removal of tripping hazards in the home and public places have the potential to prevent falls in older people. Our finding that multifocal glasses is a risk factor for falls in communitydwelling older people indicates that the use of single-lens distance glasses instead of multifocal glasses in higher-risk situations such as negotiating stairs, walking outside the home and using public transport may also reduce the risk of falling.

Two randomised controlled trials have evaluated the efficacy of discrete visual interventions as a strategy of preventing falls. The first involved 1090 subjects aged 70 years and over and used a factorial design to assess the independent and combined effects of interventions aimed at vision improvement, home hazard reduction and group exercise. The visual improvement intervention comprised
Figure 2. Mean contrast sensitivity (panel a) and depth perception (panel b) test scores for subjects wearing their usual glasses if applicable. For the multifocal glasses wearers ($n = 87$), two scores are given: for the upper and lower glasses segment viewing conditions. The ‘non-wearers’ group comprised 67 subjects wearing single-lens distance glasses and two subjects wearing no glasses. These data show that the multifocal wearers had vision comparable to non-wearers when looking through their upper glasses segments, but significantly worse vision when looking through their lower glasses segments.

Error bars indicate 1 standard error. A referral to the participant’s usual eye-care provider if the participant had impaired vision (poor visual acuity, decreased stereopsis and/or reduced field of view) and he or she was not already receiving treatment for this problem.

The eye-care provider was also given the screening assessment results. Those randomised to the visual intervention had an estimated reduction of 4.4% in the annual rate of falls (rate ratio for time to first fall = 0.89, 95% CI = 0.75–1.04), but this did not reach statistical significance.
The second trial examined the effects of cataract surgery with lens implantation on falls, fractures and health status in 306 women aged ≥70 years. Subjects were randomized to either expedited (∼4 weeks) or routine (12-month wait) surgery. Vision, visual disability, physical activity levels, anxiety, depression, balance confidence and handicap improved significantly in the operated group at the 6-month retest and over the 12 months of follow-up, the rate of falling in the operated group was reduced by 34% compared with the controls (incidence rate ratio = 0.66, 95% CI = 0.45–0.96).

Although the number of cases were few—four subjects in the operated group (3%) and 12 (8%) in the control group—this trial also demonstrated that an intervention for preventing falls can be effective in reducing fractures ($P = 0.04$).

In a recent multifactorial randomised controlled trial intervention for preventing falls, we included an intervention aimed at maximising vision in 620 community-dwelling people aged ≥75. Participants randomised to the intervention with impaired visual acuity, contrast sensitivity and/or depth perception were referred to an eye-care specialist and were provided with new glasses as required. In addition, these participants were counselled to wear single-lens glasses (as opposed to multifocal glasses) when walking outside the home and underwent cataract surgery if indicated.

Visual assessments were performed at baseline and at the 6-month time-point of the study to determine whether the intervention resulted in vision improvements. We found that in the participants randomised to the visual intervention, high and low contrast, visual acuity and edge-contrast sensitivity were maintained or were better at the follow-up assessment. In comparison, participants not randomised to this intervention demonstrated poorer scores in the visual tests, which may reflect age-related declines and use of non-optimal glasses.

Table 1 summarises the baseline and retest scores for the visual test measures for the intervention and control groups.

5.6 summary

Vision makes an important contribution to balance, and impaired vision is a significant independent risk factor for falls and fractures in older people. Reduced ability to detect low contrast hazards, judge distances and perceive spatial relationships appears to be the major visual impairment associated with falls. Multifocal glasses may add to the risk of falls because in older
people near-vision lenses impair distance contrast sensitivity and depth perception in the lower visual field, reducing their ability to detect environmental hazards.

There is now evidence that maximising vision through cataract surgery is an effective strategy for preventing falls. Further randomised controlled trials are required to determine whether individual strategies (such as restriction of use of multifocal glasses) or multi-strategy visual improvement interventions can significantly reduce falls in older people.

Public health initiatives are required to raise awareness in older people and their carers of the importance of regular eye examinations and use of appropriate prescription glasses. Many older people may also benefit from wearing only single-lens glasses when walking. This would appear to be particularly important when walking up- or downstairs and in unfamiliar settings outside the home.

5.7 check your progress

1. Explain Vision And Balance

2. Explain Vision And Falls And Fractures

3. Explain Sense Of Contrast

4. Explain Visual Interventions For Preventing Falls

Check Your Progress

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5. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.5.1. Points for discussion
5.8 References


Block 2: Types of Visual Impairment and Common Eye Disorders

Unit 1: Loss of Visual acuity

Unit 2: Loss of Visual field

Unit 3: Colour vision defect and loss of contrast sensitivity

Unit 4: Refractive errors, Vitamin-A deficiency, Cataract, Glaucoma, Corneal ulcer, trachoma, Albinism, Retinal detachment, Retinitis pigmentosa, Retinopathy of prematurity, Cortical Visual Impairment, Optic Atrophy, Nystagmus, Amblyopia, and Macular degeneration

Unit 5: Educational implications of different Eye disorders
Unit 1: Loss of Visual acuity

1.1 Introduction
1.2 Anatomical And Structural Changes
1.3 Visual Functions
1.4 Functional Vision
1.5 Societal And Economic Consequences
1.6 Assessment Of Visual Acuity
1.7 Visual Acuity
1.8 Choice Of Visual Acuity Notation
1.9 Snellen Equivalents
1.10 Ranges Of Vision Loss

1.11 Measurement Considerations
1.12 Visual Acuity Measurement – Near Vision
1.13 Modified Snellen Formula
1.14 Visual Acuity Scores
1.15 Management Strategy For Reduced Visual Acuity

1.16 Summary

1.17 Check Your Progress
1.1 Introduction

Since the visual system alone provides as much input to the brain as all other senses combined, it is not surprising that vision loss can have a devastating impact upon peoples lives. The various chapters in this section deal with the prevalence and remediation of such impacts. In this discussion, different observers have different points of view and therefore emphasize different aspects of vision loss and its consequences. Clarity about these differences is important (1). They will be discussed, using as a conceptual framework the four aspects of functional loss that were first introduced in the *WHO Classification of Impairments, Disabilities and Handicaps (ICIDH)* (2). The aspects are distinct, although different publications may use slightly different terms to describe them as shown in Table 1.

Two of the four aspects refer to the organ system, the other two refer to the person. The first aspect is that of anatomical and structural changes. The second aspect is that of functional changes at the organ level; examples are visual acuity loss and visual field loss. The next aspect describes the generic skills and abilities of the individual. The last aspect points to the social and economic consequences of a loss of abilities. In colloquial use, persons with vision loss are often described as “blind”; this terminology is inappropriate since most people with vision loss are not *blind*, but have residual vision. We will return to this issue when discussing ranges of vision loss.
1.2 Anatomical and Structural Changes

This aspect describes the underlying disorders or diseases at the organ level. Ophthalmoscopy and slitlamp biomicroscopy have given ophthalmology tools to describe anatomical changes in more detail than is possible for many other organ systems. Most of the ophthalmic literature, including this textbook, is devoted to this aspect. Yet, these changes give us relatively poor cues to the severity of their functional consequences.

1.3 Visual functions

This aspect describes functional changes at the organ level. Here again, ophthalmology has developed unique tools that can measure visual functions, such as visual acuity and visual field, in great detail. These tools are well developed and give objective measurements. These measurements can be used for two purposes: to assist in diagnosing the underlying disorder or to predict the functional consequences (see Table 2). E.g.: Tests such as ERG and VEP are helpful in diagnosing the underlying condition, but are poor predictors of the functional consequences. Since visual acuity loss can have many different causes, visual acuity testing adds little to the differential diagnosis, but can help in predicting the impact on Activities of Daily Living (ADL). The Ishihara color test is good at diagnosing even minor red-green deficiencies for genetic studies, but overestimates the functional consequences. The D15 color test on the other hand, was designed to be insensitive to minor deficiencies and to detect only those that might have
functional consequences. The discussion in this chapter will be oriented towards the functional consequences.

1.4 Functional vision

This aspect reaches beyond the description of organ function by describing the skills and abilities of the individual. It describes how well the individual is able to perform Activities of Daily Living (ADL), given the vision loss. This aspect has been described under different names. In the field of vision, the term functional vision is used. In ICIDH-80 loss (or lack) of ability was described as dis-ability. Its successor, ICIDH-2 provides a taxonomy of activities and of the ability to perform them. The use of the term disability is discouraged since it may have different meanings in different contexts. (Having a disability may be a synonym for having an impairment; being disabled points to a loss of ability; being on disability points to an economic consequence.) In the AMA Guides to the Evaluation of Permanent Impairment the term impairment refers to organ function, impairment rating refers to an estimate of the ability to perform activities of daily living.

1.5 Societal and Economic Consequences

The last aspect describes the societal and economic consequences for the individual caused by an impairment or by a loss of ability. In ICIDH-80 this aspect was described as handicap and measured in terms of loss of independence; in ICIDH-2 it is described under the heading participation. Handicaps do not preclude participation. The story of Helen Keller is one example of how some people can achieve full participation in spite of extraordinary handicaps.
1.6 ASSESSMENT of VISUAL ACUITY

The visual function that is measured most often is visual acuity. Here again, different users may measure different aspects of visual acuity. Various basic aspects of visual acuity, such as detection, resolution, hyperacuity are discussed elsewhere. In this chapter we will discuss the clinical testing of visual acuity, which is based on letter recognition. Letter recognition is a rather complex function, it requires not only the optical ability to resolve the image, but also the cognitive ability to recognize it, and the motor ability to respond. In young children, in developmentally delayed individuals and in elderly with a stroke, it may be their inability to respond, rather than optical factors, that limits their test performance. Historical developments

Reading tests have been used since before the Middle Ages to test the function of the eye. Major changes started to occur in the middle of the 19th century.

1843. In 1843 Kuechler, a German ophthalmologist in Darmstadt, wrote a treatise advocating the need for standardized vision tests (6). He developed a set of three charts, to avoid memorization. Unfortunately, he was a decade too early. His work was almost completely forgotten.

1850. Around 1850 started what later would be called the Golden Age of Ophthalmology. In 1850, Franciscus Donders, from Utrecht, the Netherlands, visited William Bowman, of anatomical and histological fame, at an international conference in London. There he met Albrecht von Graefe, who would become the father of German clinical ophthalmology. Donders and von Graefe became lifelong friends (*). With Bowman and Hermann von Helmholtz, who invented the ophthalmoscope in 1851, they became the foursome that would lead ophthalmology to become the first organ-oriented specialty. In 1850 von Graefe had just opened his famous eye clinic in Berlin. In 1852 Donders would open what would later become the Royal Dutch Eye Hospital in Utrecht.

Footnote

(*) Donders later wrote: “I had just seen Jaeger (Friedrich, Eduard’s father, ed.) performing cataract surgery alternately with the left and the right hand, when a young man stormed into the room embracing his preceptor. It was Albrecht von Graefe.”
Jaeger thought that we would fit well together and we soon agreed. Those were memorable days. Von Graefe was my guide for all we heard in practical matters, and in scientific matters he listened eagerly to the smallest detail. We lived together for a month to separate as brothers. To have William Bowman and Albrecht von Graefe as friends became an incredible treasure on my life’s path.”

1854. Thus, the scene had changed considerably when, in 1854, Eduard von Jaeger, the son of a well-known ophthalmologist in Vienna, published a set of reading samples (7). His reading samples were first published as an appendix to his book about Cataract and Cataract Surgery (8). They became an immediate success as a means to document functional vision. Since Vienna was an international center, he published samples in German, French and English and in a variety of Central European languages. He used fonts that were available in the State Printing House in Vienna and labeled them with the numbers from the printing house catalogue.

1861. Meanwhile Donders, who was a professor of physiology before he decided to concentrate on ophthalmology, was working on his epoch making studies on Refraction and Accommodation. He clarified the nature of hyperopia as a refractive error, rather than as a form of “asthenopia” and brought the prescription of glasses from trial and error at the county fair to a scientific routine. His work would be published in London in 1864 (9). For this work, Donders not only needed reading samples for presbyopes, but also distance targets to use in the refractive process of myopes and hyperopes. Initially, he had used some of the larger type samples from Jaeger’s publication as a distance target. However, he felt the need for a more scientific method and for a measurement unit to measure visual function. He coined the term “visual acuity” to describe the “sharpness of vision” and defined it as the ratio between a subject’s performance and a standard performance. In 1861, he asked his co-worker and later successor Herman Snellen to devise a measurement tool.

1862. In 1862 Snellen published his letter chart (10). His most significant decision was not to use existing typefaces, but to design special targets, which he called optotypes. He experimented with various targets designed on a 5x5 grid (Figure 1). Eventually, he chose letters (Figure 2). Some others published charts based on Donders’ formula in the same year, using existing typefaces rather than optotypes. Snellen’s chart prevailed and spread quickly around the world.
One of the early big orders came from the British army, wanting to standardize the testing of recruits.

To implement Donders’ formula, Snellen defined “standard vision” as the ability to recognize one of his optotypes when it subtended 5’ of arc. This choice was inspired by the work of the English astronomer Robert Hooke, who, two centuries earlier (11), had found that the human eye can separate double stars when they are 1’ apart. Since Snellen chose an external, physical standard, others could accurately reproduce his charts. This was different from Jaeger’s samples, which were based on existing typefaces. When others wanted to reproduce them, they had to use whatever typefaces were available locally. This accounts for the wide variability among “Jaeger” samples.

Donders and Snellen were well aware that their standard represented less than perfect vision and that most normal healthy eyes could do better. Thus, it is wrong to refer to “20/20” (1.0) vision as “normal”, let alone as “perfect” vision. Indeed, the connection between normal vision and standard vision is no closer than the connection between the standard American foot and the average length of “normal” American feet. The significance of the 20/20 (1.0) standard...
can best be thought of as the “lower limit of normal” or as a screening cut-off. When used as a screening test, we are satisfied when subjects reach this level and feel no need for further investigation, even though the average visual acuity of healthy eyes is 20/16 (1.25) or 20/12 (1.6).

While Snellen was preparing his chart, Donders already commissioned a study by one of his PhD students to document the normal changes in visual acuity with age (12), using prototypes of Snellen’s symbols. The study was published in 1862, the same year that Snellen published his chart. The similarity with more recent data (Table 3) is remarkable.

Legend, Table 3: The chart demonstrates that it is a mistake to consider 20/20 as “average”, “normal” or “perfect” vision. The gray band indicates standard vision (20/20, 1.0). Average adult visual acuity is significantly better and does not drop to 20/20 until after age 60. The “▲” markers represent a study (12) using prototypes of Snellen’s test letters, published in 1862.
The “●” markers represent a recent meta-analysis of healthy eyes from several different studies (13).

The “■” markers represent recent findings from an elderly population (including eyes with age-related changes) (5). The “M” and the “F” markers represent data from male and female Australian Aborigines (14), which were found to have statistically significant better acuity than comparable Caucasians.

The 1862 findings are remarkably similar to the recent data for healthy adults in the younger age groups and to those for unselected seniors in the older groups.

Since Snellen’s days few major improvements in visual acuity measurement have been made. Many tried to devise better optotypes, but, as A. G. Bennet remarked in an exhaustive review of historical developments (15) while preparing for the British standard (16), “the road of visual acuity measurement is littered with stillborn charts”. Some developments, however, are worth mentioning.

1868. In 1866 John Green of St. Louis had spent some time with Donders and Snellen and had written a small paper there about the measurement of astigmatism. He developed his own chart, which he presented it to the American Ophthalmological Society in 1868(17), modifying a prior proposal from 1867.

Figure 3 Segment of Green’s Chart, proposed in 1868.
Legend: Note that Green combined sans-serif letters and proportional spacing with a geometric progression, using what later would be known as the “preferred numbers” series (see text). Green’s proposals were not accepted. A century later, his principles would be incorporated in international standards.

Green’s chart featured sans-serif letters (Snellen used letters with serifs), proportional spacing of the characters and a geometric progression of letter sizes (10 steps = 10x), three features that are now part of standardized letter chart design. He was a century too early; his proposals gained little acceptance. Green went back to letters with serifs, because letters without serifs were said to “look unfinished”. A century later, the British standard would choose sans-serif letters, because letters with serifs “look old fashioned”.

1875. Snellen originally calibrated his charts in Parisian feet. At the time there were some twenty different measurement systems used in Europe. It is not surprising that the uniform Metric system (18) was gaining ground. Snellen soon changed from 20 Parisian feet to 6 meters or, for adherents of the decimal system, to 5 meters. Today, the 20 ft distance prevails in the U.S.A., 6 meters prevails in Britain, 5 or 6 meters are used in continental Europe. Conversion between these different measurements is awkward. In 1875 Felix Monoyer (*) of Lyons, France, proposed to replace the fractional Snellen notation with its decimal equivalent. (E.g. 20/40 = 0.5, 6/12 = 0.5, 5/10 = 0.5) (19). Decimal notation makes it simple to compare visual acuity values, regardless of the original measurement distance and is used in large parts of Europe. (see Table 4)

Footnote

(*) Monoyer is also know for the introduction of the diopter (20) in 1872. The diopter is the reciprocal of any metric distance; it greatly simplified lens formulas. Earlier, the power of a lens was expressed by its focal distance (f). Changing to the reciprocal of the focal distance (D) simplified the awkward formula 1/f1 + 1/f2 = 1/f3 to D1 + D2 = D3. We will see later that the Diopter notation can also simplify Snellen’s formula when used for near vision.
1.7 Visual Acuity

Measurement of visual acuity is one component of the evaluation that allows the optometrist to quantify the degree of high-contrast vision loss and, in many cases, clearly identifies the patient's visual impairment as it relates to the chief complaint. Measuring visual acuity also allows the clinician to:

- Monitor stability or progression of disease and changes in visual abilities as rehabilitation progresses
- Assess eccentric viewing postures and skills
- Assess scanning ability (for patients with restricted fields)
- Assess patient motivation
- Teach basic concepts and skills (i.e., to eccentrically view) relevant to the rehabilitation process.

In many cases, the process will afford the patient an opportunity to experience success. Furthermore, the results of visual acuity testing are the basis for determining initial magnification requirements and the potential for specific rehabilitation strategies. The methods of assessing distance and near visual acuity in visually impaired patients may be modified to address specific concerns. Best suited to evaluation of the visually impaired patient are charts that have high contrast, are moveable, and have a number of characters or options in the 100- to 800-foot size range for better quantification of visual acuity. Nonstandard testing distances of 10 feet, 2 meters, or closer can be used, and the patient is encouraged to modify posture (e.g., turn the head or eye) to achieve the best eccentric viewing position. Any such movement should be noted and recorded. Chart and ambient illumination may be varied to determine the optimum lighting situation, effects of glare, or the potential need for filters to reduce photophobia.

When visual acuity cannot be measured with standard or specialized charts, an attempt to quantify vision can be made by calculating an environmental acuity based on target size and the distance at which it is detected. Results can be recorded as detection of hand motion, light projection, light perception, or no light perception (i.e., an unequivocal measurement). "Counts
fingers” should not be the endpoint for determining visual acuity in the low vision patient; if a patient can accurately count fingers, then large characters can be read at close range.63

Nonstandard techniques or those designed for use with infants, such as preferential looking with grating acuities or visually evoked potential (VEP) can sometimes be used with young children or multiply handicapped or elderly individuals who cannot respond to other methods. The use of edible targets such as candies, environmental.

1.8 Choice of visual acuity notation

The result of the visual acuity measurement may be recorded in a variety of ways. True Snellen fractions The notation promoted by Snellen was that of a true Snellen fraction, in which the numerator indicates the actual test distance and the denominator indicates the actual size of the letter seen. The advantage of this notation is that it indicates the actual test conditions. The disadvantage is that it becomes awkward to compare visual acuity values, measured under different conditions. This is especially true for projector charts where the projector magnification is often adjusted to accommodate fractional viewing distances.

1.9 Snellen equivalents

To overcome this difficulty, Snellen equivalents are used. In Europe, the decimal equivalent of the Snellen value is used most often. This notation is clear, because there is no numerator or denominator. The notation becomes confusing when the decimal notation is converted back to a pseudo-Snellen fraction. E.g. 5/25 □ 0.2 □ 2/10; the 2/10 fraction would suggest that the subject saw a 10 M letter at 2 meter, instead of a 25 M letter at 5 meter.

In the U.S. notation, a 20 ft. fraction is usually used as a Snellen equivalent. E.g. in an examination lane of 18 ft. or 21 ft., the true Snellen fractions would be 18/18 or 21/21. Instead the visual acuity is recorded as 20/20 in both cases. Thus, seeing “20” as the numerator of a visual acuity fraction rarely implies that the actual measurement was made at 20 ft. In Britain, the 6/6 notation is similarly used as a Snellen equivalent.
Visual angle notation was used by Louise Sloan. It refers to the visual angle of the stroke width of 5x5 letters. Thus, 1’ equals 20/20 (1.0), 2’ equals 20/40 (0.5), etc. The visual angle is the reciprocal of the visual acuity value and equals the denominator of the 1-meter Snellen fraction. Others have used the term MAR. In the context of physiological optics this term is usually interpreted as Minimal Angle of Resolution and best describes grating acuity; in the context of psychophysics and clinical testing it might be better interpreted as Minimum Angle of Recognition, while in the context of vision rehabilitation it might be interpreted as MAgnification Requirement. Since higher MAR values indicate poorer vision, MAR should be considered a measure of vision loss, not a measure of visual acuity.

LogMAR notation was introduced by Bailey (31). As the name implies it is the logarithm of the MAR value, thus converting a geometric sequence of letter sizes to a linear scale. Like MAR, logMAR is a notation of vision loss since positive logMAR values indicate reduced vision, while normal vision (better than 20/20, 1.0) is indicated by negative logMAR numbers. Standard vision (20/20, 1.0) equals 0 (i.e. no loss). On a standard chart each line is equivalent to 0.1 logMAR; thus +1.0 logMAR means 10 lines lost or 20/200 (0.1), +2.0 logMAR means 20 lines lost or 20/2000 (0.01).

Since Bailey used the logMAR notation with a geometric progression of letter sizes, the term “logMAR chart” is often used to imply a geometric progression. This is not necessarily so, a logarithmic scale could be applied to any progression. The decimal values and reverse scale do not make the logMAR notation particularly user-friendly. For everyday clinical practice Snellen equivalents are easier, since they relate directly to the measured quantities of letter size and viewing distance.

The logMAR notation has gained widespread use in psychophysical studies, for statistical calculations and for graphical presentation of the results of multi-center clinical studies. It provides a more scientific equivalent for the traditional clinical statement of “lines lost” or “lines gained”, which is valid only when all steps between lines are equal.
Visual Acuity Rating (VAR, Bailey) (42) and Visual Acuity Score (VAS, Colenbrander) (43) are two names given to a more user-friendly equivalent of the logMAR scale. On the VAR or VAS 20/20 (1.0) is rated as “100”, 20/200 (0.1) is rated as “50” and 20/2000 (0.01) is rated as “0”. On an ETDRS type chart, each line thus represents a 5-point increment. The score can therefore be interpreted as a count of the total number of letters read, starting from 20/2000 (0.01). See Table 8 to relate the VAS or VAR, MAR and logMAR notations to various visual acuity levels. The VAR relates only to visual acuity, the VAS is part of a broader scoring system (see Functional Vision).

The VAS, VAR and logMAR notations convert the geometric sequence of visual acuity values to a linear scale. This is important if visual acuity values are to be averaged or subjected to other statistical calculations. The difference between averaging on a geometric scale vs. a linear scale is best demonstrated with an example. What is the average of 20/20 and 20/200? Averaging the denominators yields 20/110, a value too close to 20/200 (see Table 8). Averaging the decimal equivalents (1.0 and 0.1) yields 0.55, a value too close to 1.0. On the VAS scale, the average of “100” and “50” is “75”, which can be converted back to 20/63 or 0.32 (rounded to 20/60 or 0.3), exactly halfway.

Visual Acuity Measurement – Distance vision

1.10 Ranges of vision loss

Vision loss is not an all or none phenomenon. Since the 1970’s the WHO has recognized this by replacing the simplistic dichotomy between those who are considered “legally blind” and those who are considered “legally sighted” with a set of ranges. In ICD-9 (28) and ICD-9-CM (30) the range of “Low Vision” took its place between the ranges of normal (or near-normal) vision and blindness (or near-blindness). The word low indicates that these individuals do not have normal vision, the word vision indicates that they are not blind. The ranges used in ICD-9-CM are listed in Table 6.
Although these changes were made a quarter century ago, the use of the term “blindness” to denote partial vision loss is still prevalent. This is regrettable, since it fosters misconceptions among patients and practitioners. Patients tend to accept the statement that they are “legally blind” as an irreversible verdict of hopelessness. Telling them that they have “Severe Low Vision” (the corresponding ICD-9-CM term) tells them that they have a problem, but that there are ways to cope with this problem. To call a patient with a severe vision loss “legally blind” is as preposterous as calling a patient with a severe heart ailment “legally dead”.

1.11 Measurement considerations

Letter recognition, upon which clinical visual acuity measurement is based, is a rather complex function, which involves not only optical factors, but also cognitive and motor abilities. When choosing our test parameters we strive to keep the cognitive and motor requirements minimal, so that we measure mainly optical factors. Within the group of optical factors, we strive to keep factors such as contrast and illumination optimized, so that the main remaining variable is magnification.

Visual acuity can be thought of as the reciprocal of the magnification threshold for letter recognition. Magnification is the factor on which Snellen’s formula is based. If a subject needs letters that are twice as large or twice as close than those needed by a standard eye, the visual acuity is said to be 1/2 (20/40, 0.5), if the magnification need is 5x, the visual acuity is 1/5 (20/100, 0.2), etc.

It is not always possible to avoid the cognitive factors. This is the case for infants (see Table 11) and for pre-school children who do not yet know the entire alphabet. Here we often use other methods such as grating detection or picture recognition. It is important to realize that these are different tasks, which may have different magnification requirements. Similar considerations exist for developmentally delayed individuals. Sometimes it appears that the motor concept of directionality that is required to respond to tumbling E’s is a limiting factor. Testing with different modalities may help to give an insight into these non-optical factors. In elderly patients with a stroke and macular degeneration, the question may arise whether inability to read is the result of the macular degeneration or of the stroke. Failure to respond to larger print
may point to cognitive, rather than optical factors. In the following discussions it will be assumed that cognitive and motor factors are indeed trivial. Even so, many choices remain to be made. We will discuss the choice of test distance, the choice of letter size progression, the choice of criterion, the choice of contrast and illumination, the choice of visual acuity notation, and the choice of test symbols.

### 1.12 Visual Acuity Measurement – Near vision

Although the testing of reading vision predated the development of letter charts to measure distance vision, the methodology to accurately measure reading acuity has lagged behind. This is in part due to the fact that the prescription of a reading correction for normally sighted individuals is aimed more at achieving reading comfort than at accurate measurement. It is also due to the lack of accurate measuring tools. Reading distances are more often estimated than measured, while the “Jaeger numbers”, which are widely used in the U.S., have no numerical meaning. Under these circumstances, it is not surprising that many practitioners

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<table>
<thead>
<tr>
<th>TABLE 6 – Ranges of Visual Acuity Loss</th>
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<tbody>
<tr>
<td><strong>RANGES of Vision Loss (ICD-9-CM)</strong></td>
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<td><strong>D</strong></td>
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<tr>
<td><strong>Near-</strong></td>
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<tr>
<td><strong>Normal</strong></td>
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<tr>
<td><strong>Vision</strong></td>
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<tr>
<td><strong>0.8</strong></td>
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<tr>
<td><strong>Near-</strong></td>
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<tr>
<td><strong>Normal</strong></td>
</tr>
<tr>
<td><strong>Vision</strong></td>
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<tr>
<td><strong>0.32</strong></td>
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<tr>
<td><strong>Moderate Low Vision</strong></td>
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<tr>
<td><strong>Low Vision</strong></td>
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<tr>
<td><strong>0.16</strong></td>
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<tr>
<td><strong>0.125</strong></td>
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<tr>
<td><strong>Severe Low Vision</strong></td>
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<tr>
<td><strong>Low Vision</strong></td>
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<tr>
<td><strong>0.06</strong></td>
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<tr>
<td><strong>0.05</strong></td>
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<tr>
<td><strong>Profound Low Vision</strong></td>
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<tr>
<td><strong>Low Vision</strong></td>
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<tr>
<td><strong>0.025</strong></td>
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<td><strong>0.02</strong></td>
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</table>
believe that reading acuity and distance acuity have little in common. We will show that this is not so.

As is the case for distance vision, accurate determination of near vision acuity requires measurement of two variables: letter size and viewing distance. For distance vision the viewing distances are standardized, so that only the letter sizes vary. For individuals in the normal visual acuity range reading distances may be standardized, but the standards vary. Some use 40 cm (16”, 2.5 D reading add), or 14” (35 cm, 2.75 D add), others use 33 cm (13”, 3 D add) or even 30 cm (12”, 3.25 add) or 25 cm (10”, 4 D add, the reference point for the power of magnifiers). Individuals in the Low Vision range often need distances that are even shorter and certainly cannot be handled with a “one size fits all” distance. They need a formula in which both the letter size and the viewing distance can be varied easily.

1.13 Modified Snellen Formula

The standard Snellen formula \( V = \frac{\text{viewing distance}}{\text{letter size}} \) becomes awkward to use when the numerator (viewing distance in meters) is itself a fraction within a fraction. This can be overcome by using the reciprocal value of the viewing distance. The reciprocal of a metric distance is known as the diopter (2 diopters = 1/2 m, 5D = 1/5 m, etc.) (20).m M 1

The traditional formula: \( V = \frac{\text{viewing distance}}{\text{letter size}} \) thus becomes: \( \frac{1}{V} = \frac{\text{M}}{\text{D}} = \frac{\text{M}}{\text{D}} \)

M m m or: \( \frac{1}{V} = \text{M} \times \text{D} = \text{letter size (in M-units)} \times \text{viewing distance (in diopters)} \)

Use of this modified Snellen formula has several advantages.

- Use of reciprocal values turns the usual Snellen fraction into a multiplication, while the viewing distance changes from a fraction into a whole number. Both changes make the formula far easier to calculate in one’s head.

- The value \( 1/V \) relates directly to the letter chart acuity measured at 1 meter; the numerator indicates the amount of magnification needed to bring the subject to standard performance.
- Expressing the reading distance in diopters relates directly to the amount of accommodation and/or the reading add that must be used for this distance.
The results of these calculations are listed in Table 9. This table is based on the use of preferred numbers, so that the same values appear for the viewing distances, the letter sizes and the resulting visual acuity values.

Many reading cards are calibrated for a specific reading distance, i.e. for a specific column in Table 9. This has led to the habit of using visual acuity values to refer to letter sizes. For instance, a letter size that would represent 20/100 at 40 cm might be referred to as a “20/100 letter”. The table shows that the same letter at 25 cm would represent an entirely different acuity value. A “20/100 letter” on a 20 ft. chart is very different again.

Legend:
Columns indicate reading distances. Rows indicate letter sizes. The resulting reading acuity values are found at the intersections. The large number in each box represents the MxD value (magnification requirement). The small number represents the visual acuity value. Note that the visual acuity values are arranged in diagonal bands. The same visual acuity value can be
represented by many different combinations of viewing distance and letter size. For each diagonal band the outer edge of the table indicates the ranges of vision loss in ICD-9-CM. The J-designations in the first column refer to values found on current charts. Note that these are different from Jaeger’s original sizes, which are shown in Table 5.

As visual acuity drops (MxD increases), subjects can compensate in two ways. They may move to a different column, i.e. bringing the same print size closer by increasing the reading add (or the amount of accommodation in younger people). They can also move to a different row, i.e. enlarging the print size, while maintaining the reading distance. Large print books enlarge the physical print size; various magnification devices enlarge the virtual print size.

Under most circumstances letter chart acuity and reading acuity – if measured appropriately and with the proper refractive correction – will be similar. However, when measuring letter chart acuity, subjects are often pushed for threshold or marginal performance, whereas reading tests more often aim at a level of comfortable performance. For this reason, the magnification requirement for reading acuity may be somewhat greater than that for letter acuity. The difference, known as the “magnification reserve” (47), is needed for reading fluency.

While 20/20 (1.0) acuity implies the ability to read 1 M print at 1 m, comfortable reading of newsprint (1 M) is generally done at 40 cm, indicating a 2.5x magnification reserve (4 lineintervals).

Traditionally, the power of magnifiers is referenced to the ability to read at 25 cm (10”). 1 M at 25 cm denotes 20/80 (0.25). Note that this is the top value in the Low Vision band.

To verify the relationship between reading acuity and letter chart acuity, the two values were compared for 150 consecutive patients from the author’s Low Vision service. The results are shown in Table 10. It shows that there is a close relationship between letter chart acuity and reading acuity and that this relationship holds up at all visual acuity levels. Usually, the two are within one line from each other (diagonal gray band); for some patients the magnification need for reading is larger than the magnification need for letter recognition (spread to the right of the diagonal). This difference is the magnification reserve, defined above. Since the objective of visual acuity measurement in the Low Vision range is to help patients function with their own fixation ability, the author does not push patients for maximum letter chart acuity by pointing to
letters or by isolating letters (*see the earlier discussion under choice of criterion*). Had he used these techniques to improve the letter chart acuity, the magnification reserve for reading fluency would probably have appeared somewhat greater.

### 1.14 Visual Acuity Scores

The internationally accepted standard for visual acuity charts requires a chart with proportionally spaced lines in a geometric progression (10 steps = 10x) and 5 letters on each line. This layout was introduced by Bailey and Lovie and popularized through its use in the Clinical Trials of the National Eye Institute. These charts are often referred to as ETDRS charts (Early Treatment Diabetic Retinopathy Study).

When using such a chart, it is simple to score the visual acuity level as the total number of letters read. This scoring method assigns five points to each line. If counting is started at the 0.01 (20/2000) level, the score for standard visual acuity (1.0, 20/20) will be 100. The score can be continued beyond that level to account for better than standard performance. In this GUIDE this scale is referred to as the Visual Acuity Score (VAS) for each eye. This score was included in Tables 2 and 3 and is repeated in Table 6.

The performance of individuals in each visual acuity range may vary, based on training and practice. Indeed, no rehabilitation would be possible if the connection between impairment and ability were unalterably fixed. Nevertheless, some general statements can be made about reading performance expected in each visual acuity range. The right side of Table 6 demonstrates that these expectations fit well with the General Ability Scale, outlined earlier. The Visual Acuity Score, therefore is a reasonable estimate of acuity related visual abilities.

### 1.15 Management Strategy for Reduced Visual Acuity

Appropriate magnification systems should be determined for the patient with reduced best corrected visual acuity. Based on identified needs, this determination will be made for near or distance visual acuity improvement, or both. The required level of magnification is typically task specific, i.e., may vary for different activities. Magnification for Near. There are several
methods of calculating a starting lens power or addition (add) power for near magnification. Each method is based on either a distance and/or near visual acuity measurement. Once the starting power has been determined, the appropriate lens power can be put into a trial frame for evaluation of the patient's ability to read single letters and continuous text. Often more magnification is needed for fluent reading of continuous text materials. The initial lens power may be modified according to the results of Amsler grid or contrast sensitivity testing. Modification of the power or form of the lens (single lens or doublet) should continue until the clinician is satisfied that the most appropriate lens power has been found. Equivalent-powered lens systems (e.g., telemicroscopes, hand-held or stand magnifiers, and electronic devices) should then be explored.

Determining the most appropriate magnification system for near may take several visits or even months, because the patient is not only learning the use of a sophisticated lens system that requires a specific working distance and posture, but (often at the same time) learning the most efficient use of remaining vision. Frequently, as part of this process, training is also implemented to improve eccentric viewing skills. In essence, the patient is learning to fixate with peripheral vision. Loaner or training lens systems can be useful until a final lens prescription is determined.

• Spectacle-mounted Reading Lenses. These lenses, also called "microscopes," afford hands-free magnification, provide a wider field of view than other equivalent-powered systems, and are more "normal" looking than other reading devices. They are available in a wide range of powers, up to an equivalent power (Fe) of +80.00 D. Although binocularity is possible for some patients with a near addition power of +10.00 D, convergence demand, when working distances are less than 16 cm, is significant and may preclude binocularity, even with prismatic spectacles. The greatest challenge faced by patients using microscopes is adaptation to the close working distance required.

Working distance (expressed in meters) is determined by taking the reciprocal of the equivalent addition power; the working distance of a +20.00 D lens is .05 meters or 5 cm (2 inches).
With such close working distances, proper use of illumination is critical for optimum functioning. A reading stand may help maintain the proper focal distance and reduce postural fatigue.

Once the patient is accustomed to the working distance, however, the reading speed with this type of lens will often be faster than with other lens systems of equivalent power.127

• Telemicroscopes. Also known as reading telescopes or surgical systems, these telescop
eic systems are either designed for near or modified with reading caps or close-focus capability to be used at near. They allow magnification at a greater working distance than equivalent-powered microscopes.128 The increased working distance is achieved at the expense of field of view, which can result in reduced reading speed.129 Nevertheless, telemicroscopes may be considered for those patients who are unable (due to specific working distance demands) or unwilling to adjust to the closer working distance of microscopes but still require hands-free magnification. The working distance of a telemicroscope system is determined by the power of the reading cap, or, for focusable systems, the setting of the focusing mechanism, which also affects the equivalent power of the system.130,131

• Hand magnifiers. These devices afford magnification at variable working distances, and are especially useful for viewing targets at arm's length or for short-term spotting activities. A shorter lens-to-eye distance will allow a greater field of view. Users require practice to maintain the proper lens-to-object distance. The clinician's decision to use a patient's bifocal addition in conjunction with the magnifier is based on the magnifier-to-eye distance. Assuming the object is held at the focal distance of the lens, when the magnifier lens to eye distance is greater than the focal length of the magnifier, the patient should view through the distance part of the spectacles.

When the magnifier lens to eye distance is less than the focal length of the magnifier, the bifocal can be used for maximum magnification.132 In the first situation, using the bifocal would actually reduce the overall equivalent power to less than the magnifier itself; in the second, the
equivalent power is greater with the bifocal than without it. When the lens-to-object distance is less than the focal distance of the lens, divergent light rays leave the system, and an addition should be used, accommodation should be supplied by the patient, or a combination of both is needed.

- Stand Magnifiers. These magnifiers allow for a greater working distance with a smaller field of view than equivalent powered spectacles. Most stand magnifiers require some degree of accommodation the use of a near addition to compensate for divergent light leaving the system, or uncorrected myopia of appropriate power. Nevertheless, many patients appreciate a stand magnifier for reading needs because the lens-to-object distance is predetermined and fixed. In addition, illuminated stand magnifiers are helpful when lighting cannot be controlled. Manufacturers’ information regarding the optical parameters of stand magnifiers is not always accurate.

The clinician should verify the equivalent power and the image location of commonly used stand magnifiers in order to prescribe appropriately.

- Electronic Devices. Closed-circuit television systems (CCTVs, also known as video magnifiers), adaptive computer hardware and software, and head-mounted devices (HMDs) not only magnify the image, but can enhance contrast and allow binocular viewing. In many cases, these devices permit the user to manipulate both the magnification and contrast, including reverse contrast (i.e., displaying printed materials as white letters on a black background), to the preferred level. The working distance and usable field of view can also be varied. When extended reading or writing is a goal, a CCTV should be considered because it may enable the use of a more comfortable reading/writing posture, longer reading/writing duration, and faster reading speed than optical devices. Newer, more compact designs have been developed to address the main drawback of these devices, i.e., lack of portability. The clinician can determine the final lens or device prescription for near viewing on the basis of a number of factors, including, but not limited to:
• Ease of use (e.g., working distance, working space, reading speed, reading duration)
• Requirement for hands-free magnification
• Contrast considerations
• Lighting requirements
• Weight
• Cosmesis
• Cost

1.16 Summary

When recording visual acuity for patients in the range of normal vision, the preferred measurement tool will often be a projector chart at 5 m or 6 m or 20 ft. in a darkened room. The preferred notation will be a Snellen equivalent. In continental Europe this will most often be decimal notation, in Britain it will be the 6/6 equivalent, in the U.S. it will mean use of a 20/20 equivalent.

When recording visual acuity for patients in the Low Vision range, the preferred tool will be a lighted chart in a lighted room at a distance of 1 meter. The preferred notation will be a true Snellen fraction with 1 as the numerator. It is often useful to add the commonly used Snellen equivalent in parentheses. Thus, the ability to recognize an 8 M letter at 1 meter would be recorded as 1/8 (20/160) or 1/8 (0.125). If the same patient were tested on an ETDRS chart at 4 m the notation could be 4/32 (1/8, 20/160).

1.17 Check Your Progress

1. Write note on:
   A. visual functions
   B. 4functional vision
   C. choice of visual acuity notation

2. Explain societal and economic consequences
3. Write note on assessment of visual acuity

4. What is visual acuity?

Check Your Progress
6. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.6.1. Points for discussion
Points for clarification
1.18 Reference


Unit 2: Loss of Visual Field

2.1 Introduction

2.2 Reading And Pre-Reading Activities

2.3 Writing And Drawing

2.4 Placement In The Classroom

2.5 Mobility

2.6 Orientation And Mobility Instruction

2.7 Prisms

2.8 Management Strategy For Central Visual Field Defects

2.9 Visual Field Score

2.10 Visual Field Assessment

2.11 Summary

2.12 Check your progress
2.1 Introduction

It is crucial to have the involvement of qualified vision educators (TVI, O&M) in order to create an effective and individualized instructional plan.

Visual field losses include loss of the right or left half-field (called “hemianopia”) and loss of the lower field. These are caused by damage to different parts of the posterior visual pathway in the brain. Partial field losses may occur in which one quarter (or quadrant) of the field is affected. Field loss can be absolute (no objects seen) or relative (small, dim object not seen). Ideally, visual field loss is tested with a formal device or method that measures the extent or the sensitivity of the person’s peripheral vision. Children may need to be tested informally by observing their eye movements toward small objects in different parts of their visual field.

2.2 READING and PRE-READING ACTIVITIES

A complete right or left field loss (called “hemianopia”) may affect the scanning eye movements used in reading and thus make reading difficult and inefficient.

We recommend teaching the child with a field loss to systematically scan visual materials during any visual and visual motor tasks. Scanning a page of images should be taught from the left to right and top to bottom. This is intended to “set” a motor habit for reading in English.

Nevertheless, reading will be more difficult for a person with a right field hemianopia than for a person with a left field hemianopia. This is because we make small, saccadic eye movements to the right as we read across a line of text, which helps us decode sentences. In a complete right field loss, there is no image of a word or letter to the right of fixation and thus no immediate cues to the decoding process. People with right field loss often read with repeated series of right and left saccades in order to decode the text.

Following along the sequence of images or words with the finger moving under the images may be helpful. Engaging a motor component may be more useful and effective than relying on the child’s gaze to shift attention from left to right.
A ruler can be placed under the line to help guide the eye.

A window that masks lines above and below the line being read can be slid along the line while reading. For children with right or left field loss, columns of text may be easier to read than whole pages of uncolumned text.

In a left field hemianopia, the problem in reading involves returning from the right end of a line to the left and down to the next line. This can be difficult especially for the beginning reader. Using the finger to follow back along the line that was read, and down to the next line may be helpful.

To guide the eyes to the left and down, a ruler placed along the left edge of the text or an L-shaped guide shifted down to the next line can be used. Color coding of left and right margins may be helpful.

Inferior field losses (see specific handout on Inferior Field Loss in Young Children) affect scanning downward more than scanning to the right and left, so that the shift to the next line down in reading probably poses the most difficulty. Recommendations for left field loss above may be helpful for the child with inferior field loss.

Present visual materials on a slanted surface for viewing. A computer screen is ideal as the surface is vertical.

The position of the child’s face relative to the slanted surface or screen is important. The surface should be biased toward the child’s seeing field, upward in the case of an inferior field loss, leftward in the case of right field loss, and rightward in the case of a left field loss.

Wide arrays and lines of text should be easier to read than columns of text for the child with lower field loss.
For the young child with any type of field loss, it is important to ensure that the child is aware of the whole array of objects and both pages in a book. This can be helped by encouraging the child to feel the whole object, left, top, right and bottom, and by pointing to both pages, starting from the left one, of course!

2.3 WRITING AND DRAWING

Children with major field defects may neglect to write or draw on the part of the paper that falls into their non-seeing field. Some children will tilt the paper of the head so that more of the paper falls into the seeing field.

A slanted surface for writing may be helpful, especially for children with inferior field losses. Lined paper will assist writing for the child with a visual field loss. A bold dark felt tip pen may provide better writing and drawing than a pencil. The child should be helped to become aware of the entire piece of paper on which she/he is writing or drawing.

Placement of the keyboard for computer use should be designed so that neither the keyboard nor the computer screen is far in the non-seeing field. Placement should be consistent so that the child can anticipate where to look and place the fingers for keying.

Children with field losses often develop head turns or tilts to aid in scanning into the non-seeing field. Consistent head turns/tilts can indicate the child’s self-created adaptation to their field loss. The child may tilt a page they are reading or writing on to see the whole surface better. These adjustments should be understood as a helpful and functional adaptation by the child.

2.4 PLACEMENT IN THE CLASSROOM

Seating in the classroom should be where the child’s seeing field is maximized for visual materials presented to the class as a whole, and to view the teacher during instruction. So, when facing the front of the classroom and the teacher, the child with a right field loss should be seated
to the RIGHT facing the front, with the teacher on the child’s LEFT. And the child with a left field loss should be seated to the LEFT facing front with the teacher on the child’s RIGHT.

In a semicircular group, placement of the child with a visual field loss should be guided by the activities and where the child’s attention should be directed. If the goal is to attend to the teacher, then the teacher should be well in the child’s seeing field. If the goal is to interact with the other children, then the child with a field defect should be positioned so that as many of the other children as possible are in the seeing field.

2.5 MOBILITY

Safety during mobility is a very important consideration for children with visual field losses. Absolute (no objects seen in field of loss) and complete field losses (whole hemifield or entire lower field loss) are particularly detrimental to safe mobility. Children with field loss may have difficulty localizing objects and people at distance, even if their distance visual acuity is normal.

As in reading and other near tasks, a systematic approach to scanning objects at various distances must be designed and implemented across activities and environments.

The child’s classroom, hallways, stairways, and playground should be evaluated for potential hazards.

Modifications of the environment should be made to ensure safe movement.

Marking of crucial features such as stairs and railings, for better visibility may be needed.

Maintaining consistent placement of furniture and objects will help the child with a field loss learn the environment and make mobility easier (this is true for the home as well as school).

Introducing the child to distant safety features in the school such as Exit signs is very important.
2.6 ORIENTATION AND MOBILITY INSTRUCTION

It is strongly recommended that the child with a right/left hemianopia or a lower field loss receive a comprehensive evaluation by a certified orientation and mobility (O&M) specialist. A comprehensive orientation and mobility (O&M) assessment should include, but not be limited to, orientation skills (methods), body and spatial concepts, safety while traveling especially in consideration of walking speed, visual scanning skills, and the ability to judge distance and depth. This should be conducted in familiar, unfamiliar, and visually dynamic environments.

2.7 PRISMS

Prisms placed on glasses may be used to shift the seeing field by a certain amount (15-20 degrees) so that the non-seeing field is moved optically toward the seeing field. This potentially could improve the mobility and other functions of older children who are well motivated and can understand the purpose of the prism glasses. However, the glasses must be fit by a Low Vision Specialist (usually an optometrist) with experience fitting and training children to use prism glasses for this purpose. There are perceptual difficulties that must be overcome in using prism glasses. Training and commitment are essential for successful, continued use and must involve the educational team members.

2.8 Management Strategy for Central Visual Field Defects

A central visual field defect can significantly affect visual functioning, such as reading ability. Size, location, and density of the scotoma (relative, absolute, or both) will determine its effect on visual functioning and can influence the response to near magnification. In many cases, even with appropriate magnification, certain parameters of print reading ability (e.g., print size, reading speed, comprehension, and duration) may be compromised due to the central field disturbance and nature of the task, even though ability to navigate through the environment is relatively unaffected. In the eye with a macular scotoma, the stimulus to foveate the target may persist; however, with time or training, the patient may learn to view eccentrically.
Eccentric viewing requires the development of a new preferred retinal locus (PRL) next to the scotoma which will be used as the "new" fovea. A scotoma with areas of relative loss of sensitivity and/or distortion at the periphery of an absolute loss may make it more difficult for the patient to learn eccentric viewing. Reading with an off-foveal point is difficult and less efficient, because saccades and pursuits are difficult to execute peripherally. A scotoma to the right of fixation may make reading continuous text much more difficult, despite relatively good visual acuity and response to magnification; research has shown that a window of 5 to 7 characters is necessary for fluent reading.

A scotoma to the left of fixation may make finding the next line difficult. Although some patients do learn eccentric viewing independently, training may be beneficial to improve reading ability; this training is most often accomplished with a reading task and appropriate magnification devices. Eccentric viewing training may include any of the following strategies;

- Teaching awareness of the scotoma
- Teaching off-foveal viewing with guided practice techniques
- Reading single letters or words
- Reading with low magnification and large-print materials
- Moving the reading material rather than the eyes or head
- Using prism relocation

Once aware of the scotoma, the patient can be taught to position the scotoma with eye movements. This control can be achieved in a guided practice manner with a variety of above-threshold targets (e.g., faces, the television, or large print materials) prior to introducing magnification.

Print materials appropriate for both unaided practice and use with magnification have been developed and are most appropriate when reading is the goal. Prism relocation can be a helpful demonstration tool in some cases, by shifting the image closer to the new retinal locus, stimulating eye movement. In this manner, the benefits of eccentric
viewing can be demonstrated to the patient. Success with reading systems may hinge on the development of this critical skill. In addition, patient motivation is a significant factor in the outcome of training for eccentric viewing. However, the size and location of the scotoma can influence the difficulty of controlling eccentric viewing and the reading speed, even after training.

c. Management Strategy for Peripheral Visual Field Defects

Persons with peripheral visual field defects have more difficulty navigating through the environment than individuals with reduced acuity and no peripheral visual field losses. Training (scanning, organized search patterns, etc.) can often improve awareness of the environment and independent travel ability for those patients with debilitating peripheral visual field losses. Once careful assessment of the visual field loss has been accomplished, both the patient's understanding of the loss and the ability to compensate for it should be explored by careful questioning and observation of functioning. Mobility evaluation by a certified orientation and mobility (O&M) specialist may also be indicated. In addition, there are several optical options which may be considered, evaluated, and prescribed if deemed appropriate.

• Prisms. Prisms may be used to shift the image toward the apex of the prism. The prism can be placed segmentally (on the lens with the base toward the field defect: the prism segment is placed off center (generally temporally to the right or left, or superiorly) so that when looking straight ahead, the patient cannot see it. By glancing into the prism the patient can detect obstacles or targets in the nonseeing area with less eye movement than would be required without the prism. Fresnel press-on prisms can be used or the prism can be ground or cemented segmentally into any part of the lens. Prisms can be helpful when there is any type of restricted field (e.g., hemianopia or generalized constriction).

• Mirrors. Attached to the nasal aspect of the spectacle lens (for a temporal defect), a mirror can be angled toward the nonseeing area much like a side mirror on a car. By glancing into the mirror, the patient can detect objects within the field defect.
Image reversal, a significant perceptual factor to be considered when working with mirrors, requires the patient to understand left-right reversal. Mirrors are available in clip-on form or can be permanently affixed to the spectacle frame and are prescribed primarily for right or left hemianopic field defects.103

• Reverse telescopes and minus lenses. These devices minify the entire visual field in one or all meridians so that more information "fits" into the restricted area, but at the expense of visual acuity.103 The reverse telescope can be hand held or spectacle mounted, either in the full diameter or bioptic position. 162 Good visual acuity is required due to the minification effect of the telescope. Minus lenses held away from the eye will also minify the entire field and can be used briefly for orientation purposes, to locate objects or people, or to view larger print.163 Training in the use of visual field enhancement devices is often necessary before any true potential for success can be determined. The lens systems used and their optical characteristics are generally unfamiliar to patients, and a basic understanding of the optics involved will facilitate efficient use of the lenses. The patient should be taught basic visual skills such as scanning (especially for prisms and mirrors) and spotting (especially for reverse telescopes and minus lenses) and how to use these techniques with the lenses.103 Additional training by a certified O&M instructor, as part of a structured orientation and mobility program, may be beneficial.

2.9 Visual Field Score
A similar scoring system can be developed for visual field loss. While visual acuity loss may manifest itself primarily in a loss of reading ability, visual field loss will affect another set of ADL skills, commonly covered under the term Orientation and Mobility (O & M) skills. The importance of these skills is obvious, but designing a good measurement tool for O & M skills is difficult. The technical aspects of visual field measurement have been discussed elsewhere. Modern static perimetry plots are a great help in defining the underlying disorder; they are harder to interpret with regard to the functional consequences. Traditional Goldmann isopters were easier to interpret in this regard. Also, for diagnostic purposes, the central 30° are the most
informative, whereas a full-field plot is needed to predict O & M skills. Capturing all aspects of visual field loss in a single number is a serious oversimplification of a complex reality. Nevertheless, it has been attempted because of administrative demand.

The old AMA Guides offered two options;
(a) a formula-based calculation, and
(b) use of overlay grids.

The formula gave equal weight to upper and lower field and to peripheral and central loss. The overlay grids, designed by Esterman (53), gave double weight to the lower field and concentrated most weight in the Bjerrum area. The two methods do not give the same result and differ from the traditional “legal blindness” criterion (20° diameter, 10° radius).

The new AMA Guides use a method, which can be implemented with paper and pencil or with an overlay grid, and has the potential of being implemented on an automated perimeter (54). 50 points are assigned to the central 10° radius (20° diameter), since this area corresponds to about 50% of the primary visual cortex; the other 50 points are assigned to the periphery. The points are arranged along ten meridians, three in each of the lower quadrants and two in each of the upper quadrants. This gives the lower field 50% extra weight. Measuring along meridians within the quadrants, rather than along the principal meridians, avoids special rules for hemianopias. Along each of the ten meridians 5 points are counted from 0° to 10° and 5 points from 10° to 60°. This maintains the traditional equivalence between a visual acuity loss to 20/200 (0.1) and a visual field loss to 10°, and assigns 100 points to a field of 60° average radius. The assignments are summarized in Fig. 11.

**Figure 11**  Diagrams for field scores
Legend: These diagrams depict the test points for the Visual Field Score. Note that the central 10° radius scores 50 points and that the lower field scores 50% more than the upper field.
Similar to the Visual Acuity Score, which can be calculated as the number of letters read on a standardized chart, the Visual Field Score can be calculated as the number of points seen on a standardized grid. Table 13 compares the Visual Acuity Score with ranges of reading skills and that the Visual Field score is a reasonable estimate of O & M ability.

The next step is to combine the Visual Field Scores (VFSs), obtained for the right eye, the left eye, and binocularly, to obtain a statistical ability estimate: the Functional Field Score (FFS). As for the Functional Acuity Score (FAS) this is done by averaging. The formula is: 

$$\text{FFS} = \frac{3 \times \text{VFSOU} + \text{VFSOD} + \text{VFSOS}}{5}.$$ 

The binocular visual field is not measured directly, but constructed by superimposition of the monocular fields.

### 2.10 VISUAL FIELD ASSESSMENT

Visual acuity measurement describes the function of one small central retinal area that has the highest resolving power. Visual field measurement, on the other hand, seeks to describe the function of the entire, central and peripheral retina and the lateral extent of vision. Visual field findings are complex since they must ideally describe the sensitivity for a variety of stimuli at each peripheral point. Even though in practice only a limited number of points is tested with a limited number of stimuli, one must bear in mind that reducing this complex array of findings to a single number – as will be done in Part 3 of this GUIDE – represents a significant oversimplification. Various testing modes can be used. The following list is not exhaustive.

**Confrontation Visual Field**

This method uses only the examiner’s hands.

Seated in front of the subject, the examiner moves his/her hands from the periphery inward, to test for the peripheral field limits. Finger movements may be used to find gross scotomata. This method is too gross for evaluation in the context of this GUIDE, but it provides a quick way to detect significant abnormalities that may effect the subject’s mobility.
**Tangent Screen Testing**

This method uses a black screen on which variously sized objects may be moved. Prior to the advent of standardized testing equipment, this was the most objective way of visual field testing.

The original definition of “legal blindness” in the U.S.A. was based on the use of a 1 cm white object, presented at 1 meter. The problems of this method are that it is hard to standardize the illumination level and that the actual testing distance increases as the target moves towards the periphery. Beyond 45° the measurements lose accuracy.

**Goldmann-type testing**

The Goldmann visual field equipment provided the first standardized measurement technique. For many decades it was considered the “gold standard”. Testing is done in a bowl, so that all testing distances are equal while the background and stimulus luminances can be tightly controlled.

The usual mode of testing is known as kinetic perimetry, since a test stimulus of constant size and intensity is moved by an operator. The use of an operator introduces the potential for operator bias, but has the advantage that certain areas of interest can be explored in more detail. The test results are reported as “isopters”, contour lines that outline the areas where stimuli of various intensity can be perceived. The functional implications of certain isopter patterns are relatively easy to interpret. Agencies (such as the Social Security Administration in the U.S.A.) often require Goldmann type testing for eligibility determinations.

**Automated Perimetry**

In recent decades, there has been a move from manual to automated perimetry. (Commonly used equipment includes Humphrey, Octopus, Dicon and other brands.) Since kinetic perimetry is not easily automated, this move has been accompanied by a move to static perimetry. In static perimetry (which is possible, but quite laborious in the manual mode), the stimulus size and intensity are varied, while presentation is limited to various fixed locations.
The sensitivity found in each point can be presented in a matrix of numbers, or as a gray scale pattern with interpolation for the points that were not tested.

Automated perimetry reports are better suited for automated statistical analysis, but less intuitive for human interpretation with regard to functional vision. It is possible to convert the plots to an isopter representation, but doubts have been voiced whether these are always equivalent, since the perception of moving stimuli sometimes differs from that of static stimuli (referred to as static-kinetic dissociation).

While it is possible to test up to 60° from the center, most automated clinical tests are limited to the central 30°, since this is the most interesting area for medical diagnostic purposes. For the functional assessment of visual field loss, however, testing to 60° or beyond is necessary.

Macular Perimetry

The advent of the Scanning Laser

Ophthalmoscope (SLO) has made it possible to present stimuli under direct control of the macular image. This type of testing has provided important information about the effects of parafoveal scotomata and about the use of eccentric viewing in patients with macular degeneration or macular scars. By itself it is not sufficient for a functional field evaluation, since it does not test peripheral vision.

Monocular vs. Binocular fields

Since intact visual field areas in one eye may compensate for field loss in the other eye, the binocular field of view may be substantially better than the field of view of either eye alone. Therefore, considering both monocular and binocular function is even more important for a functional assessment of the field of vision than it is for visual acuity.

Direct testing of the binocular visual field presents problems, however. Binocular testing of the central field might be possible on a tangent screen at 1 m or 2 m. Binocular testing of the peripheral visual field in the standard bowl perimeter is not possible, since the fixation monitoring devices will not work when the head, rather than the eye, is centered. Secondly, the
small bowl diameter would require a significant amount of convergence. This convergence may not occur in the absence of fusional landmarks other than the single central fixation mark and cannot be monitored.

For the purposes of this GUIDE, it is recommended that the fields of each eye are measured separately and that an estimate of the binocular visual field is derived from the superimposition of the two monocular field plots.

2.11 Summary and conclusions

The functional effects of ganglion cell death in glaucoma have been studied by diverse methods with converging results. Each of the studies used a common method of behavioral perimetry to assess the clinical stage of visual field loss from experimental glaucoma to relate the separate investigations of the structure–function relationship. The principal studies addressed:

(1) the psycho-physiological links between ganglion cell loss and the depth of visual field defects,

(2) the relative metabolic effects of glaucoma on neurons in the parallel afferent M- and P-pathways to the visual cortex, and

(3) scotopic and photopic ERG measures of optic neuropathy from glaucoma.

The overall findings have shown that the loss of visual sensitivity from glaucoma is best explained by the reduction of probability summation among stimulus detector mechanisms. The general progression in the loss of sensitivity from the midperipheral to more central retina produces concurrent decreases in metabolic products along the afferent visual pathway that are not selective to either of the M- or P-cell parallel processing streams. Thus, these results suggest that the accuracy and precision of clinical perimetry should be improved by employing stimuli that are specific to smaller numbers of detecting mechanisms in either the M- or P-cell pathway. Alternatively, in lieu of subjective testing, objective methods for diagnosing and assessing progression of glaucoma, such as ERG recordings, may be employed. Several ERG methods are capable of isolating a ganglion cell component, but the two that appear to have the best potential for clinical and research utility are the PhNR and the mfERG.
Interestingly, the preliminary comparisons of these techniques also suggest that each might have better sensitivity at a different stage of optic neuropathy. In fact, this result may be in agreement with a more general concept that different subjective or objective procedures should be optimal for the clinical management of early vs. advanced glaucoma.

As a whole, these studies demonstrate that experimental glaucoma in monkeys is a unique model for investigations of the psychophysical, electrophysiological, histochemical, and/or anatomical characteristics of a prevalent ocular disease. In the monkey-model, laser-induced ocular hypertension is the sole factor in the development of the glaucomatous optic neuropathy and, because the intraocular pressure is generally quite high, the full extent of the damage occurs in a period of a few months. The experimental condition eliminates all but one of the well-known epidemiological risk factors for clinical glaucoma, while all other aspects of cell death and clinical presentation appear to be identical in experimental glaucoma and clinical glaucoma. Therefore, although experimental glaucoma cannot be used for studies of the mechanisms by which factors such as age, race, genetics, etc., increase the probability of acquiring glaucoma, it is a valid model for any of the causes/effects associated with neural losses from glaucoma.

Furthermore, because the visual systems of macaque monkeys and humans are practically identical, the results from the array of experiments that have been described can be applied directly to glaucoma in patients.

2.12 check your progress

1. Explain reading and pre-reading activities

2. Write note on following;

   A. Writing and drawing

   B. Placement in the classroom

   C. Mobility
3. Explain orientation and mobility instruction
4. Describe management strategy for central visual field defects
5. Explain visual field score

Check Your Progress
7. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.7.1. Points for discussion
Points for clarification
2.12 Reference


Unit 3: Colour vision defect and loss of contrast sensitivity

3.1 Introduction

3.2 The Rabin Cone Contrast Test

3.3 Color Vision

1. Subjects
2. Equipment
3. Procedure

   1. Cambridge Colour Test
   2. Arrangement Tests
   3. Contrast Sensitivity
   4. The Macadam’s Ellipses Test
   5. Arrangement Tests
   6. Contrast Sensitivity

3.4 Comparison Between Test Results

3.5 Summary

3.6 Check Your Progress
3.1 Introduction

Color vision deficiency in glaucoma was first described in 1883.1 Blue-yellow deficiencies generally are associated with early glaucoma, and red-green deficiencies generally are associated with advanced glaucoma.2–6 However, it is difficult to measure or quantify acquired color vision deficiency, and color tests performed with standardized color test charts such as the pseudo isochromatic plates or panel D-15 frequently characterize it as combined or nonspecific color vision deficiency.

Recent investigations of chromatic discrimination using computer-generated color tests have shown that color contrast thresholds are elevated in patients with glaucoma.8–10 In these tests, the subject is asked to report the presence of a color target such as a spot, bar, or grating on a background of a different color. Regan et al.11 designed a sophisticated computerized color vision test known as the Cambridge Colour Test. The stimulus arrays resemble the plates of a traditional pseudo isochromatic test, such as those of the Ishihara test. The target is C shaped, differing in chromaticity from the background. This test has been used to evaluate acquired color vision deficiency.12–15 Another current computerized test is the Color Assessment Test developed by Birch et al.,16 which is being used in occupational environments. This test is based on a spatiotemporal luminance masking technique devised by Birch et al.16 In this technique, part of a uniform background is formed by spatially discrete elements that are equal in timeaveraged luminance with respect to the background. During the stimulus presentation, each element scintillates while its luminance varies. These two tests are capable of quantifying the degree of color vision loss by use of color thresholds.

Rabin et al.17 developed a new computer-based, cone-specific (L, M, S) contrast sensitivity test.

3.2 The Rabin cone contrast test

(RCCT) uses a randomized series of red, green, and blue letters visible to a single cone type (long [L], medium [M], short [S]) in decreasing steps of contrast to measure the threshold for letter recognition. The RCCT, which provides numeric scores of color vision and identifies the type and severity of color vision deficiency, can be completed in only 6 minutes. The RCCT offers an intuitive, robust index of color vision that accurately detects the type of color vision deficiency. The rapid, threshold letter recognition task is well suited for clinical application. The
authors reported that it has sensitivity and specificity comparable to those of anomaloscope test results for hereditary color vision deficiency detection and categorization. We hypothesized that the RCCT may also be useful to evaluate acquired color vision deficiency in glaucoma, and we used the test to evaluate color vision deficiencies in patients with glaucoma.

3.3 COLOR VISION

Human color vision is exquisitely sensitive. Normal observers are capable of distinguishing over 100,000 hues generated from various combinations of three "primary color" light sources (Geldard, 1972). Most investigations of age differences in color vision have employed color confusion tests in which the observer is required to arrange sets of "color caps" into an ordinal series extending between two anchored color exemplars (e.g., the Farnsworth-Munsell 100 Hues or FM-100 Test). The number and type of errors exhibited via this arrangement of color samples is quantified into a color sensitivity profile. Numerous studies utilizing this technique have reported that color discrimination errors increase significantly with advancing age. These errors are primarily limited to fine discriminations within the "blue-green", or short wavelength, region of the spectrum (e.g., Knoblauch, Sanders, Kusada, Hynes, Podgor, Higgins, and de Monasterio, 1987). Similar findings of a differential blue-green color discrimination weakness among older adults have been reported using color matching (i.e., anomaloscopic) techniques (e.g., Eisner, Fleming, Klein, and Mauldin, 1987). Cooper, Ward, Gowland and Mchtosh (1991) examined color discrimination using the Lanthony New Color Test in a large group of observers ranging from 30 to 89 years of age. They found that the ability to distinguish desaturated shades of blues and greens was the first age-related loss to emerge - beginning around age 60. This change was followed soon thereafter by a less severe loss in the ability to distinguish between desaturated reds and yellows. Most of the age-related weakness in color discrimination appears to result from reduced retinal illumination due to optical changes in the eye. In fact, Knoblauch, et al. (1987) showed that young observers demonstrate similar blue-green weaknesses at low illumination levels and that age differences in color discrimination performance were minimized at high levels of target illumination. Although the magnitude of the age-related loss in blue-green color discrimination is small, Cody, Hurd, and Bootman (1989) demonstrated that older adults with poor FM-100 test scores were more likely to make errors discriminating between medicine capsules with similar color-coded markings. Knoblauch, et
ale's findings, however, suggest that such errors can be minimized if optimized lighting conditions are employed.

1. Subjects

We studied patients that make use of chloroquine for the treatment of rheumatic diseases but, at the same time, had no ophthalmoscopic signs of retinopathy. Patients were referred by rheumatologists in both centers. All patients were submitted to an ophthalmological examination that included evaluation of corrected visual acuity, biomicroscopy, tonometry and indirect ophthalmoscopy. Patients with any finding that would be related to chloroquine retinopathy or other ophthalmological pathology were excluded from the present study. Informed consent was obtained from all subjects, in accordance with the Declaration of Helsinki determinations.

Patients were tested in São Paulo (n=10; aged 38 to 71 years; mean=55.8 years) and Belém (n=22; aged 20 to 67; mean=40 years). The prescribed accumulated chloroquine dose was 45 to 430 g (mean=213 g; sd=152 g) for the São Paulo group and 36 to 540 g (mean=174 g; sd=183 g) for the Belém group.

2. Equipment

The São Paulo group used commercial version of all tests. The Cambridge Colour Test, CCT v2.0, with VSG 5 card and Sony FD Trinitron colour monitor, was purchased from Cambridge Research Instruments, England. The arrangement tests were the Farnsworth Munsell 100 Hue and D15 tests (Gretag Macbeth, N.Y.) and the Lanthony Desaturated test (D15-d Luneau Ophtalmologie, Chartres, France). The Belém group used a self-built system. The software was written using C++ programming language, OFS/Motif 1.1, AIX-Windows R4, and IBM-GL graphic library, all for AIX 3.2.x environment. The software was developed for IBM POWERStation RISC 6000.
The stimuli were displayed in IBM 6091 19i colour monitors, 1280 x 1024 pixels, 81.32 kHz horizontal refresh rate, 77 Hz vertical frame rate. They were generated by using IBM GT4-3D graphic adapters, 24 bits / 8 bits per gun. A dithering routine was used to obtain 10 bits grey level resolution. The software was developed by C. R. Botelho-de-Souza (luminance contrast sensitivity test), A. M. Braga (FM100) and author ARR (CCT, FM100).

3. Procedure
All tests were performed with spectacles to correct any refractive error.

1. Cambridge Colour Test
Testing was performed monocularly in a darkened room and with the subject positioned at 3 m from the stimulus monitor. The subject was instructed to indicate the position of a Landolt C opening by pressing the corresponding button in a response box (São Paulo) or the respective keyboard arrows (Belém). The short protocol, the Trivector, was determined first, for screening purposes. Subjects that exceed the values of 100x10\(^{-3}\) u’v’ units in either the deutan or protan axis or 150x10\(^{-3}\) u’v’ units in the tritan axis were excluded.

The Trivector was followed by a longer procedure, the MacAdam Ellipses protocol. Eight-vector or twenty-vector ellipses were determined in the São Paulo and Belém laboratories, respectively, for all subjects that passed the Trivector protocol. The u’v’ coordinates for the center of the three ellipses lied along the protan-deutan axis (Tritanopic set) and were: Field 1: 0.197, 0.469 for Ellipse 1; Field 2: 0.158,0.473 for
Ellipse 2; Field 3: 0.242, 0.463 for Ellipse 3. These CIE (Commission Internationale d’Éclairage) chromaticities constituted the background colour against which hues corresponding to equally spaced vectors were tested (21) (Figures 1 and 2).

The CCT used the staircase psychophysical method to measure threshold discrimination, presenting two staircases in random alternation. In each staircase testing began with a saturated hue and proceeded to a less saturated hue every time the subject answered correctly, with a maximum excursion of 0.110 u’v’ units and a minimum excursion of 0.002 u’v’ units in this space. Reversibly, incorrect responses or no responses are followed by presentation of hues with higher saturation value. Step size is halved or doubled, following respectively correct or incorrect responses. After a criterion of 6 incorrect responses or 6 reversals, the series is terminated and a threshold is computed. In succession, testing on a new pair of hues is begun. The results are expressed in u’v’ coordinates in CIE colour space.

2. Arrangement Tests

The arrangement tests were used by the São Paulo group in their original formats, according with the test’s instructions, with the specified illumination provided by a fluorescent
lamp (Sylvania mod. Octron 6500K FO 32W) in an otherwise darkened room. This procedure was followed in the application of the FM100, D15 and Lanthony Desaturated tests. The Belém group used a locally made computerized version of the FM100. The general procedure is the same as in the commercial version, but all measurements were repeated four times and the results were presented as mean and standard deviation for each data point.

3. Contrast Sensitivity

The contrast sensitivity was evaluated only in the Belém group of patients. Achromatic contrast sensitivity was measured monocularly, both eyes being alternately tested, at eleven spatial frequencies, ranging from 0.2 to 30 cycles / degree.

The stimuli consisted of stationary, black-and-white, vertical sine-wave gratings, with a mean luminance of 188 cd/m2, placed at 3 m, subtending 6.5 x 5 degrees. Each measurement was repeated six times and the mean value was taken as representative of contrast sensitivity.

Theories of colour vision
The process of colour analysis begins in the retina and is not entirely a function of brain. Many theories have been put forward to explain the colour perception, but two have been particularly influential:

1. Trichromatic theory. The trichromacy of colour vision was originally suggested by Young and subsequently modified by Helmholtz. Hence it is called Young-Helmholtz theory. It postulates the existence of three kinds of cones, each containing a different photopigment which is maximally sensitive to one of the three primary colours viz. red, green and blue.

   The sensation of any given colour is determined by the relative frequency of the impulse from each of the three cone systems. In other words, a given colour consists of admixture of the three primary colours in different proportion. The correctness of the Young-
Helmholtz’s trichromacy theory of colour vision has now been demonstrated by the identification and chemical characterization of each of the three pigments by recombinant DNA technique, each having different absorption spectrum as below (Fig. 2.6):

- **Red sensitive cone pigment**, also known as *erythrolabe* or long wave length sensitive (LWS) cone pigment, absorbs maximally in a yellow portion with a peak at 565 nm. But its spectrum extends far enough into the long wavelength to sense red.

- **Green sensitive cone pigment**, also known as *chlorolabe* or medium wavelength sensitive (MWS) cone pigment, absorbs maximally in the green portion with a peak at 535 nm.

- **Blue sensitive cone pigment**, also known as *cyanolabe* or short wavelength sensitive (SWS) cone pigment, absorbs maximally in the blue-violet portion of the spectrum with a peak at 440 nm. Thus, the Young-Helmholtz theory concludes that blue, green and red are primary colours, but the cones with their maximal sensitivity in the yellow portion of the spectrum are at a lower threshold than green.
It has been studied that the gene for human rhodopsin is located on chromosome 3, and the gene for the blue-sensitive cone is located on chromosome. The genes for the red and green sensitive cones are arranged in tandem array on the q arm of the X chromosomes.

2. Opponent colour theory of Hering.
The opponent colour theory of Hering points out that some colours appear to be ‘mutually exclusive’. There is no such colour as ‘reddish-green’, and such phenomenon can be difficult to explain on the basis of trichromatic theory alone. In fact, it seems that both theories are useful in that: _ The colour vision is trichromatic at the level of photoreceptors, and

_ Colour opponency occurs at ganglion cell onward.
According to opponent colour theory, there are two main types of colour opponent ganglion cells:

_ Red-green opponent colour cells use signals from red and green cones to detect red/green contrast within their receptive field.

_ Blue-yellow opponent colour cells obtain a yellow signal from the summed output of red and green cones, which is contrasted with the output from blue cones within the receptive field.
All patients presented normal ophthalmological exams with corrected visual acuity of 20/20. No patient was excluded from the present study. In São Paulo, all patients were evaluated in every test. In Belém, all patients were tested in the FM100, but only 5 patients were tested in the CCT. Nine of the 10 patients tested in São Paulo and 15 of the 22 tested in Belém, presented acquired dyschromatopsia revealed by the CCT and/or by the arrangement tests – the FM 100 and Lanthony. The D15 test was not sensitive enough to reveal losses in these patients. Since previous work on norms for the CCT (Ventura et al., in press) showed no statistical difference between the ellipse parameters obtained in the São
Paulo and Belém setups in normal subjects, all results were grouped. The same was true for the data from the FM 100.

4. The MacAdam’s Ellipses Test

Figure 1 shows the CIE 1976 u’v’ color space representation containing MacAdam’s ellipses around three chromaticities for two chloroquine treated patients and for an age-matched control subject. The central point in each ellipse represents the background chromaticity and each data point (crosses) is a color discrimination threshold, between the background color and one of the tested colors. The tested colors ranged from red to violet. The resulting ellipse is represented by the interpolated line. The shape of the ellipses obtained reveals the type of colour vision loss. Horizontal ellipses tilted towards the red or green vertices of the color triangle in the diagram correspond to protan or deutan losses, respectively, while ellipses pointing to the blue extremity correspond to tritan losses. A diffuse loss increases the ellipse in all directions.

MacAdam’s ellipses obtained in patients treated with chloroquine were enlarged in comparison with those measured in age-matched controls (Figures 1 and 2). The pathologic changes were either tritanopic (6/10 in São Paulo and 2/5 in Belém) or diffuse (3/10 in São Paulo and 3/5 in Belém) and the average ellipse areas were asymmetric for fellow eyes. Total ellipse area from the worst eyes, regardless of shape, showed a statistically significant difference between chloroquine treated patients and controls for Fields 2 and 3 (p = 0.041 and p = 0.046, respectively) but not for Field 1 (p = 0.14). No significant difference was observed when the best eyes from the chloroquine treated group were compared to the control.

The large variability in these data is related to the fact that the patients had different levels of accumulated dose of chloroquine. In fact, accumulated dose of chloroquine was highly positively correlated with ellipse area, especially in Field 3, which is closer to the blue end of the colour space (Figure 3).

5. Arrangement Tests

Typical results for the FM100 Test are shown in Figure 4 for a control subject and for two chloroquine treated patients, one with diffuse loss, the other with a light tritan loss. The
numbers in the periphery of the graph correspond to the Munsell colors that are ordered in the test. The radial plot shows the magnitude of each error that was made when arranging the colours sequentially. Error magnitude indicates the distance between each colour and the next one. A test result with no errors is represented by a radial plot that constitutes a perfect circle. Errors made by subjects with protan, deutan and tritan deficiencies fall along the respective confusion lines.

The average error score for the FM100 test was higher in the chloroquine treated patients than in the age-matched controls and it was different between the two eyes (Figure 5a).

The FM100 error score was worse even after the first few doses of chloroquine for both the best and worst eyes in all patients (Figure 5b and 5c). The best eye results were statistically different from the controls (p = 0.013). Twenty four patients showed pathologic changes in the FM100, either tritanopic (5/22 in Belém) or diffuse (9/10 in São Paulo and 10/22 in Belém). However, three patients from the Belém group that scored within the normal range in the FM100, showed tritanopic (2 patients) or diffuse (1 patient) losses in the CCT.

In an attempt to compare the FM100 results with those from the CCT, the ellipse area was plotted against the FM100 error score. The result showed no statistically significant correlation. The Lanthony test revealed losses in three out of seven patients, while the D15 showed loss in only one of these patients.

6. Contrast sensitivity

Contrast sensitivity was unaffected by the chloroquine treatment in the patients in which this visual function was evaluated. However, since the group tested in Belém received a lower accumulated dose of chloroquine, a loss in contrast sensitivity is not excluded for higher accumulated doses.

3.4 Comparison between test results

The results obtained with the CCT showed that, among chloroquine treated patients, there were cases of selective tritanopic colour vision loss (6/10 in São Paulo and 5/22 in Belém) and of diffuse loss (3/10 in São Paulo and 10/22 in Belém). Although losses were also present in the
FM100, there was no statistically significant correlation between the FM100 error score and the ellipse area measured by the CCT.

The Lanthony desaturated test was more sensitive and closer to the CCT than the FM100 in the indication of losses. The D15 was not sensitive enough to show these losses. Contrast sensitivity was within normal values for all patients. The extent of the losses in colour discrimination was positively correlated with the accumulated dose.

3.5 summary

Patients without chloroquine retinopathy presented functional alterations in color discrimination but did not show changes in contrast sensitivity. Colour vision loss due to chloroquine toxicity in these patients increased with accumulated dose values and was present at even the lowest dose (45 g of chloroquine) for at least one patient tested. Colour discrimination was worse in the patients than in the agematched controls in three of the four tests used – CCT, FM100 and Lanthony desaturated tests. Both the CCT and FM100 were sensitive enough to detect these losses. The Lanthony test was less sensitive than the other two tests, since it failed to indicate loss in about half the patients, and the D15 was the least sensitive test, having failed to indicate loss in 9 out of 10 patients. Further work with a larger number of patients is in progress to strengthen and broaden these comparisons.

The finding that in some patients functional changes are associated with very small doses of chloroquine suggests that these cases correspond to the early susceptibility described by several authors(9,14-15) and it would be important to find out if these patients have mutations in the ABCR (ABCR4) gene, which has been suggested as a link between retinal toxicity by chloroquine and Stargardt’s disease.

The present results support the recommendation made by other authors to monitor visual function during treatment with chloroquine. Among the tests used here, the CCT is the most highly recommended for both diagnosis and follow up because it is sensitive, uses a very rigorous psychophysical procedure and provides quantitative data that can be directly interpreted.
in CIE colour space, while the FM100 is a test that is influenced by training and by other subjective factors.

3.6 check your progress

1. Explain In Detail Color Vision
2. Write Note On Following;
   1. Cambridge Colour Test
   2. Arrangement Tests
   3. Contrast Sensitivity
   4. The Macadam’s Ellipses Test
   5. Arrangement Tests
   6. Contrast Sensitivity

3.7 References


Unit 4: Refractive errors, Vitamin-A deficiency, Cataract, Glaucoma, Corneal ulcer, trachoma, Albinism, Retinal detachment, Retinitis pigmentosa, Retinopathy of prematurity, Cortical Visual Impairment, Optic Atrophy, Nystagmus, Amblyopia, and Macular degeneration

4.1 Introduction
4.2 Vitamin A deficiency and measles (xerophthalmia)
   (Plate 1)
4.3 Cataract (Plates 23–24)
4.4 Albinism (Plate 26)
4.5 Childhood glaucoma (Plate 29)
4.6 Retinopathy of prematurity
4.7 Retinitis pigmentosa (RP) (Plate 31)
4.8 Macular ulcer
4.9 Optic atrophy
4.10 Corneal ulcer
4.11 summary
4.12 Check Your Progress
4.1 Introduction

Outpatient departments forms the major component of health care systems in national health services. Successful management of OPD services is costly requiring funding for building itself employment of medical and clerical staff and use of paramedical services. Even if an organized OPD setup is available people usually do not present to get the eye care facilities until and unless a potentially blinding emergency is faced. A study conducted at Aravind Eye Hospital, South India to evaluate the utilization of eye care services in rural South India.

5150 randomly selected subjects underwent ocular examinations and previous use of eye care services was collected via questionnaire in order to determine utilization of eye care services in a rural population of Southern India. 3,476 (72.7%) of 5,150 subjects examined required eye care examinations. 1,827 (35.5%) people gave a history of previous eye examinations, primarily from a general hospital (n= 1,073, 58.7%). Another study was done in Andhra Pradesh to understand the reasons why people in rural south India with visual impairment arising from various ocular diseases do not seek eye care. Barriers to seeking treatment among those who had not sought treatment despite noticing a decrease in vision over the past five years were personal in 52% of the respondents, economic in 37% and social in 21%. In spite of the fact that modern technical facilities like phacoemulsification and microincision cataract surgery are available in most parts of the world but old traditional treatment methods like couching are still practiced in certain parts of the world like Africa Complications of couching like hypheama, glaucoma and panuveitis are prevalent in these parts of the world. Spencer Eye Hospital was built in 1940 and has such a location that it drains population not only from central parts of Karachi and Lyari and its associated areas (less privileged / low socioeconomic status) but also caters for the population from the coastal areas as Makran and Balochistan. We Conducted an OPD survey with the objective to determine the pattern of different diseases among the patients attending the OPD.
4.2 Vitamin A deficiency and measles (xerophthalmia)
(Plate 1)

Definition: Scarring of the cornea due to poor wetting by the tear film caused by vitamin A deficiency.

Cause: In developing countries the diet of children is often deficient in this vitamin. Red meat, liver, green vegetables and carrots are all rich in vitamin A but rice, wheat and maize, often the staple diet in developing countries, are not. Vitamin A is essential for the health of a number of different types of cell in the body including the cells of the conjunctiva, which produce the mucus of the tear film. The health and transparency of the cornea depend on wetting from tears and chronic severe deficiency of this vitamin results in loss of corneal transparency often with blood vessels growing into it. Vitamin A is also a main ingredient for the rod visual pigment, rhodopsin and hence deficiency can also produce night blindness. Another group of cells for which this vitamin is important are the skin cells. After an attack of measles with its accompanying rash, the body’s supply of vitamin A is used up as the skin is regenerated. Hence this virus can severely worsen any existing vitamin A deficiency and accelerate the corneal scarring. From the above explanation it will be clear that this will be a very uncommon cause of visual impairment in developed countries but it remains a very important factor worldwide.

Eye structures affected: Conjunctiva, tear film, cornea and the rod receptors of the retina as above.

Effect on vision: This will depend on the size and position of the corneal scarring, central scars having a more severe effect on visual acuity.

Other associations: These children are often suffering from severe malnutrition and about a quarter will not survive.

How it is detected: Characteristic appearance of the dried-out conjunctiva and cornea in a situation where malnourishment is likely.
Medical treatment: Prevention is by far the most important medical intervention for this condition. This involves education to mothers about diet and, where necessary, supplementary vitamin A given in single large doses. Once the damage has been done medicine or surgery offer little.

Corneal grafting is notoriously difficult and gives poor results. An optical iridectomy as explained in the previous section (page 57) may be helpful.

Progression: If severe vitamin A deficiency persists the cornea may thin out and eventually perforate which will cause the eye to collapse and results in permanent and complete blindness in one or both eyes.

Educational implications: These are as explained for the congenital anomalies (page 57) but in the countries where this condition tends to arise, facilities for education of visually impaired children are usually limited if indeed they exist at all. Therefore the outcome may unfortunately be that the child receives no school education.

4.3 Cataract (Plates 23–24)
Definition: Loss of transparency of the lens as shown in Plate 23.
Cause: A variety of causes include genetic, infections affecting the mother during pregnancy, general biochemical disorders of childhood which affect the eye (such as defects in the way certain sugars or calcium salts are handled). Sometimes no cause is found.
Plate 23  Cataract
Eye structures affected: By definition it is the lens of the eye which is affected. Sometimes cataract may be part of a syndrome affecting other parts of the eye as well: for example, aniridia and microphthalmos.

Effect on vision: It has recently been discovered that good vision during the first three months of life is critical for the growth and development of the visual brain. When cataracts are discovered at birth, cataract surgery is ideally carried out during the first few weeks of life (provided the cataracts are severe enough to be significantly affecting vision) and replacement lenses given straight away. In cases where surgery has been delayed there may be permanent significant visual impairment (called deprivation amblyopia) despite later surgery, because the initial programming of the visual brain has not taken place. Children born with cataract in one eye rarely regain useful vision following surgery in the affected eye since deprivation amblyopia is exaggerated when the other eye sees well, although such children will not be visually impaired. Some opacities of the lens are of no consequence and may not even be noticed. The effect on vision depends on:

a) The age of onset – cataracts present at birth or in infancy can cause severe amblyopia;
b) The density of the opacity – ie how much light can pass through it and;
c) Position – opacities in the centre of the lens interrupt light passing to the macula and therefore tend to cause a more severe loss of acuity than opacities situated near the edge of the lens.

In addition to reduction in vision, cataracts can cause light entering the eye to be scattered therefore causing the child to experience glare. This is particularly common if the opacity is situated towards the back of the lens, and this type of cataract is often associated with retinitis pigmentosa and uveitis.

Other associations: Cataract may be associated with a variety of disorders affecting the eye such as the rubella syndrome, retinitis pigmentosa, chronic uveitis, aniridia and many others. It may also be associated with disorders affecting the rest of the body such as Down’s syndrome, or the biochemical disorders mentioned above.
How it is detected: Since early treatment is very important for successful treatment of cataracts present at birth, it is essential that they are detected very soon after birth. Doctors in charge of babies make a routine examination of the whole baby soon after birth and this should include shining an ophthalmoscope at the eye and looking at the pupil which normally has a reddish glow (as seen in flash photography).

Significant cataract will block this “red reflex” showing as a black shadow (Plate 23). Thus all newborn babies are “screened” for cataract. Suspicious cases are then referred to an ophthalmologist for examination with the microscope.

Medical treatment: Children with cataracts significantly affecting the vision of both eyes require cataract surgery which involves removing the lenses. Absence of the lens is termed aphakia. The lens accounts for about a third of the eye’s refractive power and its absence results in reduced focusing power. All aphakic people used to have to wear thick, convex spectacle lenses (Plate 24) after cataract surgery to correct this, but now almost all adults undergoing cataract surgery have an artificial lens implant inserted in the same site as the natural lens. This removes the need for such thick glasses and gives much less distortion of images than the glasses used to. There is an increasing trend towards the insertion of such implants in infants and children as well, but there are a number of technical problems associated with this so it has not been popular in the recent past. There are a large number of school-age children at present who have had cataracts removed and have not had artificial lenses implanted. They require either contact lenses or thick glasses (called aphakic glasses) to achieve a clear image. Contact lenses give a better quality of image and may therefore be preferable if they can be tolerated by the child and managed by the family. Indeed, aphakic spectacles enlarge the image so much (a side effect of their thickness) that they cannot be used unless both eyes are aphakic, since if one eye is normal, the sizes of the images created by the two eyes would be so different that the brain could not combine them resulting in double vision. Whichever form of optical correction is used (including the intra-ocular lens implant), extra reading glasses are essential for near work since, as described in Chapter 1, it is the elasticity of the natural lens which allows the eye to focus on near objects (accommodation) and this variable focus is absent in aphakia.
The trend is towards early surgery if it is required. The other trend is towards implanting artificial lenses wherever possible even in very young babies. It is of course essential that aphakic children (especially under the age of eight) wear their aphakic optical correction all the time, be it glasses or contact lenses, because, as we have said, blurred images in young children can lead to permanent amblyopia. Even if a lens implant is present, glasses or contact lenses may also be necessary since as the eye grows, its focusing power changes. Reading glasses will certainly be required before school is started because the lens implants in current use do not have the facility to change shape as the natural “elastic” lens does to bring the normal eye into focus (Chapter 1). Usually further surgical or laser procedures are required if the lens capsule (left in place at the initial operation to support the lens implant) thickens up causing a similar blurring of vision to the initial cataract. Progression: This is variable. Some cataracts may not interfere with vision when first detected, but the child needs to be watched carefully over time in case vision gets worse and requires surgery at a later stage. Other cataracts may never progress to a stage requiring surgery.

4.4 Albinism (Plate 26)

Definition: Any congenital condition in which the colouration (pigmentation) is reduced involving the skin and the eyes (oculocutaneous albinism), or the eyes alone (ocular albinism).

Cause: This is a genetic condition, though the way it is inherited varies. Some forms are passed down through the generations (dominant), some occur with no warning when both parents are coincidental carriers without the disease (recessive) and some forms affect only male children but are passed on only through female carriers (X or sex linked). The more severe forms tend to have recessive inheritance and the milder forms dominant. Albinism affecting only the eyes (ocular albinism) tends to be inherited as X-linked. (See Glossary for more details of these inheritance types.)
Eye structures affected: The iris and choroid lack colouration and in obvious cases the light reflected from the retina through the iris may give the eye a reddish appearance. The fovea is not properly developed and there is some miswiring of nerve fibres where they cross.

Effect on vision: The abnormal fovea means that visual acuity is reduced and this is associated with nystagmus (or wobbly eyes). (Other diseases which cause severe visual impairment from birth, such as untreated cataract or cone dystrophy, may also be associated with nystagmus.) Distance vision tends to be more affected than near, probably because the nystagmus is less for near vision (Plate 8) and hence the image is stabilised. The degree of visual impairment can vary with visual acuities between 6/9 and 6/60 in the majority of cases. The lack of colouration in the iris and choroid means that too much light enters the eye and is not absorbed properly. Therefore bright light causes discomfort which is called photophobia. In focal bright light conditions the image can be degraded (Plate 27). Refractive errors and squint are common.

Other associations: Children with oculocutaneous albinism lack colouration in the skin as well as the eye. This colouration is protective against the harmful effects of sunlight and hence these children are more prone to skin cancers. Appropriate skin care is therefore required.
This is a more significant risk in hot countries where the normal population have darker skin for greater protection from the sun. In such countries light skinned people with albinism will also look more noticeably different from the normal population and may suffer correspondingly more social stigma. Rarer associations include repeated infections (Chediak Higashi syndrome) and easy bruisability (Hermansky-Pudlak syndrome). There is some evidence that people with oculocutaneous albinism have a tendency to have a high IQ.

How it is detected: Ophthalmic examination may reveal subtle thinning of the iris in mild cases as well as light colouration of the choroid. Nystagmus may be the first indication, and knowledge that other family members are affected, or examination of family members to detect subtle disease or gene carriers may be helpful.

Medical treatment: Any refractive errors must be corrected and low vision aids are often helpful. Tinted lenses are helpful in reducing photophobia.

Progression: The disease is non-progressive.
4.5 **Childhood glaucoma (Plate 29)**

Definition: A range of conditions all involving the pressure inside the eye being too high and causing progressive damage to the optic nerve and impairing vision.

Cause: The exact cause of straightforward childhood glaucoma is not known though hereditary factors are thought to play a part.

Eye structures affected: The wall of the young eye (sclera and cornea) is more elastic than that of the adult eye and it will stretch when the pressure inside it goes up, enlarging the eye (buphthalmos) mentioned earlier. The stretching of the cornea may damage its transparency and leave characteristic stretch marks, visible under high magnification. As explained in Chapter 1, the optic disc where the optic nerve leaves the eye is vulnerable to damage by raised pressure and the nerve fibres can progressively die and disappear as they pass through the disc.

Effect on vision: In many cases early detection and surgical treatment controls the pressure and prevents loss of vision, but blindness can occur in a minority of cases. Corneal stretching, damage to the optic nerve and amblyopia due to visual deprivation at an early age all contribute to the visual impairment. Optic nerve damage at the optic disc usually affects parts of the peripheral field of vision before central visual acuity is lost because nerve fibres from the peripheral retina are the most susceptible to raised pressure.

Childhood glaucoma 30 Retinoblastoma
(buphthalmos) Other associations: Glaucoma can also occur as a part of or as a result of several other conditions affecting the eye such as aniridia, rubella syndrome, Reiger’s anomaly (a group of conditions running in families in which the pupil may be an irregular shape and the iris is abnormal), uveitis (particularly the type of uveitis associated with childhood arthritis) and retinopathy of prematurity.

How it is detected: Apart from enlargement of the eye and corneal clouding which may be obvious, affected infants characteristically rub their eyes and may dislike bright light. The eyes will often water a lot (though glaucoma is an extremely rare cause of watery eyes in infancy).

Medical treatment: Surgery is usually required to achieve a lasting reduction in pressure though even if this is achieved, a significant proportion of eyes may remain visually impaired. Because the eye may be enlarged, a refractive error is likely to be present (enlargement of the eye tends to cause myopia as explained in Chapter 2) and prescription of appropriate glasses may help the child make full use of available vision.

Eye drop treatment to maintain a low pressure in the eye may be required in the long term.

Progression: Once the pressure in the eye is controlled the visual impairment should not progress. Uncontrolled pressure will result in progressive damage to the optic nerve and with it the visual field.

4.6 Retinopathy of prematurity

Definition: A scarring disease of the retina developing in premature and low birth-weight infants. The disease used to be known as retrolental fibroplasia.

Cause: This disease has developed only relatively recently (1942) as the care and therefore survival of severely premature babies has dramatically improved. Before this, babies at risk of the condition would not have survived. Retinopathy of prematurity is becoming an increasingly
common cause of visual impairment in developing countries as the quality and availability of neonatal care improves.

The exact cause of the condition is not known, but relates to the fact that the blood vessels which supply the retina are not fully developed until a baby reaches full term, so when babies are born very prematurely, parts of the retina do not have adequate blood supply. In the early cases, excessive oxygen therapy was thought to be the principal cause, but now this is administered to babies at risk more cautiously. This has resulted in a reduction in the frequency of the disease but not eradication, and it is likely that other factors relating to birth weight and genetics also play a part.

Eye structures affected: The retina is the main site of the problem and there are various stages of severity of involvement. The milder degrees of the disorder usually resolve spontaneously and only the more severe stages require any form of treatment. These severe stages involve scarring of the retina and most severe of all, the retina being pulled away from its normal position against the choroid (retinal detachment).

As explained in Chapter 1, the retina depends on the choroid for most of its oxygen supply, and therefore such detachment from the choroid produces permanent damage to the retina.

Other effects on the eye seen in this condition include myopic refractive errors, squint (misalignment of the eyes so that they are not looking in the same direction), amblyopia and optic atrophy.

Effect on vision: As understanding of the condition and its prevention and treatment has increased, the outlook for vision has improved significantly, so that serious eye disease is now largely confined to infants of less than 1000g birthweight. Even among these children, only a minority become blind in both eyes. In less affected children, acuity may be reduced by macular scarring, amblyopia or optic atrophy, and the peripheral visual field may be affected by peripheral retinal scarring or optic atrophy.

Other associations: Because these children are usually born prematurely there is a relatively high incidence of associated brain damage, which may cause learning difficulties and cerebral palsy.
How it is detected: Currently all premature and low birthweight babies at risk should be examined by an ophthalmologist so that any disease requiring treatment can be detected.

Medical treatment: This is performed either with a freezing probe applied to the outside of the eye which freezes right through the wall of the eye onto the affected retina, or with a laser beam directed at the affected retina through the pupil. If severe scarring and detachment develop, complex surgery is occasionally carried out, but the results of this are often very disappointing in terms of the vision achieved. Older children may require patching therapy for amblyopia, and refraction and correction of the short sightedness which commonly accompanies the disease.

Progression: The disease develops and progresses only during the first weeks of life and it is during this time that careful examination is required. Once the child reaches school age, any damage will have been done and further progression would not be expected.

4.7 Retinitis pigmentosa (RP) (Plate 31)

Definition: A group of genetic conditions initially involving progressive night blindness and peripheral visual field loss and in some cases progressing to loss of vision. The condition may be confined to the eye or part of a more widespread disorder affecting other parts of the body.

Cause: This is genetic and it can be inherited in a dominant, recessive or sex-linked way. The recessive and sex-linked types tend to come on at an earlier age and to affect vision more severely than the dominant types.

Eye structures affected: It is the rods of the retina which are primarily affected, though cones may be affected later. This accounts for the poor night vision and loss of peripheral vision as early symptoms, and the later involvement of central vision. The appearance of the retina when examined by the ophthalmologist gives a black speckled pattern, paleness of the optic disc (since the nerve fibres of the ganglion cells which make up the optic disc gradually die off as a result of the retinal damage) and narrowing of the blood vessels which supply the retina. Apart from the primary retinal problem, cataract may develop and also the macula of the retina may become waterlogged (called macular oedema).
Effect on vision: The early problems comprise reduced vision in poor light and reduced peripheral visual field. Early visual field defects tend to be in the upper field but these gradually grow to give a ring shaped field defect (ring scotoma). Further progression in the more severe cases may lead to only a tunnel of central vision remaining (Plate 12). Central vision may be affected by progressive involvement of the cones in the disease or by cataract or macular oedema.

How it is detected: Retinitis pigmentosa may be diagnosed at various ages depending on its severity. The child will usually describe difficulty seeing in the dark. Older patients may present when they notice their field of vision becoming increasingly constricted (by which time they often have severe visual field loss). Examination reveals the signs mentioned above and the diagnosis is confirmed by performing an ERG (see Chapter 2, page 51) which has a characteristically reduced result especially in the dark.

Medical treatment: There is no specific treatment for retinitis pigmentosa except in the case of Refsum’s disease and abetalipoproteinaemia. Medical care may initially be limited to full and sympathetic explanations together with genetic counselling. Macular oedema is sometimes treated with medication such as steroids and cataract surgery is sometimes required, though not usually in childhood.

Progression: This varies according to the type of the disease. Sex-linked cases of retinitis pigmentosa are night blind in early childhood, and tend to show extensive field loss by the early teens and central visual loss in the twenties. By the fourth decade most patients have vision reduced to less than the ability to count fingers. The recessive form is extremely variable but is usually early in onset and severe. The outlook is much better in the dominant form in which night blindness and field loss may develop in childhood, but in the long term most patients retain reasonable visual acuity until the age of forty or fifty or even throughout life.
4.8 Macular ulcer

Definition: These are a group of inherited disorders where the central part of the retina responsible for central vision and visual acuity (the macula) is predominantly affected.

Cause: The cause is genetic, and both dominant and recessive forms of inheritance are seen.

Eye structures affected: By definition it is the macula which is primarily affected. The typical picture is of gradual onset loss of visual acuity in both eyes during the first two decades of life. The degree of acuity loss is variable. In one type of macular dystrophy, Best’s disease (which is dominantly inherited), most people keep reasonable reading vision until adult life. Another type, called Stargardt’s disease (usually recessively inherited) involves gradual deterioration of acuity to the 6/60 or “count fingers” level in most patients though acuity may only be mildly reduced at the outset (see page 39). Colour vision is usually normal early in the disease but becomes abnormal as the macular damage progresses. Peripheral visual fields are usually well maintained in these conditions since the peripheral retina is unaffected. It is appropriate to mention another condition called “juvenile retinoschisis” in this section. It is not strictly a macular dystrophy but the main effect on vision is from damage to the macula which involves splitting of the layers of the retina in the macular region (hence the name schisis). It is inherited in an X-linked pattern and only boys are affected. It is often picked up between the ages of 5 and 10 causing reading difficulties or failure of the school eye test. Visual acuities are usually in the range of 6/12 to 6/36 at presentation and the outlook for vision is quite reasonable, progression being slow.

Other associations: These disorders are not associated with abnormalities in other parts of the body.

How it is detected: There is often a characteristic appearance of the macula when it is viewed with an ophthalmoscope. For instance, there is a yellow discolouration of the macula in Best’s disease which is said to resemble egg yolk (hence its alternative name of vitelliform dystrophy from the Latin for “yolk”). Electrical tests of the retina as outlined in
Chapter 2 (page 51) can be helpful in making the diagnosis.

Medical treatment: No specific medical treatments are yet available.
Genetic counselling is important for the families of these children as in all cases of inherited disorders of vision.

Progression: Slow deterioration through life is the general rule, though the speed and degree of this deterioration is variable.

4.9 Optic atrophy

Definition: A group of diseases involving damage to the nerve fibres of the optic nerve which normally transmit signals from the retina to the visual brain.

Cause: The cause is usually genetic and the type of inheritance varies.
Dominant inheritance is the most common and tends to be associated with milder visual impairment than the rarer recessively inherited optic atrophy. Leber’s optic neuropathy (completely different from Leber’s amaurosis) has an unusual genetic inheritance whereby it is only transmitted through the mother and more commonly affects males, usually as teenagers or young adults. Other causes for such damage to the optic nerves include poisonous side effects of certain rarely used drugs or exposure to heavy metals such as lead. Pressure from a tumour or invasion from a cancer such as leukaemia can damage the optic nerves as can a severe head injury, particularly if the skull is fractured near the small openings at the back of the orbits through which the nerves pass towards the brain.

Eye structures affected: The optic nerves are the only structures usually affected.
Effect on vision: Children with dominant optic atrophy usually present before the age of ten often at the school eye test with symmetrical mildly reduced acuities in the range of 6/9 to 6/24. Visual field defects may affect both fixation and enlargement of the normal blind spot (centrocaecal scotoma). Blue-yellow colour vision defects may also be present. Leber’s optic neuropathy tends not to present until the late teens with fairly sudden and profound loss of
central vision in one eye, followed shortly thereafter by the other eye. Limited but useful recovery may occur over the following two years. DIDMOAD syndrome (see below) is a rare condition which produces severe but not total loss of central vision and colour blindness. One specific type of visual field loss occurs when the optic atrophy is caused by a tumour pressing at the crossover of the optic nerves (optic chiasm). It is the nerve fibres from the nasal side of each retina which cross over and it is these fibres which are damaged. The nasal part of the retina corresponds to the outer (temporal) part of visual space and hence it is the outer part of the visual field which is damaged in both eyes (called a bitemporal hemianopia), leaving only a narrow strip of vision in the centre. A child with such a bitemporal hemianopia may complain that objects disappear because there is a segment of blindness arising from overlap of the temporal field defects beyond the object of interest, and may show behaviour consistent with this observation.

Other associations: Wasting of the optic nerves (optic atrophy) may occur in association with a number of other illnesses. DIDMOAD syndrome (Diabetes Insipidus, Diabetes Mellitus, Optic Atrophy, Deafness) consists of two types of diabetes as well as both visual and hearing impairment. There is a group of inherited diseases involving the brain and spinal cord and which cause learning difficulties, and difficulties in controlling posture and movement, which may also be accompanied by optic atrophy. Such diseases include Behr’s disease, Friedreich’s ataxia and others.

How it is detected: Instead of having a normal healthy pink appearance, the optic nerve heads appear pale and white when examined with the ophthalmoscope. Electrical tests may also help make the diagnosis.

Medical treatment: Any cause for the wasting of the nerves such as a tumour, malnutrition or poisoning must be removed if possible. Any additional abnormalities such as diabetes must also be appropriately treated. There is no successful medical treatment for the optic atrophy itself.
Progression: As already mentioned this is variable. Dominant optic atrophy is only slowly progressive and usually mild, whereas Leber’s optic neuropathy is characterised by rapid onset severe visual loss with only limited if any recovery. **Cortical visual impairment**

Definition: Impairment of vision due to brain damage affecting the visual cortex or the pathways within the brain.

Cause: The most common cause of this condition is inadequate oxygen reaching the brain around the time of birth. Premature babies are particularly vulnerable to this type of injury (since the blood vessels supplying parts of the brain are fragile). Since more infants are now surviving due to improved medical care, the incidence of cortical blindness is increasing, and probably now represents the most common cause of visual impairment in children in developed countries. Other causes of damage to the visual brain include accidental or non-accidental head injury, infection such as meningitis and, as described in the following section, hydrocephalus.

Eye structures affected: In general the eyes themselves are unaffected, though there may be disordered control of eye movement (with difficulty in tracking moving objects), or squint present.

Effect on vision: This can range from the subtle defects of complex visual processing to complete absence of functional vision, depending upon the site and extent of the brain damage. One-sided field defects (hemianopias) may occur if the damage is asymmetrical. Damage to the left visual brain results in absent or disordered vision on the right side and vice versa. If the damage has been caused by an interruption of the blood supply to the brain there may be sparing of central vision despite severe damage to the peripheral fields on one side or the other. This phenomenon is called macular sparing and is thought to arise because the part of the visual cortex corresponding to the maculae (and hence central vision), which is situated right at the back of the brain, has a spare blood supply to keep it going if the main supply is damaged. Cortically blind children may navigate comfortably round objects of furniture and show awareness of moving objects surprisingly accurately even though they appear blind when their vision is tested by normal methods. This form of subconscious vision is called “blindsight” and is thought to arise from the alternative visual pathway which never reaches the visual cortex and hence never reaches consciousness. This pathway is faster than the cortical pathway and is
specially adapted for navigational tasks involving perception of movement (stationary furniture is moving visually when a child moves past it). This form of vision is present in human beings and most other species. It is more highly developed in animals such as birds which have to fly through trees at high speeds without crashing and where fast visual reflexes are essential. This type of vision may not be apparent at birth or even during the first two or three years of life. However, gradual development of navigational vision may take place during the ensuing years. Different aspects of visual processing such as the recognition of motion and recognition of geometric shapes or faces, occur at different sites in the visual cortex, some predominantly in one side of the brain (eg face recognition on the right side, and reading vision on the left) and other aspects of vision on both sides (eg colour and movement perception). The specific weakness of one such aspect of visual processing is called a visual agnosia. For example, inability to recognise faces is called prosopagnosia. Many of these agnosias are still being discovered and defined but they clearly have a profound effect on the way a child handles visual educational material. Figure 1.6 (page 25) illustrates some of the agnosias which are known to be associated with damage to particular areas of the brain.

This information has come from carefully assessing patients’ visual capabilities, identifying a particular weakness and looking at brain scans to locate the site of the brain damage. For example it has been found that patients with prosopagnosia commonly have damage to one particular site in the right side of the brain near the back, and so we conclude that the processing of face recognition occurs in this site in the brain.

Other associations: Learning difficulties, posture and movement difficulties (cerebral palsy), seizures and hydrocephalus may all accompany the visual problems in these cases.

How it is detected: The child has visual problems but examination of the eyes themselves reveals no abnormality. Scans of the brain are good at showing up areas of damage and can enable doctors to localise the areas of damage which may give clues as to what type of visual disorders to look for. Children with cognitive visual impairment tend not to be aware that they have a visual problem. Damage to a part of the brain for a specific visual function is associated with damage to the part of the brain responsible for knowing and understanding that function, so that
the affected person is not aware of her deficiency. The diagnosis is therefore made by watching
the child’s visual behaviour and identifying specific inconsistencies of this behaviour.

Medical treatment: No specific treatment is available once the damage is sustained and medical
care of vulnerable neonates and infants is directed at trying to reduce the risk and severity of the
brain damage occurring in the first place.

Progression: Episodes of cortical visual impairment may be temporary, though complete
restoration of vision is unusual. Gradual improvement of visual function may be slow, taking
months to years. One study found that cortically blind children often had no light perception
initially and with time gained colour vision, form perception and finally, improved visual acuity.
Some degree of visual agnosia often remains, however.

4.10 Corneal ulcer

Definition: These are a group of diseases passed on through families and affecting both corneas.
Cause: Genetic

Eye structures affected: Different ulcer affect different layers of the cornea. For instance
congenital hereditary stromal dystrophy (CHSD) affects the middle layer of the cornea, whereas
in congenital hereditary endothelial dystrophy (CHED) it is the back layer of the cornea (which
usually acts as a pump to keep the cornea dry and hence transparent) which is affected, and so
the cornea becomes waterlogged, losing its transparency. Another rare dystrophy called Posterior
polymorphous dystrophy (or PPMD) also affects the back layer.

Effect on vision: Although the disease is present from birth, loss of corneal transparency usually
progresses with age and only those mentioned above are likely to cause visual impairment in
childhood. As for other causes of corneal opacity, visual acuity is reduced and glare may be a
problem. Amblyopia may be an additional problem particularly with CHED and PPMD where
the cornea is cloudy from birth.
Other associations: None

How it is detected: There may be a family history (though often not in severe cases). Cloudiness of the cornea is noted and microscopic examination of the cornea in the clinic will reveal which layer of the cornea is affected and hence which dystrophy is present.

Medical treatment: Corneal grafting may be required in severe cases though recurrence of the disease in the graft is possible.

Progression: The cornea tends to become more cloudy with time.

4.11 Summary

Our study shows that infectious disease and cataract are more prevalent in this area as compared to other ocular disorders especially those of posterior segment. This fact may be the direct result of poor hygienic and sanitary conditions prevalent in this area and poverty.

Illiteracy and ignorance are additional factors. So the available funds and resources should be directed in these lines. Although less common diseases cannot be ignored since this hospital is a referral center for Lyari and Baluchistan areas.

4.12 Check Your Progress

1. Describe the effect of vitamin A deficiency and measles.
2. What is cataract?
3. What is albinism?
4. Write note on childhood glaucoma
5. Explain:
   A. Retinopathy of prematurity
   B. Retinitis pigmentosa
C. Macular Ulcer  
D. Optic Atrophy  
E. Corneal Ulcer  

Check Your Progress
8. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.8.1. Points for discussion
Points for clarification
4.13 Reference

Unit 5: Educational implications of different Eye disorders

5.1 Introduction
5.2 Congenital Abnormalities Of The Cornea,
5.3 Cataract:
5.4 Coloboma:
5.5 Albinism:
5.6 Laucoma:
5.7 Retinopathy Of Prematurity:
5.8 Retinitis Pigmentosa:
5.9 Macular Ulcer
5.10 Cortically Visually Impaired
5.11 Keratoconus:
5.12 Summary
5.13 Check Your Progress
5.1 Introduction

The clinician should review and discuss examination findings with the patient at the conclusion of the clinical evaluation. Providing the patient and the family a clear understanding of the ocular diagnosis, the natural course of the disease, the prognosis, and the functional implications is an important aspect of successful low vision management and rehabilitation. The advantages and disadvantages of various treatment options and the prognosis for success should be thoroughly discussed. The time required as well as the importance of patient motivation and compliance for successful rehabilitation should be discussed frankly and should not be underestimated. These factors should be reviewed and discussed at follow up visits, because low vision rehabilitation is a dynamic, ongoing process. Patient counseling and education may include but is not limited to:

- Review of the patient's visual and ocular health status in relation to visual symptoms and complaints
- Explanation of available treatment options, including risks and benefits
- Recommendation of a rehabilitation plan, with the reasons for its selection and the prognosis for attaining identified goals
- Written information and/or instructions for the patient
- Discussion of the need for follow up care and ongoing patient compliance with the treatment prescribed
- Recommendation for follow up and re-examination.

It is important to work with a qualified teacher of visually impaired children to establish the day to day educational implications of a child's visual impairment. The following educational implications described should be used as indicators – all readers should also become familiar with the practical approaches contained in Chapter 4. Where appropriate, children should always be asked what works best for them.

Educational implications

5.2 Congenital abnormalities of the cornea,

Both near and distance acuities are severely reduced to variable degrees. The extent of this reduction will determine whether Low Vision Aids (LVAs) will enable print reading or whether
braille will be required. Clouding of the cornea can cause uncomfortable glare because of the way light is scattered as it enters the eye.
Positioning of light sources and windows behind the child may be both more comfortable for him or her and prevent worsening of visual function (due to scattering of the light by the corneal opacities) if glare is a

5.3 Cataract:

Children should be encouraged to wear their glasses or contact lenses at all times at home and school. Separate reading glasses will usually be required for close work. Bright diffuse lighting without glare will improve visual performance in many cases.

This is because it causes the pupil to become smaller, resulting in greater depth of focus, allowing the child to see more clearly for near, distance and intermediate distances (see page 12). The teacher should look out for any apparent deterioration in vision in the child with unoperated cataract (where the cataract may be getting worse) or with operated factor. cataract (where capsule thickening may occur as explained above).

Frequent hospital visits and sometimes multiple operations may be necessary which may interfere with school, and should ideally be planned during school holidays if practicable and appropriate.

5.4 Coloboma:

These are as variable as the condition itself. Only children with both eyes affected may be visually impaired. Severe anomalies may produce significant visual and cosmetic impairment. Large iris colobomata may result in photophobia and reduced vision in bright focal lighting conditions similar to that experienced by children with aniridia. The importance of specialised training for the teachers of children with dual sensory impairment (whether due to CHARGE syndrome, Usher’s syndrome or other causes) is well recognised.
5.5 Albinism:

Positioning in the classroom is important both in relation to lighting (having windows and lights behind the child rather than in front will reduce photophobia as will the use of translucent material to diffuse the sunlight) and in relation to distance from the blackboard, remembering that distance vision is usually poorer than near.

5.6 Laugoma:

Visual impairment may involve acuity (corneal clouding and amblyopia) and/or peripheral visual field (optic disc damage). Both factors must be considered for each child, remembering that children with limited acuity may benefit from sitting close to the front of a class and possibly from LVAs, and that children with limited peripheral vision may have only partial visual appreciation of the classroom environment around them and may need help with mobility.

Classroom lighting needs to be considered since photophobia can be a feature, in which case diffuse lighting is therefore preferable. The wearing of glasses if appropriate should be encouraged. The child may be self-conscious about the unusual appearance of the eyes which may be different sizes from each other or obviously enlarged. Regular hospital visits and repeat operations are sometimes necessary which may interfere with schooling.

5.7 Retinopathy of prematurity:

These of course vary with the severity of the visual impairment which varies from mild to blindness, indicating possible braille usage. The macula is often involved and Low Vision Aids (LVAs) may therefore be helpful in addition to spectacles for myopia. Additional learning or movement control disorders (cerebral palsy) may be present, posing additional challenges to the child, family and teachers.
5.8 Retinitis pigmentosa:

It must be remembered that most children with RP will have quite restricted visual fields despite reasonable acuity, and that this has implications for the way in which the learning environment in the classroom should be set up, and for the child’s ability to navigate through the environment as he or she moves around.

Obviously, lighting levels must be adequate since vision is poor in dim lighting. Ironically many RP children have poor vision in bright sunlight and have problems in adapting from bright to dim illumination. Tinted lenses can be helpful in this respect, especially in summer. The most severe cases will have reduction in acuity even at school age and Low Vision Aids (LVAs) may be required.

5.9 Macular ulcer

Those children with more severe macular damage may benefit from the use of Low Vision Aids (LVAs). As the condition tends to progress gradually during school-age years, during which time educational material becomes progressively more detailed, a time can be reached when the child starts to experience visual difficulties. It is important to watch out for this problem. Initially, it remains possible to read but it takes longer. This can be associated with frustration, falling behind, and on occasion, challenging behaviour. Enlargement of educational material, where appropriate, and other strategies such as LVAs will help to address these problems.

5.10 Cortically visually impaired

These children often have a short visual attention span and their visual skills often seem to vary from minute to minute which can cause confusion to carers – tiredness and overly complex visual information can impede visual perception. Colour vision sometimes appears to be better preserved than vision for shapes and form, and children may be attracted to red and yellow objects in particular. This may be because colour vision is processed on both sides of the brain and so even if damage is sustained to one side, there may be some remaining “spare” brain on the other side for processing colour. It will therefore be helpful to represent shapes and letters
being taught to the child in colour against a highly contrasting and uncluttered background. Children with hemianopias may turn their head to the side when reaching for objects in order to use the good side of their visual field.

Cortically visually impaired children may find it easier to view educational material at a closer range than would be expected. In addition to magnifying the target (the closer you move your eyes to an object, the bigger it becomes) this also reduces the amount of visual information to be processed (the closer you move your eyes to an object, the fewer additional objects there are round the edges of the picture). The reduction in visual performance due to too much visual information is called “crowding” and teachers should be aware of the limits of the amount of visual information that can be taken in by the child at one time.

A typical example in a younger child is the inability to find a toy on a patterned carpet but the ability to find it on a plain one. A cortically visually impaired child may need to be presented with visual targets one at a time whereas children with other forms of visual impairment may be able to perceive a number of targets simultaneously. Another strategy which may help the child overcome this crowding phenomenon is to trace or follow objects with a finger.

An analogy which illustrates the impairment of processing would be to consider the effect on supermarket queues if, instead of having ten checkout counters working simultaneously, nine of them went out of order and all the customers had to pass through the same counter, one after the other. This lack of ability to parallel process visual information has a profound effect on the way in which visual tasks and processes are learned. If, for instance, a simple task such as dressing a doll is considered, a child will typically learn to do this by seeing the doll and the dress and imagining simultaneously in his or her mind’s eye the doll with the dress on, so that they know what the next stage of the task involves.

A cortically visually impaired child may not be able simultaneously to perceive the doll, the dress and the imagined dressed doll and hence will need to be taught to perform the task in a stepwise manner by imitation, with repetition and gradually more of the task being performed by
the child themselves. This will be quite time consuming, especially when more visually complex educational tasks are taught and learned. It is important not to expect the same speed of performance from children with cortical visual impairment as those children in the same class with visual impairment resulting from eye disease.

Some children like to gaze at bright lights, even to the point of gazing into the sun which should be discouraged by the carer because of the risk of burns to the retina. Paradoxically, other children with this condition are distressed by bright light (photophobia).

5.11 Keratoconus:

This condition is now successfully treated by corneal grafting and few if any affected children require specialist educational input. However keratoconus does sometimes accompany other conditions such as Leber’s amaurosis and Down’s syndrome and it is therefore worth noting. Children at risk of developing keratoconus should be discouraged from persistent eye rubbing. Visual acuity for near and distance may be reduced by corneal scars or severe astigmatism.

Children may require help with contact lens care before or after surgery. Children who do undergo surgery require many hospital visits and the operation should be timed with the child’s educational programme in mind. Any child who has undergone a corneal graft should be referred back to the hospital urgently if he or she develops a red eye since there is a risk of the graft rejecting and if a rejection is treated quickly the graft can often be saved.

5.12 summary

Visual impairment can have a significant impact on the patient's quality of life. The presence of a visual impairment can affect the ability to read, watch television, drive, work, learn, perform simple activities of daily living, and, in many cases, to maintain independence in a safe manner.

As the population ages, the number of patients who are visually impaired is increasing, as is the need for appropriate evaluation, management, and rehabilitation services for these patients.
Optometrists are uniquely qualified to manage visually impaired patients in that they can assess ocular status, evaluate visual functioning, prescribe low vision devices (e.g., optical, non-optical, electronic), and provide therapeutic intervention or coordinate other forms of care to improve the functioning of the patient's impaired visual system. Comprehensive optometric low vision care can significantly improve the quality of life for visually impaired patients.

5.13 Check Your Progress

1. Write note on following:
   1. Congenital abnormalities of the cornea,
   2. Cataract:
   3. Coloboma:
   4. Albinism:
   5. Laucoma:
   6. Retinopathy of prematurity:
   7. Retinitis pigmentosa:
   8. Macular ulcer
   9. Cortically visually impaired
   10. Keratoconus:

5.14 References


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Block 3: Implications of Visual Impairment and Needs of Visually Impaired

Unit 1: Psychosocial implications of visual impairment

Unit 2: Factors affecting implications of visual impairment: Age of onset, degree of vision, type of vision loss, prognosis, and socio economic status of the family

Unit 3: Effect of visual impairment on growth and development: Physical, Motor, Language, Socio-emotional, and Cognitive development

Unit 4: Educational needs of the visually impaired and need for expanded core curriculum

Unit 5: Implications of low vision and needs of children with low vision
Unit 1: Psychosocial implications of visual impairment

1.1 Introduction
1.2 Social-Cognitive Development
1.3 Theory Of Mind Development And Children Without Vision
1.4 Memory & Learning
1.5 Memory Performance
1.6 Using Spatial Mental Imagery
1.7 Imagery And Imagination
1.8 Summary
1.9 Check Your Progress
1.10 References
1.1 Introduction

The performance of children (and sometimes adults) with visual impairments (VI) on a range of tasks that reflect learning, memory and mental imagery is considered in this contribution. Sometimes the evidence suggests that there are impairments in performance in comparison with typically developing children with vision and sometimes some advantages emerge. The author’s aim is to describe some of her own and others’ findings and explore what they tell us about the cognitive characteristics of such children, so that progress with practical interventions can be advanced through understanding. The paper starts by focussing on social-cognitive development and in particular to consider the potential benefits of language in that development. This is followed by a review of some studies of learning and memory performance which provide a coherent picture of development without vision and finally ends with a consideration of spatial mental imagery.

1.2 Social-Cognitive Development

There has been increasing interest in the process by which children acquire social understanding and develop social relationships. Mothers, siblings, best friends – early life involves from the outset interactions with others and these ‘others’ often provide the richest source of knowledge from which to learn about the world. Theory of Mind (ToM) understanding is the term used to encapsulate young children’s ability to understand the thoughts, beliefs and desires in another person's mind. We can predict behaviour because we know what people are thinking. The mind of a mother retrieving a ladder and a new light bulb, following a loud bang from the direction of a light fitting, can be completely transparent when ToM ability is acquired and incomprehensible if it has not. Sighted children of about 4/5 years can master simple Theory of Mind tasks in quite explicit ways. Their development in this respect seems very much to depend on vision and researchers have emphasised the roles of eye-gaze, pointing, and joint visual attention as the early important precursors of this ability. ToM deficits can have serious consequences for children – this is seen not least in autism, where it is a defining feature. A visual impairment restricts the chance to associate emotional and mental states with their
behavioural correlates, since it is generally through watching others, and other situations, that such associations are learnt. This reasoning leads us to predict that children with VI may have difficulty with ToM development (see Pring, 2005 for a review).

1.3 Theory of Mind development and children without vision

The majority of children with profound visual impairment certainly have a delay in developing ToM, and this can mean that many do not show comparable ability to their sighted peers until about 12 years of age. A subset of such children with low verbal abilities may have longer-term difficulties when followed up individually and as a group (Peterson, Peterson & Webb, 2000; Green, Pring & Swettenham, 2003; Brown, Hobson, Lee & Stevenson, 1997).

Outcomes following this delay are uncertain and some of the potential risks include.

– social development and friendships may be harder to achieve,
– it may be harder to read and give social signals,
– personal style may be less empathic,
– play will be less likely to include pretence (this is because imaginative play may be dependent on understanding mental states), – learning may be problematic at school, partly because of the literal interpretation of language, and because of difficulties in adjusting learnt behaviour to the context- see Rita Jordan (2005) for more about this and other educational implications.

Vision is not the only critical channel for ToM development. Tager-Flusberg (1993) suggests that the primary way in which children get to know the contents of other people’s minds is through language. Language can be seen as a mechanism for sharing attention. Thus in this context it explains why Harris (2000) saw the role of conversation as being so critical for social understanding. Dunn’s work with young children and the content of their language has also provided a great deal of insight into these early sociallanguage mechanisms (e.g. Dunn, 2000; Cutting and Dunn, 1999; Hughes &
Dunn, 1998; Brown, Donelan-McCall N & Dunn, 1996). Her research suggests that in some ways parent-child language interactions are not as critical for social understanding as child-child interactions, where more mental-state language is used. Caregivers’ language has a particular quality: ‘eat your peas’, ‘time for the bath’, while a child may mention ‘I wish…’, or ‘pretend you’re a princess!’. So early social and conversational experiences in sighted children, even with members of the wider family, may have a positive impact on social understanding. Sibling conversations provide an enriched environment for children learning about others’ minds: friends playing in pairs and siblings use more imagination and mental state terms than do mothers and teachers. This effect is particularly true for children who are verbally less able. It is interesting to note that similar results have been found with children with hearing impairments, where ToM is delayed (e.g. Woolfe, Want and Siegel, 2003) and in this study, the quality of sibling relationship also had an impact. Clearly the quality of language input and language understanding is critical, as well as early social understanding, and this is being followed up in current research with Valerie Tadic (Tadic, Pring: Goldsmiths, London University; Dale & Salt: Developmental Vision Research team, UCL Institute of Child Health/Great Ormond Street Hospital London).

1.4 Memory & Learning

Moving on from social understanding and language to a consideration of more general aspects of cognitive function, it is unsurprising that many aspects of development in children with VI seem to show initial lags. Fortunately these children often learn to compensate for vision loss and achieve similar levels of intellectual and educational attainment to their sighted counterparts. However, there are some areas of research that have yielded somewhat less predictable findings and these can be unexpected and not so easy to account for. There are specific contexts where performance was found to be both superior and perhaps surprising. The first concerns the research on memory different types of information and the second concerns spatial mental imagery.
1.5 Memory Performance

It was during some research with blind children learning Braille that the author first began to see signs of superior memory performance in children with vision loss. She argued that the children’s ‘sound-based’ approach to learning to read explains their relative facility with developing literacy but it was not so easy to understand why their short-term memory seemed so good. Indeed over the years she noticed that there are many memory-related situations where children (and adults) who are blind outperform those with sight.

There are no definitive explanations for why such memory advantages should occur. However it would seem persuasive that relatively greater resources are allocated to auditory processing for those without vision and this greater attentional effort is likely to lead to better retention of the material. An outcome of the increased attention to such material may be to store it for longer-term retrieval in a ‘verbatim form’: a memory strategy that might be far less common amongst the sighted. Extra processing resources in the auditory channel could lead to a ‘seeing ear’ as French put it in 1952 (in Blau, 1964).

Certainly recent studies of individuals with congenitally profound visual impairment show processing of speech is faster than in sighted people (Röder, Rösler and Neville, 2000) and there is also better discrimination of speech in the context of a noisy room when compared to sighted people (e.g. Muchnik, Efrati, Nemeth, Malin and Hildesheimer, 1991). This may well be related to, but does not provide an explanation for, some of the memory advantages which are listed below and briefly discussed.

Short term memory advantages
– Number order in digit span tasks (Smits and Mommers, 1988; Pring et al, 1990)
Remembering the sequence of items, for example in a list of numbers, is particularly important in human memory. Without this ability information that depends on sequence such as spoken language cannot be properly retained and later understood and analysed. In other words verbal learning is dependent on this ‘shortterm working memory’ component that stores sequential
information ready to be further analysed by semantic and conceptual processing mechanisms that organize knowledge into our long-term memories.

*Prose comprehension task advantage (literal and inferential ability)*
– (Edmonds and Pring 2006).
In this task there was an overall advantage shown with the verbal material but additionally there was some suggestion that the literal prose memory, i.e. the verbatim memory for the text, was particularly accurately recalled.

*Recall of taped (auditory presentation) and brailled words and tactile pictures* (Pring, Freestone and Katan, 1990). Amongst other methods in this study, simple raised line drawings of objects were presented along with their names for the children to comprehend. It was interesting to find that their memories for the names were significantly better than their sighted controls.

- *Pitch (of voice speaking a word)* (Pring and Painter, 2002)
In this study adults with and without congenital vision loss were compared on their memory for a long list of words presented on an auditory tape. After their attempts at recalling the names they were asked if they could report whether the voice that spoke the words was a man’s (i.e. low pitch) or a woman’s voice (i.e. higher pitch). The participants who were blind were significantly better at accurately recalling this ‘perceptual’ information while the control participants had lost this information. The people with VI had superior pitch memory.

- *More accurate recollections of personal semantic memory* (Pring & Goddard, 2002)
This study was part of a larger series of investigations on autobiographical memory. In one part of the memory test there was a clear advantage in favour of the blind participants in that they were far more fluent in generating names of friends and teachers from semantic long-term memory and this pattern was particularly marked in the case of distant memories from primary school days.

Thus we have seen that memory advantages exist and can be helpful in a variety of settings for children and adults with VI but we are uncertain how to
capitalise on them. Accurate recall is not the same thing as greater intellectual knowledge — it is a different kind of knowledge. Nevertheless this memory recall advantage is probably related to the fact that children who are visually impaired often do have interests in music (Pring & Ockelford, 2006), good pitch memory (as seen above) and potentially absolute pitch abilities. This may go someway to explaining the abilities of a prodigious musical savant who is also congenitally and profoundly blind that Adam Ockelford and the author have been studying (see Pring, 2007).

At the outset of this paper it was mentioned that learning, memory and imagery would be considered in an attempt to understand better the psychological characteristics of children and adults with visual impairments.

Research findings in social understanding and memory have suggested that there are strengths and weaknesses associated with visual impairment. The following section attempts to restrict the area of enquiry to the nature of the internal mental representations constructed from touch-based perceptions.

For people with vision it is often difficult to think of objects, scenes and experiences without assuming that a visual mental world has to be involved. Yet research clearly shows us that whether individuals are blind or sighted, they often use spatial mental codes, and not visual ones, to represent thoughts that are spatial in nature (as in the game of chess).

1.6 Using Spatial Mental Imagery

Like many mothers the author has found the sharing of books with babies and toddlers as well as older children a profoundly satisfying activity. It was therefore a shock to discover, early in her research career, that there were almost no ‘picture’ books for children who were blind. Subsequently she explored how children with VI could gain from raised line and raised picture materials. For example Pring and Rusted (1980) asked children to feel raised line drawings of rare animals and to listen to a text about these animals. What they found was that having a picture present aided memory recall for the text — a result already known in the context of
education of sighted children. Indeed, not only did the children remember more of the information represented in the picture itself (e.g. long neck) but also the abstract textual information (e.g. Lives in Africa). How were the raised lines understood? Research with raised line maps as well as drawings of objects has shown that people with VI tend to use featural analysis strategies rather than a global strategy approach (see Ungar, Blades & Spencer, 1995). Pathak & Pring (1980) reported that blind children could confuse a raised picture of a daffodil with a toothbrush, or a watch (with strap) for a roundabout. This error pattern emphasised the structural nature of the representations as well as the featural approach.

Recently elegant studies by Vecchi and colleagues (e.g. Vecchi, Tinti and Cornoldi, 2004) in Italy have shown how effectively sequentially perceived tangible material can be integrated into stable spatial mental representations. Such research has helped educationalists both at school and in museums and galleries to consider the best ways to utilise such materials.

1.7 Imagery and imagination

Although it has been argued that individuals born without sight can understand tangible materials and form spatial mental representations, it has been said that they are impaired on ‘active’ spatial imagery tasks (e.g. Vecchi, 1998). A consequence of this would be a difficulty in creating novel forms using imagery alone. The creative imagination of children and adults with VI in the context of spatial imagery was the subject of a series of studies that Alison Eardley and the author conducted. The idea was to show the participants (twelve congenitally blind individuals and fifteen blindfolded sighted participants) a set of shapes and ask them to imagine the shapes in their minds, moving them around in order to form a new but recognisable form out of the four parts. They were told that the new form could be anything – such as an object, a letter, a number or a picture. They were also told that they could vary the size, position or orientation of each of the parts but that they were not allowed to bend or otherwise alter the form of the individual parts.

Some examples of shapes and the generated forms are given in Figure 1 below.
The investigators showed the participants the different shapes in 2 dimensional (2D) and 3 dimensional (3D) forms. They wanted to see how well they could construct a novel form with the shapes and whether there were differences if they were dealing with 2D (reliefs) or 3D shapes. See Figure 2. Would both groups produce similar number of re-constructed images? Would they produce different images?
Findings

First, there was no way found to differentiate the two groups’ imaginative reconstructions; they seemed to fall into the same categories. However, as can be seen in Figure 3 below the pattern of the performance across the two groups of participants did differ when it came to the number of legitimate responses they constructed.

![Graph showing mean number of legitimate patterns across 2D and 3D conditions for visually impaired and sighted participants.]

Interestingly, the same number of novel shapes was generated in the 3D condition across the groups but there was a highly significant interaction, with the participants who were blind producing significantly more legitimate shapes with 3D materials than with the 2D materials and the reverse being true for the blindfolded sighted group. No doubt this is partly because of familiarity with the materials. Yet the overall results of this experiment suggest that the ability to generate something novel using imagery is common to both those born with and without sight and pose interesting questions concerning the imagination and the role of our senses (further information about the nature of the mental codes involved e.g. visual or spatial, is tested and discussed in Eardley & Pring, 2007).
1.8 summary

Research on the psychological characteristics of children and adults with VI reveal that we cannot readily predict performance. In terms of social understanding there is likely to be a need to support development in order to avoid impaired performance. Yet we also need to be aware of memory advantages that allow children to display significant strengths in certain contexts. In the future it is hoped that both research and practical considerations can best guide teachers to design child-specific programmes for children with VI, hopefully bearing in mind their not inconsiderable abilities with tangible materials.

Psychosocial Consequences of chronic condition in later life that directly affects everyday functioning and life quality (Birren & Williams, 1982). Eye diseases such as glaucoma, age-related macular degeneration, and diabetic retinopathy show a clear positive correlation with chronological age. For example, the Framingham Eye Study found that only 1.6% of those 52 to 64 years old but 27.9% of those 75 to 85 years old can expect to suffer from age-related macular degeneration (Kini et al., 1978). This percentage grows to 53.3% in those over 85 (Gibson, Rosenthal, & Lavery, 1985).

Legal blindness, which may occur in conjunction with a variety of eye diseases, predominantly appears in the older-than-65 age group and increases from 1% in those 70-74 to 11.4% in those 85-89 (Salive et al., 1992).

The goals of this study are (a) to analyze the psychosocial consequences of age-related visual impairment by comparing the visually impaired with unimpaired older adults, (b) to identify the typical losses incurred by visual impairment in contrast to another age-related chronic condition with direct effect on everyday life, namely, mobility impairment, as well as (c) to report findings on the long-term consequences of visual impairment based on a 5-year observation period. In our study, we consider behavioral competence in the domains of everyday functioning and leisure as well as aspects of emotional adaptation (such as subjective well-being and future orientation) to be the major psychosocial consequences of age-related visual impairment.
Our research draws on two bodies of studies that, first, examine the role of sensory functioning (and vision in particular) within a broad scope of variables in order to predict outcomes in the behavioral and emotional domain, and, second, directly focus on the psychosocial consequences of visual impairment in older adults. Regarding the first body of studies, Marsiske, Klumb, and Baltes (1997) revealed with structural equation techniques that both vision and hearing moderate practically all of the agerelated variation in everyday competence. By differentiating between basic and expanded everyday competence (the latter covering also leisure and social activities), vision (opposed to hearing) was more strongly associated with the expanded component of everyday competence. Using a biographical perspective, Maas and Staudinger (1996) found that visual impairment predicted experienced drop of what these authors call "life investments" even after controlling for a broad range of sociostructural, personality, and cognitive variables. Similarly, Smith, Fleeson, Geiselmann, Settersen, and Kunzmann's (1996) multivariate analysis of the sociostructural, psychological, and health predictors of subjective well-being demonstrated the need to consider the direct influence of subjective visual impairment and the indirect influence of objective visual impairment in order to attain a sufficient model fit. Additional evidence for the relative importance of visual functioning as a predictor of everyday competence and leisure activities comes from large surveys, such as the cross-sectional study by Rudberg, Furner, Dunn, and Cassel (1993), and a study based on a 1-year observation period by Laforge, Spector, and Sternberg (1992); both included a sample of elderly adults living at home. The evidence is further supported by epidemiological research in the field such as the Salisbury Eye Examination (SEE; West et al., 1997). A recent study of 18,000 nursing home residents conducted by Resnick, Fries, and Verbrugge (1997) also revealed the statistically significant influence of vision on social engagement and use of leisure time.

Studies that directly focus on the psychosocial consequences of age-related visual impairment, the second body of work relevant to this research endeavor, clearly show its dramatic influence on the aging process. In a 5-year follow-up study, Branch, Horowitz, and Carr (1989) found visual impairment to have a stronger negative effect on instrumental activities of daily living (IADLs) than on basic activities of daily living (ADLs).
Hakkinen (1984), in an earlier, cross-sectional study, reported similar findings. Horowitz's (1994) study with nursing home residents revealed that visual functioning still has a statistical effect on everyday competence even after controlling for other potentially influencing factors such as comorbidity. Another study frequently cited in the field is the one conducted by Heinemann, Colorez, Frank, and Taylor (1988), which reported the negative effects of age-related visual loss on leisure activities. Branch et al. (1989) found that the emergence of visual loss in later life leads to a significant decline in life satisfaction 5 years later. The negative impact of visual loss on the aging self and on subjective well-being has been reported in other longitudinal (Anderson & Palmore, 1974) and cross-sectional (Gillman, Simmel, & Simon, 1986) analyses as well. However, the objective degree of visual impairment had no observable effect on life satisfaction (Horowitz & Reinhardt, 1992). A higher incidence of depression as a consequence of age-related visual impairment was also found in several studies (for review, see Horowitz, 1995).

Taking both of these research traditions together, there is clear indirect and direct empirical evidence that age-related visual impairment has a negative effect on the aging process. This study replicates and extends those findings by focusing on three shortcomings in the current literature. First of all, the specific consequences of age-related visual impairment—controlling for other potentially influencing variables such as age, gender, household composition, education, and objective and subjective health—have not been made clear. Second, it is not clear how the psychosocial consequences of visual impairment differ from those that arise from other chronic impairments that directly affect daily life (such as mobility impairment). Third, research concerned with the long-term outcome of the visually impaired elderly population is very rare.

A conceptual approach to these three research issues must adopt an explicitly psychological perspective in order to understand and explain the experience of age-related visual impairment; unfortunately, no such approach can be found in the current gerontological literature. Environmental geropsychology (environmental gerontology), as well as recent research on the psychological resilience of older adults, seem to be particularly promising theoretical avenues in this regard. From the perspective of environmental gerontology, the
significant loss of vision may be regarded as a dramatic alteration of person-environment (PE) transactions leading to PE misfits that negatively affect behavioral competence and significantly enhance the "docility" of the aging person for "environmental press" as suggested by the press-competence model developed by Lawton and associates (e.g., Lawton, 1982; see also Carp, 1987; Wahl, 1994; Wahl & Oswald, in press; Wahl, Oswald, & Zimprich, 1999; Willis, 1991). In this regard, the degree of visual impairment should play a major role as well; that is, even severely deficient visual capacity should lead to better behavioral outcomes than complete loss of meaningful visual contact with the outside world.

Furthermore, studies from the domain of environmental gerontology illustrate the critical role played by place attachment and familiarity in adapting to old age (Parmelee & Lawton, 1990; Rowles, 1983). Those findings suggest that visual impairment undermines behavioral competence outside the home more strongly than behavioral competence inside the home. Finally, because visual functioning is so essential to everyday competence (Lawton, 1982; Willis, 1991), one would expect lack of competency to be more pronounced in visually impaired persons compared with persons suffering from other chronic conditions that directly affect PE fit processes such as impairments in mobility.

Psychological resilience refers to the fact that older adults are remarkably adept at preserving a sense of well-being into old age, a period characterized by significant role loss and health decrements (e.g., Rowe & Kahn, 1997; Staudinger & Fleeson, 1996; Staudinger, Freund, Linden, & Maas, 1996; Staudinger, Marsiske, & Baltes, 1995). From this point of view, we would expect that probable losses in the behavioral competence domain due to a vision impairment should not generalize as strongly to the domain of emotional adaptation; that is, we expect a smaller influence of visual impairment on emotional than on behavioral functioning. Also, we would not expect significant differences in emotional adaptation between different degrees of visual impairment or between the visually and mobility-impaired older adults. While elderly adults with very severe visual impairment may be expected to bear a heavier psychological burden, less visually impaired older adults frequently are stressed by the fear of a progressive deterioration of their visual capacity. This may be the main reason that earlier research failed to find even modest correlations between objective degree of visual loss and
indices of emotional adaptation (Horowitz & Reinhardt, 1992; Wahl, 1997). Also, we would expect that psychological resilience is effective in other chronic conditions as well leading to the assumption that the emotional adaptation of mobility-impaired elderly adults is not fundamentally different from those visually affected. Furthermore, according to the psychological resilience perspective, elderly people suffering from a visual impairment will do everything to compensate for their loss and thus preserve their behavioral and emotional functioning for as long as possible. It is important to note that powerful and "natural" compensations—such as more extensive use of the auditory or tactile senses—are available to visually impaired older persons (Backman & Dixon, 1992).

The level of functioning they maintain, however, is probably lower than that exhibited by the unimpaired elders. If long-term losses do appear, we would expect them to arise predominantly with regard to outdoor activities, where compensation is more difficult than in the familiarity of one's own home.

In summary, the following hypotheses guided our empirical research. First, we expect that visual impairment leads to negative consequences in the behavioral and emotional domain even after controlling for potential influences such as age, gender, household composition, education, objective health, and subjective health. The negative effects should be stronger in the behavioral domain compared with the emotional domain, particularly among those who have lost all meaningful visual contact with their physical environment. Whereas the objective degree of visual impairment should differentially effect behavioral competence (with higher visual impairment leading to lower behavioral functioning), the severity of impairment is not expected to have a differential effect in the emotional domain. Second, we expect visual impairment to have a stronger effect on behavioral competence than mobility impairment, even after controlling for the potential influences just mentioned. No difference between the visually impaired and the mobility impaired is expected in the emotional domain. Third, in the long run, we expect the visually impaired elderly to be capable of preserving their behavioral and emotional level of competence, although on a lower level than normally aging individuals, because of psychological resilience. If decreases occur, they should predominantly appear in behavioral competencies that are exercised outside the home.
The issue of psychological distress associated with advanced proliferative retinopathy has recently been reviewed (2). Individuals with stable vision loss, whether complete or partial, exhibited psychological distress that was inferred to be secondary to the loss of capacity for diabetes self-management and to the limitations placed on physical activity. It was also suggested that there were even greater levels of psychological distress during the stage of acute and fluctuating vision loss. During this stage of active medical and surgical intervention the individuals had increased uncertainty about their future abilities. It was especially at this early stage that rehabilitational and support services frequently were not available. Wulsin et al. (2) further suggested that psychosocial disturbances were manifested early in the development of proliferative diabetic retinopathy and emphasized the need for early intervention and rehabilitation services as well as prospective longitudinal studies of psychosocial symptomatology and metabolic control.

In our study, the participants were evaluated as two groups: group A, those with stable visual impairment (partial or complete), and group B, those with unstable or transitional visual impairment still receiving ophthalmological intervention. The psychological assessments indicated low levels of self-esteem and self-reliance in diabetes management in both groups. Data from the MMPI, the Zung Self-Rating Depression Scale, and the Rand Mental Health Index suggested that subjects with stable vision impairment were moderately compensated relative to the transitional group. Significantly more patients in the former group were able to read Braille and had already been involved in rehabilitation programs for the blind before their participation in this study. Subjects with transitional vision loss manifested higher degrees of psychological distress, particularly depression. There was a trend toward poorer metabolic control reflected through fasting glucose and glycosylated hemoglobin among patients in the transitional phases of vision impairment, supporting a relationship with increased psychosocial distress, as proposed by Wulsin et al. (2) and Jacobson (20). Most of the individuals in the transitional group had not yet experienced rehabilitative intervention and very few had learned to read Braille. There appeared to be greater depression and lower self-esteem in men in the transitional phase of vision impairment who lacked adaptive skills such as Braille-reading ability.
It might be speculated that for men the loss of control implicit in the recent and fluctuating decrement in visual acuity was particularly traumatic because of culturally learned self-expectations with regard to independence and control.

These results support the inference by Wulsin et al. (2) that there is greater psychosocial disturbance among patients with acute and fluctuating visual impairment. It is not possible to state with certainty the reason for this association. It may be that the uncertainty and the unpredictable fluctuations themselves decrease the individual's sense of personal control and increase depression. However, in this group there was also less time since the onset of visual impairment and less exposure to rehabilitation services of any kind. Therefore, it might also be postulated that there has simply been less assistance and time to adapt to the vision impairment. For example, Braille-reading ability can be viewed as a marker for acquisition of adaptive skills. Lack of Braille reading (and lack of opportunity to learn) appear to be related to the decreased confidence and increased psychological distress demonstrated among the subjects with transitional vision loss.

Both groups demonstrated significant improvement in all psychological profiles after participation in this intensive, highly structured, 12-wk program. On several variables, the transitional group continued to exhibit, at the end of treatment, greater psychosocial distress relative to the stable impairment group despite roughly parallel rates of improvement. It is possible that over time and without benefit of intervention some psychological improvement can be expected. It is unlikely that the highly significant improvements in psychological profiles were due to the natural history of the visual impairment over the 12-wk intervention period. The subjects had visual impairment for an average of 1 yr in the transitional group and 5 yr in the stable group. It is not determined from these data which aspects of the program were essential for the observed clinical improvement.

A major role may be played by the alteration in the patients' isolation and opportunity for social exposure to peers and health-care providers. This in itself is important because this program was designed to utilize peer support and contact with health-care personnel as therapeutic modalities. It is our opinion that the structured quality of the treatment program and
the specific predetermined content made it especially valuable for these patients whose sense of personal control had been compromised. The degree of the observed effect maintained after the end of active treatment is a critical issue and psychosocial follow-up is necessary.

In conclusion, it appears that patients with transitional vision impairment have greater psychological distress than those with chronic stable vision impairment, although individuals in the latter group may be totally blind. Both groups demonstrated low self-esteem and self-reliance at baseline, and both responded favorably to an intensive multidisciplinary program offering physical exercise training, instruction in diabetes self-management techniques for the visually impaired, and group support. We suggest that early intervention is of clinically demonstrable benefit and may positively influence the course of the diabetes management. Further studies are indicated to determine the specific needs of individuals with diabetes in various states of visual impairment as well as the long-term effects of intervention.

1.9 check your progress

1. What is social-cognitive development?
2. Explain theory of mind development of children
3. Write note on:
   A. Memory & learning
   B. Memory performance

1.10 References


33. **Losada, Martinez, Ma Jose, Gonzales-Benito, C. (2005):** Early Attention and Family Adjustment with Blind and/or Visually Impaired Children, ICEVI European Conference – Conference Report (str. 507-513), Sachsisches Forderzentrum Chemnitz, Chemnitz.


Unit 2: Factors affecting implications of visual impairment: Age of onset, degree of vision, type of vision loss, prognosis, and socio economic status of the family

2.1 Introduction
2.2 Eye Conditions
2.3 Socio-Economic
2.4 Early Intervention In The Family Of The Visually Impaired Children
2.5 Functionality And Quality Of Life (Qol)
2.6 Barriers Preventing The Poor From Accessing And Utilising Eye Health Services
2.7 Degree Of Vision
2.8 Summary
2.9 Check Our Progress

2.10 References:
2.1 Introduction

Statistics on vision impairment are available from a number of sources and/or agencies, depending upon the information needed. The purpose for developing this document was to pull together commonly requested statistics so the reader can easily find answers to many frequently asked questions about vision impairment.

In obtaining the statistics included in this manual, the most recent and clearly defined statistics were used whenever possible. Users should note that estimates may vary depending upon the definitions used, specific age groups included and the method of data collection employed. Therefore, while this document attempts to use consistent statistics regarding definitions and populations to which the estimates apply, this is not always possible (e.g., some data is based on only persons age 45 and over, while different sources need to be used for younger age groups).

The statistics included in this manual were gathered from a variety of different sources and should be cited accordingly using the reference list provided. When available, the actual source and date of the information is also included in addition to the publication information.

As our population ages, cases of age-related macular degeneration (AMD), glaucoma, and cataracts are on the rise in Canada.

For instance, research indicates that people in their 50s have about a two per cent chance of getting AMD. This risk increases to nearly 30 per cent in those over age 75. Many misconceptions exist about vision loss. For example, very few people who are blind live in a world of total darkness. More than 80 per cent of people who are blind still have some degree of vision.

Some can see the outline of objects while others can tell from which direction light is coming. Sometimes, it may be hard to tell if someone is visually impaired at all. As a caregiver, you can maintain the person’s dignity and comfort level by remembering the following points:
• Identify yourself and address a person who is blind or visually impaired by name. Let the person know if you are leaving the room.
• Pointing won’t help. When giving directions, be specific.
• Describe the surroundings to the person you are caring for each time you are in a new location. Knowing the layout of a room or the view outside the car window will help the person feel comfortable.

2.2 Eye Conditions

Each eye condition presents different degrees of vision loss. Here are illustrations of some of the most common: Age-related macular degeneration (AMD) affects 25 to 30 million people worldwide and is the leading cause of vision loss in Canada.

The macula is located in the centre of the retina, at the back of the eye. It processes the images our brain translates into central vision. The size of a pea, the macula helps us see sharp detail, such as a freckle on a nose.

As our eyes get older, the membrane separating the macula from retinal blood vessels can weaken, depriving the macula of nourishment. When the macula degenerates, so does central vision. AMD can seriously affect one’s central vision in just a few months or over the course of several years. In severe cases, scar tissue from leaky blood vessels can cause irreversible blind spots. AMD will never cause total blindness since peripheral vision remains unaffected. For example, people with AMD may see the colour of someone’s shirt, but not his face; they might spot a dime on the floor as they walk through a room but cannot read the clock on the wall. Even when looking straight at you, a person with AMD will likely be able to see the colour of your hair or if you’re wearing a shirt with a collar but will not recognize your face. AMD also makes variations in colour hard to distinguish; for example, someone with AMD may “see” a raspberry-coloured sweater as a soft pink instead. While no two individuals with AMD experience exactly the same degree of vision loss, brighter light and sharp contrast in colour can make objects more visible to anyone with the condition. Ways to improve lighting and colour contrast to help the person’s peripheral vision are explained later in this handbook.
There are two forms of AMD: the dry form, which is the most common, and the wet form, which is less common but causes more severe and sudden sight loss. With dry AMD, varying degrees of sight loss are caused by deposits of drusen (age spots) that form in the macula. Wet AMD results from abnormal blood vessels forming and leaking into the macula.

The cause and cure for AMD are unknown. However, treatments are available in a small percentage of cases. Possible risk factors for the condition include smoking, genetics, hypertension, sun exposure, farsightedness, light skin or eye colour, and poor diet.

Age Of Onset Impairment

The age of onset blindness or impairment can have a significant effect on the affective development of individuals (Rosa, 1993). During the years the author spent working as a lifeskillstutor at the RLSB some students who were congenitally blind observed that they considered themselves lucky to be born blind instead of losing their vision later in life. These students felt that they were not missing anything because they had no idea what it actually meant to see. Jill a blind student went as far to remark that she preferred being blind than visually impaired. For her, the total loss of a sense was more comforting than having “something that did not function properly.” The view that being congenitally impaired (usually congenitally blind) is easier to come to terms with is often mentioned in the literature (Morse, 1983; Warren, 1984) but should not be over generalized. Affective development is individual and context dependent. Clearly there will be differences in the adaptation of the congenitally and adventitious impaired. Time is an important variable to consider. First, a congenital impairment forces an almost automatic acceptance of the condition. An adventitious impairment on the other hand is often accompanied by an element of surprise, trauma and depression that requires a certain accommodation period. The shock usually affects the individual and the family and communication between both parties is essential.

Training or experience should also be considered, as functional and positive selfdevelopment will depend on the individual’s mastery of the other senses and/or residual vision for the organization of information and active participation in society.
Facing Change

Vision loss is one of the many physiological changes people face as they age. When combined with other physically debilitating conditions, they can threaten a person’s self-confidence.

As a caregiver, your role involves empowering and encouraging the person under your care to take charge of his own rehabilitation process — to start working toward that first success that will mean so much.

Later in this handbook we will discuss lifestyle changes that will help maintain the person’s daily living activities. Imagine the sense of accomplishment and pride that a grandmother with AMD will feel once she bakes a batch of cookies for her grandson — thanks to the new adaptive lighting recently installed in her kitchen.

Peer support groups are invaluable. They offer the opportunity to learn how others are coping with their vision loss and how they’ve learned to do old things in new ways. Vision rehabilitation workers and eye-care professionals can also provide creative solutions to the challenges of living with various eye conditions.

The Caregivers’ Role In Facing Change

• Advocate for the person receiving care. Make sure you are both getting the information and services you need. Accompany the person to appointments. Make lists of questions and record the answers.

• Acknowledge that the person may not be a “joiner” and may prefer to talk one-on-one about experiences rather than joining a peer support group. Contact the CNIB to find out more about the counselling services it offers (see Chapter Five, page 33).

• Listen carefully. As the person receiving care adjusts to the loss of vision, he will ask for help only when it’s needed. Don’t always assume your help is required.
• Ensure the person has access to aids for daily living, such as magnifiers and other items discussed on pages 23 and 24.

• Encourage the person under your care to use his peripheral vision.

• Communicate with family members and especially with other caregivers. Form a support network of your own.

2.3 Socio-Economic

There is a far greater risk of becoming blind for people in the lower and extreme lower socio-economic status than in people in other socio-economic income categories [30]. For example, in poor countries, disadvantaged communities and especially poor households within these communities in rural and poor regions are more likely to be affected by trachoma [36]. Ho and Schwab (2001) in their comparison of the socio-economic status of countries found an inverse relationship between economic development and blindness [26]. The possibility of blindness was also found to increase with decreasing monthly income according to the findings of the Andhra Pradesh Eye Disease Study [30].

2.4 Early Intervention In The Family Of The Visually Impaired Children

Different perspectives on intervention with young blind children tend to influence development of children Simmons, Davidson, (1985), and it is important to understand implications of different programs for children with visual impairment, one example is given by Klein, And, (1988) when describing implications of Parent and Toddler Training Project for Visually Impaired and Blind Multi handicapped.

Scientists aim finding predictors of successful development of visually impaired children, how increased support make positive shift etc. Fazzi et al. (2005) emphasis early intervention in visually impaired infants and states it is mandatory. Oslo, treatment of sensory input impairments should begin as early as possible in a positive emotional setting that enhances the child's motivation and relationship with caregivers.
Fajdetić (2005) points out that it is important to give support to the family of visually impaired children. Support to the family helps family members, and Gaston, Lucerga, Rodrigez de la Rubia (2005) state that family contributes to personal growth to children with visual impairment. This could be elaborated that, not only parents of the child are immediate family. Household can have different members of the family – grandparents, uncles, aunts, siblings etc. Therefore, family of child with visual impairment is not homogenous group. This fact hast to be strongly considered when offering activities and programs of the support Walthes (2005, Fazzi et al., 2002), since all members of the family influence dynamics with their attitudes and views what is the best approach to the child with visual impairment. Among other important factors are several ones: culture, religion, education, life style, socio-economic status. Many of those are not addressed or approached in the proper way. Even though, support in the immediate home environment, has many challenges, general benefit that visually impaired child has is without doubt, something that proves early intervention is worth investing in. However, even with timely intervention, young children with visual impairment may have difficulty developing all needed skills.

Walthes (2005) cites O’Brien (2001) and say that it is important predictor of successful development of the blind child is early intervention. Early intervention gathers numerous programs aiming toward support of early development of visually impaired child. New approach in early intervention, imply support for the parents of the visual impaired child, who may be traumatized by this circumstance. The mothers generally bear most of the responsibility of early education of the child, and are deeply affected by new organizational, emotional and competence circumstance. Cormany (1992) presents the results of the research were development of family support services was the aim of the researched. A post-intervention survey indicated significant feelings of increased support and a positive shift in attitude by agency staff from a child-focused approach to a family-centred philosophy.

Beelmann A, Brambring M (1996) have realized research and results from a comprehensive evaluation of a home-based early intervention project for congenitally
blind young children. Five full-term and five preterm blind children, who had a mean age of 12 months at the beginning of the project, were visited at home with their families every 2 weeks over a 2-year period. Results showed that an individualized, handicap-specific early intervention using different types of parent involvement (co-therapist, parent counselling) could be implemented successfully. Compared with controls, developmental test data from the ages of 12 to 36 months showed an accelerating impact on the full-term children. However, no intervention effects could be found in the preterm children.

While working in the family, experts have to adjust approach, to be able to explain the specifics of the development of the child. Since partners in this process are parents, it is important to use teaching situation and well supported activities of learning, to explain the context and influence of maturation of the child with visual impairment (Grinhuis, Woundenberg, 2002).

2.5 Functionality And Quality Of Life (QoL)

Vision loss severely impacts on multiple dimensions of people’s lives. Healthy eyes and good vision play a critical role in the development of an individual and how the person interacts with others in society, therefore, vision loss impacts negatively on an individual’s quality of life and their functionality, and has major impacts on the global economy [34] [35]. This is confirmed by numerous studies that show that vision impairment has a major impact on the quality of life of individuals [31]-[33]. QoL is dynamic and subjective to the individual’s social, cultural and health perception [33] [37]. For most patients, going blind or losing their vision means adaptation to new conditions and way of life. There are those who consciously adapt, so as to overcome unknown impairments, and learn to function at higher levels than when they first develop the disability [38]. However, for those who find it difficult to accept their condition of functional deficit, their levels of adaptation vary and their ability to cope often influences their functionality and quality of life [38].
Lamouroux *et al.* (2009), contend that vision impairment/blindness threatens to restrict the individual from being able to conduct daily tasks and maintaining the dignity and respect which is earned by the ability of being independent [32]. Those who are already affected by the disease suffer from other health problems such as depression, distress and sometimes dementia, in cases of older people [37]. Other factors that are affected by vision impairment include physical mobility, functionality, education or academic status and social interaction and overall functionality [33]. These disabling factors of blindness prevent affected individuals from finding employment and securing a good life for themselves, and thus they become more vulnerable to poverty [33].

In addition, individuals who have impaired vision from eye diseases such as trachoma and conditions such as cataracts, often need assistance from their family members and other people to conduct daily tasks as it becomes increasingly difficult for them to move around [39] [40]. Without the ability to move around, including the ability to see where you going, affected individuals are forced to stay at home and furthermore they require the help of an extra able bodied person to assist them. Thus, Lee *et al.* argue that there is a significant association between vision impairment and a person’s functionality [39] [40]. If the person required to care for the blind person is a family member, the affected household is forced to live without the income of the two individuals who have been pre-occupied by the needs of blindness [41]. The lack of income is likely to expose households to risks of becoming poor, and if finance is not acquired soon, the family often sinks deeper into poverty. Children serving the role of care givers may be deprived of an education and subsequently face a greater challenge in escaping poverty as an adult [41].

2.6 Barriers Preventing The Poor From Accessing And Utilising Eye Health Services

The eye health state in developing countries is considerably alarming. The majority of the poor in developing countries are still burdened by treatable and preventable eye diseases, amongst other factors [42]. This suggests that poor people are unable to access the health services that they require. An important question to ask then, is “what prevents poor people from accessing and using eye health services”? The evidence suggests that underutilization of eye health services is aggravated by a wide range of public health issues common to both poverty...
and blindness such as gender inequalities [43], low socio-economic status [44] [45] [30], low income [46], low employment, illiteracy [47] and cost barriers [48]. In addition gender issues in some cultural contexts become a barrier to the proper correction of vision [5] [49] [50]. Women are often prohibited from accessing eye care services, while it is usually acceptable for men to seek treatment [12]. In some instances cultural beliefs regarding the concept of illness and utilisation of health care results in a situation where illness causation is interpreted as social and spiritual disfunction [51] [52]. Supernatural intervention is regarded as the main cause of serious illness in some communities, thus individuals and families seek relief from traditional healers instead of going to the local clinics and health care facilities [52].

**Barriers To Consider When Developing Eye Health Interventions For The Poor**

Eye health problems and diseases is a pandemic in developing countries due to a lack of resources, inadequate facilities and the lack of knowledge and accessibility to affordable health facilities [5] [13] [53]. Simply addressing health conditions without exploring and dealing with the barriers preventing people from accessing and utilising eye health services effectively hinders societies ability to combat health issues in developing countries [30] [34] [54] [55]. The following barriers need to be understood and considered when developing eye health interventions and implementing eye health strategies for the poor: clinical, knowledge, geographic, and financial barriers. These are discussed below:

**Clinical Barriers**

Clinical barriers that prevent the poor from accessing and utilising eye health services include lack of skilled public sector health practitioners, inadequate equipment and the lack of appropriate facilities to provide quality services [49]. The poor are also prevented from adequate eye health services because the clinical competencies of practitioners are difficult to maintain due to the rapid expansion of knowledge and technology [56]. In addition to these barriers, inadequate application or clinical and translational research results in the delivery of invalidated eye health treatment options. According to Frazier *et al.* (2009), these barriers result in people, often the poor, not receiving quality care that is adequate and appropriate [56]. Therefore this situation is exacerbated in the developing world—where access to eye health services is already limited, especially for the poor.
Knowledge Barriers

Apart from the clinical barriers to accessing eye health services, the lack of eye health knowledge by the poor is another barrier [29]. The majority of people in developing countries, especially those from poor households are illiterate and uneducated when it comes to eye health [42]. Good quality information and advice concerning eye health have not been widely available to the public, especially in developing countries. According to Gilbert (2008), people from poor households lack eye health knowledge, are illiterate and they lack motivation for reasons to correct eye conditions [29]. There are individuals who believe blindness is a natural part of ageing and therefore nothing should be done about it [57]. Gilbert (2008) affirms that for older people in developing countries, going blind is considered inevitable and they see no reason why it should be prevented or treated [29]. The lack of knowledge does not only prevent people from accessing services, but it also perpetuates the conditions which are detrimental to their well-being. As stated by Gooding (2006), households find themselves deeper into poverty after acquiring the disease than before the disease because they lack the knowledge needed to treat their condition [12]. In addition, illiterate people (often those who are poor) are usually left in the dark as some believe that treatment will make their vision worse [51]. In a recent, 2011, study conducted in KwaZulu-Natal by the Brien Holden Vision Institute [57], respondents reported that the fear of poor outcomes from eye correcting techniques prevents them from correcting their vision. Individuals from poor households believed that eye treatment may make their vision worse [57]. In accordance, Gooding (2006), points out that other studies have found that individuals in developing countries are exposed to conditions leading them to contracting eye conditions, and since they lacked knowledge on how to treat them, their lives have changed from good to worse [12].

This situation does not help the poor elevate themselves from poverty, instead being limited from knowledge causes them to remain in their poverty stricken situation [51]. Knowledge and education in eye health and the treatment options available as well as the facts and clarification of common misbeliefs are therefore critically important. Gooding (2006) affirms from research conducted that people who have been educated on eye health and the services available are more likely to undertake surgery or any type of vision correction as
compared to those who do not receive education and remain illiterate [12]. However, the ability to read and write has been noted as a major challenge for most people in developing countries when being educated on eye health.

**Financial Barriers**

Aside from inadequate or a lack of eye health knowledge, one of the most common barriers to accessing eye health services for the poor is finance [58] [59]. According to Kuper *et al.* (2010), the majority of individuals who are vision impaired in developing countries fail to meet direct and indirect costs of financing their health care needs [34]. Lack of funds play a huge role in the uptake of health services. Patients experience difficulties paying for treatments, transportation, and often they are unable to take time off from work to visit the health facilities—because they fear losing a day wage [59]. Ninety percent of those who have impaired vision reside in developing countries, most of whom live in conditions of poverty. Their priority is to acquire enough food for nourishment [60] and for most families in poor regions, acquiring food for sustenance is not a guarantee. Intrinsically, it is difficult for them to cater for their basic needs, let alone finance travelling to access health care [58].

People from lower income households are prone to suffer from uncorrected vision impairments [61]. According to He *et al.* (2007), patients in Nepal indicated that the lack of finances were responsible for their inability to correct their eye conditions, while in rural Nigeria, 61% of the un-operated patients could not afford eye treatment [49].

Financing eye health services and the uptake of eye correction is usually deciphered by the bread winners in the family or household [62]. In cases where the patient does not have personal savings, the main source of financing their health-related costs are generally supported by other family members. Other common sources of financing health related expenses have been found to be derived from loans or sale of property [59]. Selling property is only an option for the affluent families, since the poor usually do not have property to sell and thus their options to financing their health care needs are very limited.
In the absence of income and financial support from other family members, ill-health persons in developing countries tend to depend on self-made herbal remedies, most of which are self-medication and unsuitable for treating the conditions [51]. Such actions further perpetuate or complicate the condition and by the time they seek out qualified medical help, such as nurses and medical practitioners, their condition has escalated and large sums of funds are required for treatment [51]. In this case, vision impairment and possibly permanent eye disability or blindness pushes the individuals and families deeper into poverty.

The lack of funds has been the most acceptable and convenient explanation for limited use of services available to the public, however, this hypothesis has not been challenged much until the findings by Lewallen (2008), who found that even though some people will claim finances to be the main barrier, when they are interviewed, they give other reasons as well, such as the lack of concern in correcting vision [62]. Poverty is therefore a limiting factor but not the only factor influencing the uptake of services. Other interesting findings include the willingness of the patients to finance their eye health needs [49]. In the study conducted by He et al. (2007), patients with low vision were prepared to pay less than those with good vision, for the correction of their condition [49].

This could be explained by the fact that people with low vision may be restricted further in gaining an income. Further the younger generation was also willing to pay more than the older; this could be explained by the fact that younger people place great value on clear vision and mobility.

Age of onset

Our primary goal was to investigate the psychosocial consequences of visual impairment by comparing the visually impaired to normal older adults and simultaneously controlling for relevant covariates. The study was based on the theoretical background of environmental psychology and gerontology (e.g., Lawton, 1982; Wahl & Oswald, in press) and research on the psychological resilience of older adults (e.g., Staudinger et al., 1996; Staudinger et al., 1995), as well as a considerable body of current empirical research (e.g., Gillman et al., 1986; Heinemann et al., 1988; Horowitz, 1994).
Comparisons with normally aging elders confirmed the hypothesis that age-related visual impairment is associated with negative effects in the behavioral as well as emotional domain at the initial time of measurement; stronger negative effects were found in the behavioral domain even after important covariates were controlled for (Figure 1, the "a" section of each panel). However, the distinction between inside and outside activities did not reveal itself to be as important as theoretically expected in the behavioral domain. The degree of visual impairment was important in the behavioral domain (particularly with regards to ADL-IADL and the use of outdoor resources) but not with regards to leisure activity or emotional adaptation.

Furthermore, what the analyses of this study clearly show is that covariates such as number of self-reported illnesses (which was taken here as a proxy variable for "objective" health and comorbidity) and subjective health also play a significant role in predicting behavioral and emotional outcomes. The same was true with respect to age (particularly relevant with respect to functioning in ADLs) and household composition, where a better performance level with respect to ADL-IADL functioning was observed in those living alone.

According to our second research goal, we compared the competence and emotional profiles of visually impaired older adults with those of mobility-impaired older adults who were otherwise similar to both low vision groups at T1 (Figure 1, the "b" section of each panel). The result was that the blind group revealed higher impairment in ADL-IADL and the use of outdoor resources areas compared with the mobility impaired, whereas the results with respect to the severely visually impaired were somewhat mixed: Although lower in IADLs, these visually impaired elders tended to be comparable or even better in basic ADLs and the use of outdoor resources. One explanation for this finding may be that IADLs such as meal preparation, medication use, or unassisted telephone use generally require a modicum of visual capacity, whereas basic ADLs can be carried out in an automatic fashion. In regard to the use of outdoor resources, mobility impairment may have a greater effect on this capability than severe visual impairment. Visual impairment does not preclude rudimentary spatial orientation; hence, navigating in the "outside" world is still possible for many visually impaired elderly persons. No statistically significant differences were observed in the domain of leisure activity level (except regarding leisure outside) and in the domain of emotional adaptation. The covariates controlled
for in this study were found to have the same effects as in previous analyses contrasting the visually impaired and unimpaired.

Finally, the investigation shows that our third research goal, the long-term consequences of visual impairment, requires adifferentiated approach (Figure 2). As expected in theory, visually impaired older adults demonstrated stability in the behavioral domain (except in their use of outdoor resources).

Although the use of outdoor resources showed some degree of decline, it did not produce a significant Time X Group interaction effect. In contrast to our expectations based on psychological resilience, emotional adaptation decreased over time and in particular from the 4th to the 5th year of observation. Life satisfaction sank perceptibly (no Group X Time interaction), and future orientation dropped even more drastically (with an interaction between Group X Time showing stronger decline in the visually impaired elderly). In predicting outcomes at T3, the change of comorbidity across the 5-year observation period proved to be a statistically significant predictor of three outcomes (ADL-IADL, use of outdoor resources, general life satisfaction).

The same was true for changes in the subjective evaluation of health and the prediction of future orientation. In contrast, the number of reported illnesses and subjective health at T1 had only minor effects on long-term adaptation.

In order to properly evaluate and interpret these results, one must first compare and contrast them with former research in the field. With this study, another piece of research is at hand that clearly underlines the negative psychosocial consequences of severe visual impairment in the later years and its deleterious effects on behavioral competence and emotional adaptation. Differentiation is needed, however, with regard to the severity of the visual impairment; also, visual impairment is particularly crucial for functioning in complex IADLs. Thus, our results also point to the need for differentiation within the scope of everyday tasks depending on which environment-related competence (vision or mobility) is affected. Differences were less pronounced with respect to leisure activity level and emotional adaptation. In the latter,
comorbidity and subjective health were found to be even more important statistical influences on outcomes than being a member of a specific participant group. These insights can further contribute to the empirically established fact of a noncorrelation between the severity of visual impairment and emotional adaptation (Horowitz & Reinhardt, 1992) as well as the need to control for other variables and thus isolate the "pure" effect of visual impairment (see also Horowitz, 1994).

From the perspective of environmental gerontology, our findings also underline the crucial role that the visual system plays in PE transactions as predicted by the press-competence model (Lawton, 1982) or the PE fit model (Carp, 1987); visual contact with the physical environment, however rudimentary, helps to preserve action capacities in daily functioning. Conversely, the loss of meaningful visual contact leads to a dramatic PE misfit and a clear reduction of action capacities. In an exploratory study, we found evidence that this is not true for elderly individuals who have suffered from blindness since their early childhood (Wahl, Heyl, Oswald, & Winkler, 1998). These individuals performed significantly better on indices of daily functioning, leisure activities, and subjective well-being than adults who experienced visual impairment in later life, a finding that underscores the protective role of lifelong adaptation. On the other hand, the weaker negative effect of visual impairment on subjective well-being (compared with its effect on ADL-IADL) and the equivalence observed with respect to future orientation at T1 may be regarded as support for the assumption of psychological resilience (see also Rowe & Kahn, 1997; Staudinger et al., 1996; Staudinger et al., 1995). Although the visually impaired older persons cannot always compensate for decrements in everyday functioning, they can activate a whole scope of psychological mechanisms to counteract the negative emotional consequences of the loss experience. These mechanisms include trying to "make the best out of it," adjusting one's aspiration level, and drawing favorable social comparisons (e.g., rationalizing that visual impairment is better than being dependent on a wheelchair) as we have observed in additional data analyses (Wahl, 1997). All of these strategies are geared toward optimizing secondary control (Heckhausen & Schulz, 1995; Rothbaum, Weisz, & Snyder, 1982), and they take precedence when vision can no longer be corrected or restored through primary means of control. Although psychological resilience seems to be an important buffer to the negative consequences of visual impairment, it is probably not specific to it; rather, these
mechanisms have protective potential in many different kinds of loss situations caused by chronic conditions in later life. Nevertheless, when reflecting on coping behaviors and the role of resilience, we must also differentiate between those living alone and those living with others. Those living alone may demonstrate better functioning in ADL-IADL and more use of outdoor resources (as found in this research) simply because they must maintain a high level of action potential in order to continue living a solitary lifestyle. Conversely, the competence of those living with others may be undermined, at least to some degree, by dependency-supportive interaction scripts played out by the visually impaired and their significant others (Baltes & Wahl, 1996).

In the long run, however, the challenge posed by visual impairment may turn into a personal tragedy when the effects of age combine with worsened physical circumstances. The present study's findings again underscore the need to differentiate between behavioral competence and emotional adjustment. The visually impaired individual's performance on basic as well as instrumental ADLs and on leisure indices is stable (although in some cases lower than the performance level of the unimpaired elderly persons). This finding underscores the importance of psychological resilience as a tool to enhance action capacity.

And indeed, as we have also found in this study and summarized elsewhere (Wahl et al., 1999), the visually impaired older persons actively compensate for losses in daily functioning whenever possible. Note that this behavior would have been expected on the basis of theoretical arguments as well (Backman & Dixon, 1992). In theory, compensation efforts should be more effective inside the home because of familiarity and controllability of the home environment; this may explain the long-term loss in the use of outdoor resources we observed in this study.

With respect to emotional adaptation, however, the situation is different and, unfortunately, less encouraging. The observed longterm decline in both general life satisfaction and particularly in future orientation may be interpreted as warning signs that underscore the limits of psychological resilience in older adults and especially in those affected by a chronic condition. Again, however, additional factors such as change in comorbidity are important and support a cumulative-risk model. Obviously, the practical implication of this finding is that effective rehabilitation should include both psychosocial and psychotherapeutic elements; it is crucial for older adults with poor
vision to receive such intervention soon after the onset of visual loss (Tesch-Romer & Wahl, 1998).

Although this study has replicated and extended the findings from current research, the limits of this work deserve mentioning as well. Among the most critical of these is the relatively small sample size at T1, which was inevitably further reduced across the observation period of 5 years. Furthermore, we observed a tendency toward positive selection among the participants which increased even further across the whole observation period; this may have overestimated the potential of psychological resilience and adaptation over time. Also, measurements across time would be more comparable if all data collections had been performed in a face-to-face manner. This would also have allowed for remeasurement of visual function and the inclusion of these data in the final analyses. On the other hand, it should be acknowledged that the visually impaired older adults in this study were carefully selected based on ophthalmological expertise (and not based only on ratings done by trained interviewers). The participants were also observed for 5 years, which is a considerable length of time; longitudinal intervals of this length are seldom found in the current research literature. Thus, for future research, we argue for more longitudinal studies with visually impaired older adults. Control groups and control variables that have revealed themselves to be important in this, as well as other studies, should also be included.

2.7 Degree Of Vision

The World Health Organization (WHO) International Classification of Impairment, Disabilities, and Handicaps (ICIDH) system is used to classify disorders (diseases), impairments, disabilities, and handicaps.

The definitions are as follows:

A disease is an illness or medical condition, irrespective of origin or source, that represents or could represent significant harm to humans. An impairment is any loss or abnormality in an anatomical structure or a physiological or psychological function.
A **disability** is any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being. A **handicap** indicates a person’s disadvantaged position in society, resulting from impairment and/or disabilities.32

The term "visual impairment" refers to a functional limitation of the eye(s) or visual system due to a disorder or disease that can result in a visual disability or a visual handicap. For example, macular degeneration (a disorder) can result in reduced visual acuity (an impairment in vision). A visual disability is a limitation of the ability(ies) of the individual (in this example, the inability to read small print), and a visual handicap refers to a limitation of personal and socioeconomic independence. Simply put, a visual impairment may be considered as vision inadequate for an individual's needs.

The classification of visual impairment varies worldwide.33 The WHO classifies levels of visual impairment based on visual acuity and/or visual field limitation, and defines blindness as profound impairment (this can refer to blindness of one eye or blindness of the individual).32 The WHO definition of blindness specifies visual acuity less than 20/400 and/or remaining visual field less than 10 degrees in the better seeing eye. Visual acuity of 20/70 to 20/400 (inclusive) is considered moderate visual impairment or low vision. (Table 1) The National Eye Institute defines low vision more loosely, as a visual impairment not correctable by standard glasses, contact lenses, medication or surgery, that interferes with the ability to perform activities of daily living.

### 2.8 Summary

The purpose of this paper was to define (collect) and interpret existing literature (a body of recorded work) that has been produced by researchers and practitioners. The aim was to explain different aspects that affect emergent literacy of visually impaired children and can result with a delay in reading and language development. Interpretation of the relevant and up to date literature lead to the following conclusions:
(1) early intervention in the family of visually impaired child supports emergent literacy, but positive outcome can be under influence of the family values, dynamics, culture, religion, socio-economic status, etc.,

(2) emergent literacy of the child with visual impairment is strongly influenced by literacy media selection, that should be addressed with adequate literacy media approach,

(3) team approach and team work of the parents of visually impaired children, kindergarten teachers, VI teacher, early interventions and other professionals has significant role in supporting emergent literacy,

(4) not properly supported emergent literacy skills (pre-reading skills) of partially sighted and blind children, could result with poor skill acquisition and delay in language development; have impact on language related skills (socio-communicative skills),

(5) early life experience (global and supporting experience, and specific words and concepts) addressed through all perception modalities, help supporting emergent literacy in partially sighted and blind children,

(6) well applied methodology in supporting emergent literacy in early intervention (treatment targets, techniques and context), as well as procurable organizational models are inevitable elements in preventing delay in language development.

2.9 check our progress

1. Write a short note on Eye Conditions
2. Explain Early Intervention In The Family Of The Visually Impaired Children
3. Explain Functionality And Quality Of Life (Qol)
4. Which Barriers Preventing The Poor From Accessing And Utilising Eye Health Services?
5. Write note on Degree Of Vision
2.10 References:


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Unit 3: Effect of visual impairment on growth and development: Physical, Motor, Language, Socio-emotional, and Cognitive development

3.1 Introduction
3.2 Neuropsychological Profile: Cognitive Profile
  Intelligence
3.3 Language And Verbal Cognition
3.4 Motor Development
3.5 Stereotypies
3.6 Social Emotional Functioning
3.7 Early Social Functioning In Typical Development
3.8 Development In Social Understanding In Vi
3.9 Emotion
3.10 Theory Of Mind
3.11 Social-Cognitive Development
3.12 Theory Of Mind Development And Children Without Vision
3.13 Summary
3.14 Check Your Progress
3.15 References
3.1 Introduction

Ground-breaking progress in the field of neuro-developmental disorders has allowed us far more insight into blindness and visual impairment (VI). The field of cognitive neuroscience has now established itself solidly in the literature, combining the knowledge from cognitive psychology, clinical studies related to brain damage and neuroscience to open the way to significant advances in understanding. In recent years the optimism engendered from the adult studies has played a large part in providing the impetus for developmental studies and in particular developmental neuroscience (Johnson, 2005; Tager-Flusberg, 1999). It is from this developmental neuroscience perspective that we can begin to understand the cognitive and behavioral manifestations associated with blindness and visual impairment; albeit with the proviso that children with VI present particularly heterogeneous developmental patterns when compared to typically developing children (Fraiberg, 1971).

In considering the effects of blindness and visual impairment this chapter will focus on social understanding, language, cognition and motor-development. However it begins with brief introductions to epidemiology and the effects of blindness on the functional and structural organization of the brain, which it is hoped will provide a useful context in which to consider the development of children who cannot see.

Today the number of blind people in the world stands at some 45 million even though up to 75% of blindness could be avoided either by treatment or by prevention. The number of people with avoidable blindness will have doubled from 1990 to 2020 unless there is rapid and effective intervention, and the total number of the blind is projected to be as many as 76 million by 2020. To prevent this scenario, the World Health Organization (WHO) and the IAPB International Agency for the Prevention of Blindness (IAPB) have jointly initiated Vision 2020, a project that aims to eliminate the main causes of avoidable blindness by the year 2020 with the ultimate long-term goal of a world in which all avoidable blindness is eliminated and in which everyone with unavoidable vision loss reaches their full potential.

The top priority of Vision 2020 is the prevention of childhood blindness. At present there are 1.4 million children under the age of 15 who are blind. Around 500,000 children become
blind each year, 75% of them in developing countries. Shockingly, up to 60% of these die within a year of losing their sight. The survivors will not only have a lifetime of blindness to contend with but will also be adversely affected in terms of their emotional, social and psychomotor development. Blindness in children is complex, requiring multi-disciplinary collaboration from community, educational and medical services. Sight restoration and blindness prevention programs are among the most cost-effective interventions in health care and some 40% of the causes of childhood blindness are preventable or treatable.

The epidemiology of pediatric blindness clearly reflects socio-economic development. The prevalence ranges from 3/10,000 in affluent societies to 15/10,000 in the least affluent. The main cause of childhood blindness in the developing world is corneal opacification resulting from measles, Vitamin A deficiency and the use of traditional eye medicines whereas the main causes in the USA are cortical visual impairment, retinopathy of prematurity and optic nerve hypoplasia. At the other end of the spectrum in older age commonly reported causes of eye problems are cataracts, glaucoma, general ill-health and diabetes.

Congenital impairment certainly has different outcomes from late blindness and it is important for clinicians to distinguish cerebral from peripheral disorders (Dale & Sonksen, 2002). The cerebral congenital disorders of the visual system are more common and are associated with additional disabilities, including learning difficulties and cerebral palsy. Congenital disorders of the peripheral visual system (CDPVS) can be further subdivided into two groups. The first group is referred to as ‘potentially complicated’ CDPVS, which involves children in whom the peripheral eye disorder is a part of diagnosed paediatric disorder, including underlying damage to the central nervous system. Examples of ‘potentially complicated’ CDPVS are cataracts in Down Syndrome and retinal dystrophy in peroxysomal disorders (i.e., a group of congenital diseases characterized by the absence of normal peroxisomes in the cells of the body, such as Joubert Syndrome). The second group is referred to as ‘potentially uncomplicated’ CDPVS and involves children in whom there is no known involvement of the central nervous system in the visual disorder diagnosis. In the ‘potentially complicated’ CDPVS the incidence of additional disabilities is higher than in the ‘potentially uncomplicated’ where only 17% of global learning difficulties has been reported (Sonksen & Dale, 2002), which is relatively low for the
general VI population. Because of lower expected confounding variables of learning difficulties and motor impairments, the ‘potentially uncomplicated’ CDPVS group is a target population that is particularly useful for psychological investigations of vision-loss. Example diagnoses falling under the ‘potentially uncomplicated’ CDPVS classification are: Glaucoma, Mycopthalmia, Aniridia, Coloboma, Persistent hyperplastic primary vitreous, Familial exudative, vitreo-retinopathy (Norrie’s Syndrome), Cataracts, Leber’s Congenital Amaurosis, Cone Dystrophy, Optic Nerve Aplasia and Optic Nerve Hypoplasia.

3.2 Neuropsychological profile: Cognitive profile

   Intelligence

   Kolk (1977) reviewing many studies of intelligence concluded that ‘in general, average IQ scores do not differ significantly’ for blind children as compared to sighted children. Gerhradt (1982) reported that in terms of early categorical classification of form and function, as would be expected in free play, visually impaired infants of 14, 16 and 18 months followed the expected developmental path as would be predicted for sighted infants. Amongst the early studies though Tillman (1967) and Zweibelson and Barg (1967) refer to a more concrete concept bias at the cost of an understanding of abstract terms in the early childhood of blind children.

   There have however been some suggestions that differential visual impairment diagnoses are linked with specific cognitive strengths and weaknesses. While no definitive evidence has been published in this respect, an ongoing investigation suggests that the exception may exist in a superior intelligence exhibited by those with a diagnosis of Retinoblastoma (Tobin, personal communication forthcoming).

3.3 Language and verbal cognition

   Language has generally been seen as playing a powerful role in the development of children born with severely impaired vision (Landau & Gleitman, 1985; Warren & Hatton, 2003). Pérez- Pereira (1994) and colleagues have maintained over the years that language
provides a privileged tool for children with VI, who rely on it and benefit from it to a greater extent than children who are sighted.

Verbal reasoning and intelligence helps children to develop strategies to cope with the loss of a sensory channel. So linguistic competence is an important factor not only in terms of knowledge acquisition where it clearly plays an important role but also that it helps mediate social outcomes in children with severely impaired vision. For children who are visually impaired language-based measures are commonly used to assess their general intellectual level, making it difficult to isolate the contribution of language irrespective of a child’s general cognitive ability. With regards to the “regular language” skills of children who are visually impaired from birth, research generally shows that these are developed with relative ease. A number of studies have demonstrated some specific delays and irregularities in early vocabulary acquisition and production, syntactic knowledge and acquisition of semantic concepts in children with VI (Andersen, Dunlea, & Kekelis, 1984; Dunlea, 1989), but generally speaking the development and use of “regular language” is largely in line with that of sighted children (e.g. Landau & Gleitman, 1985). An interesting example concerns the use of color terms. Studies with school-aged children have found that blind children do understand that vision endows color information and that this information is associated with objects and scenes. They have learnt then that bananas are generally ‘yellow ‘and that the sky is ‘blue’ and show the same expectations or predictions of the use of such color terms in verbal prose along with understanding the subtleties which the color terms are associated.

While “regular language” skills such as articulation of speech, use of grammar, vocabulary level and conceptual understanding of the vocabulary in question, may enable a person to converse fluently they are not sufficient for achieving a successful socio-communicative interaction with another person. For this, one must also master pragmatic language skills, i.e. use language appropriately in a given context. Vision is implicated in language development in general, as visually-driven joint attention experiences in early childhood are seen as providing a framework within which language learning occurs (Tomasello
& Farrar, 1986). For this reason visual input may be of particular importance in the development of pragmatic language skills which are a cardinal feature of social communication.

The picture is somewhat unclear regarding language use for social and pragmatic purpose in children with VI. Research studies looking primarily at preschool children with VI, have raised concerns that children with congenital VI tend to use stereotyped language, show impoverished use of gestures for communicative purposes and use questions, sometimes inappropriately and to a greater extent than typically developing sighted children. It has been suggested that pragmatic language of children with VI has features that are similar to those of children with pragmatic language impairment (PLI) (Mills, 1993). Although it has been argued that such features of pragmatic language use of children with VI may have an important function in promoting their cognition and social interaction by providing an adaptive strategy to gather information, analyze speech, reduce memory load and avoid isolation. We ourselves have found that there are some irregularities in language presentation of a group of 15 children that we studied with congenital VI age range 6-12 yrs (Tadic, Pring & Dale, 2008a). Our findings were based on a structured language assessment (The Clinical Evaluation of Language Fundamentals – 3 : CELF- 3; Semel, Wiig, & Secord, 2000). We also used parental ratings of language and communicative behaviors using the Children’s Communication Checklist (Bishop, 2003). The checklist targets both structural and pragmatic language behaviors observable in an everyday context, but also social interaction skills evident from everyday language use. The children in this study were matched with typically developing children with the same age, gender and verbal IQ scores. The findings suggested that there is a discrepancy in presentation of language ability in children with VI; that is, average to good and potentially superior regular structural language skills, but weaker use of language for conversational and social purpose. The pragmatic language difficulties in the VI group were observed in a substantial proportion of the children, these together with the checklist scores on social interaction and restricted and repetitive actions combined to suggest that many were of clinical concern and consistent with autistic spectrum disorder (discussed below).
3.4 Motor development

Vision is implicated in balance, posture, gross and fine motor functions and although there is large individual variation significant motor delays have been reported. Hatton et al. (1997) looked at motor delays in 113 children aged between 12 and 73 months with a range of visual impairments but no additional disabilities. On the motor scale of the Battelle Developmental Inventory it was clear that the children with severe and profound visual impairment were very delayed in development, at 30 months of age their score was equivalent to 18 months, for example. However, sight made a significant impact since the children with some form perception, at the same chronological age scored at the level of 22 months and this trend continued with the availability of more sight.

Generally, the suggestion is that achievements that require self-initiated mobility are most significantly delayed such as elevating on arms in prone position, raising to a sitting position, pulling to a stand and walking alone. Vision seems to afford the impetus to cue a change in behavior and especially reaching out and grasping. Sound-initiated interest and the role of sound-making play objects in establishing the attention to and interest in objects to be grasped for the blind child are important. However research continues to find that there is some delay in both gross and fine motor development. In a study of 40 children with severe visual impairment, Levtzion-Korach et al. (2000) found that in all 10 aspects of motor development studied the children were slower than the sighted controls and the measurements predicted by the Bayley Developmental Scale (1993). For instance, they found that the children were delayed in standing alone with support (14.4 months compared to sighted children on average at 8.1 months). Not surprisingly climbing stairs with help (28.8 and 16.1 months) and standing on one foot (52.4 and 22.7 months) were amongst the greatest discrepancies reported.

Methodologically it is a challenge to gain insight into the meaning of motor-movements or the absence of movements in the young blind infant and child. For example, Lewis (2002) in her book on disability points out that the baby may turn her head, not to locate the sound, but in order to equalize the time at which the sound reaches both her ears. Another example would be the ‘freezing’ movement which is also a very common behavior in VI and initiated in response to
a noise or some interesting stimulus, reflecting an increased attentional focus on sound-based information by a child with VI (even though there may be no head movement).

3.5 Stereotypies

One of the most noticeable behavioral abnormalities found among children with SVI and PVI is that of “stereotypies” – these are perseverative or ritualized movements or postures (Brambring & Tröster, 1992; Hobson, Lee, & Brown, 1999; Wills, 1968). According to parental reports, the most prevalent stereotypies are eye poking, body rocking, hand and finger movements and manipulation of objects. Such repetitive and stereotypic behaviours are also a striking feature of autism and in that context have been linked with compromised mental flexibility (e.g., Lopez, Lincoln, Ozonoff, & Lai, 2005). Amongst children with visual impairment raised levels of such repetitive behaviors and stereotypic mannerisms in the school years correlate with certain attentional aspects of pre-school behavior such as the ability of the child to shift attention when so directed by an adult (Tadic, Pring & Dale, 2008b). They are to be distinguished from similar behaviors seen in mental retardation (Burack et al, 2000, p 265).

3.6 Social emotional functioning

Social understanding

In recent years, there has been a particular emphasis on the deleterious effects of visual impairment on the social communication and social understanding of children with severe or profound visual impairments. The increasing prominence of this potential vulnerability is caused partially because it affects many other aspects of cognition and impact on behavior. Certainly a number of researchers and clinicians have noted striking behavioral resemblances between children with congenital VI and children with autism spectrum disorders (ASD) for whom the use of visually-based information has been called into question (see Pring, 2005 for a general overview). Some preschool children who are blind can display a range of ‘autistic-like’ clinical features, including poor sociability and communicative competence, repetitive and restricted
patterns of play, unusual sensory preoccupations, unusual mannerisms, stereotypes of behavior patterning and echolalia. The mechanisms underlying specific social difficulties and the autistic-like presentation shown by some children with VI, as well as the mechanism by which many children with VI are able to overcome such developmental challenges, still remain poorly understood. Early social functioning and later social understanding in children with typical development and children with autistic spectrum disorder is outlined briefly below in order that the behavior of children with VI can be put into context.

3.7 Early social functioning in typical development

Infants benefit from varied and stimulating social lives from the earliest stages of their development. Early social experiences are dyadic in nature, with an infant taking part largely in face-to-face interactions only with one social partner at a time. Typically developing sighted infants demonstrate responsive conscious appreciation of the adult's communicative intentions and signaling by engaging in mutual eye-gaze, vocalization and rhythmic turn-taking patterns of behaviors (e.g., such as in social games like ‘peek-a-boo’). From around six months of age the new patterns of communication emerge, as the child moves from the purely dyadic interactions with one social partner into the world of objects. The main characteristic of these novel experiences is the infant’s awareness that their experiences of objects, people and events can be shared with others.

The coordinated sharing of attention (known as joint attention) between the child, an adult and objects in space has been the subject of much research. Its behavioral manifestation encompasses a complex set of actions, such as eye-gaze directing and following, point following, showing and pointing, the purpose of which is to negotiate and share the mutual focus of interest with a social partner. Research evidence (Tomasello & Farrar, 1986) suggests that such behaviors emerge typically between six and twelve months and consolidate by eighteen months of age. These shared experiences between infants and their caregivers are largely driven by visual modality, hence they are often referred to as ‘joint visual attention’. Later on these young children begin to show more complex aspects of social understanding. By between 18 and 24
months of age a child may engage in pretend play. Pretend play involves the child understanding that one object can stand for another, that pretend properties can be attributed to real objects and that pretend interaction can be carried out with a non-real object. Certain ways of thinking then, that follow on from joint attention and precede theory of mind, (discussed below) underlie the child’s ability to reason about hypothetical situations (e.g., pretending that a banana is a telephone).

As the child develops and has more varied experiences of the world and people, s/he develops a critical milestone of social understanding – Theory of Mind. ‘Theory of mind’, ‘mind reading’ and ‘understanding of others’ minds’ have been used synonymously in psychology to refer to the child’s ability to understand and attribute a range of mental states to self and others in order to explain and predict their actions and behaviors (Leslie, 1987). In other words, to make sense of the sophisticated social environment that surrounds them, children must be able to understand that other people have intentions, desires, thoughts, beliefs and feelings which are different from their own and that such states of mind will influence people to act and behave accordingly. Our actions then can best be understood by a child if s/he can guess what is in our mind but can be baffling if s/he is unable to do this. Understanding that people’s actions can be caused by their intentions is typically acquired by the age of five. Between the ages six and eight the child’s awareness becomes more sophisticated not just in terms of appreciating that people have beliefs about the world (which may be different from the child’s own beliefs), but also a growing sensibility/realization that they have beliefs about the content of others’ minds (i.e., about others’ beliefs), and similarly, that these too may be different or false. Over the later school years more complex and sophisticated use of theory on mind abilities are developed including, for example, the use of irony (Happé, 1994).

3.8 Development in social understanding in VI

Research has shown that children with VI can develop free from any cognitive, social or behavioral difficulties, and where difficulties do exist, these may be overcome, being viewed
simply in terms of a delay. Nevertheless, it has been reported that some children with blindness continue to experience problems, in particular in the areas of social interaction and communicative competence; emotional expressiveness and emotional recognition; symbolic and functional (i.e., pretend) play; behavioral mannerisms, rituals and stereotypies; repetitive and unusual patterns of language use (i.e., echolalia and pronoun reversal) and autistic-like developmental regression (Cass, Sonksen & McConachie, 1994).

In typically developing sighted children joint attention ability is believed to develop spontaneously, evolving out of a natural context of routine child-caregiver interactions; the caregiver’s sensitivity and responsiveness to the child are the key ingredients to the child’s developing interpersonal engagement. Vision is likely to facilitate the caregiver’s involvement, the manifestation of which is likely to be different for children whose attention cannot be directed through eye-contact and visual gestures. However, Preisler (1991) while watching very young children with VI, noted that the children’s interactions at first seemed to be developing well, but from around their first birthday they had a notable difficulty with establishing the ability to engage in joint attention. Although they could share themselves with their mother, aided by the mother’s affect attunement, the children were unable to co-ordinate their attention at the same time towards an object in the external world. The triangulation then between the two actors and the object was not apparent. Interestingly, Preisler also noted that the infants with VI were attentive to the sounds in the environment and reacted to those sounds by establishing frozen bodily and facial postures. However, while these subtle signs, in addition to distinctive body pointing towards the sound, may provide the means of ‘attention directing’ from the visually impaired child’s perspective, such behaviors may be too subtle and ambiguous for the parents to interpret or notice.

Rogers and Puchalski (1984) commented that where the child is visually impaired, both partners in the child-mother interaction are disadvantaged. While the child is deprived of visual information and the lack of effective communication by the mother, who cannot interpret the child’s signals, the mother is deprived of positive and responsive cues from her child that would let her know that she is doing the right thing. The study by Rogers and Puchalski highlighted the
poverty of responsive social exchanges and initiations in mother-child dyads in cases of children who are visually impaired in contrast to the interactions of sighted children and their mothers. Presumably, this ‘vicious circle’ of impoverished parent-child responsiveness is likely to be both a cause and a result of impoverished joint attention capacity in children with VI.

However, in a study of two infants with congenital profound VI, Urwin (1978) showed that the nature of caregiver-child responsiveness is largely adaptive; once the mother has discovered particular cues that elicit the response of their child with VI, they were able to use these cues repeatedly: “[They] used phased touching routines to alert the babies’ attention; they would trace their fingers around the babies’ mouths, blow on their faces, and encourage them to explore their own body parts. [They] would mock-imitate the babies’ fusses, coughs, splutters and sneezes to ‘dramatize’ the babies’ actions” (Urwin, 1978, p. 88). However, despite the effective socio-interactive routines that facilitated the dyadic relationships between the children with VI and their mothers, both infants studied by Urwin showed difficulties and delays in their triadic interactions that require children to incorporate objects into their interactions with adults and establish reversible exchanges of actions on objects. Neither child exhibited spontaneous ‘showing’ behaviors to initiate joint interaction with the mother; if any reverse actions of ‘giving and taking’ emerged, they were largely a result of specific training provided by the mother.

It must not be forgotten that the effects of vision are extremely powerful and as Bigelow (2003) argues, some behaviors will serve a different function in children with VI compared to sighted children. This serves to exemplify the challenges of research in this field. Children with severely impaired or absent functional vision depend developmentally on tactile information and memory, as well as auditory input such as sound changes, air currents, echolocation (Millar, 1988) and verbal guidance by others. Such experiences must at least to an extent allow them to learn to coordinate the spatial placement of objects and establish a shared focus on such objects with others. However, despite the evidence of some joint attentional engagement in children with VI, it generally appears that the nature of such engagement is qualitatively different from what is known about joint attention capacity of sighted children, and this is particularly evident at the level of joint attention.
In terms of play in young children with VI there have been mixed reports. Fraiberg (1971) was perhaps the first one of many who mention the lack of “pretend” or symbolic play as opposed to functional play among blind children. Symbolic play involves the substitution of one object for another, for example when a cardboard box becomes a ‘car’ or a wooden spoon takes on the features of a ‘baby’. According to the results of a parental survey by Tröster and Brambring (1994) blind children and sighted children who engaged in ‘undifferentiated manipulation’ of objects were aged 16 and 8 months respectively, those relating to objects were 26 and 13 months respectively, those manipulating objects appropriately were 40 and 24 months respectively and those playing symbolically were 55 and 35 months respectively. While Hughes et al. (1998) demonstrated in a study of young pre-schoolers that children with profound visual impairments (n=6) spent significant amounts of time in indiscriminate mouthing and manipulating of the toys (up to 75% of their time), while children with only severe sight loss (n=7) but some form vision far less so (44% of their time). It is clear from the above that some children who were blind demonstrated extremely delayed play behaviors though some contrasting results from Pérez-Pereira and Castro’s (1992) report that twin 3 year-old girls, one of whom was blind, frequently engaged in imaginative play, and Chen’s (1996) observation of symbolic play between blind children aged 20-30 months and their parents. Lewis et al (2000b) studied 18 children with VI and found some impairment in functional and symbolic play, but when they removed from the sample the 4 children who met the diagnostic criteria for autism then a different picture emerged, one where symbolic play was at a comparable level to children with sight. Bishop, Hobson & Lee (2005) also removed children who met a diagnosis of autism from their study of play in a group of congenitally blind children. They found that while some, socially able children were able to use symbolic play and were very similar to sighted children, the less socially able group showed significant poverty of symbolic play when compared to a matched mental age and IQ sighted group. Children with VI are restricted by their vision-loss and are likely to be vulnerable to developmental delay as a result but we have still a long way to go to see why some children with the same degree of blindness seem to be influenced by, what we could call, protective factors.
3.9 Emotion

Children who have profound visual impairments do have an understanding of cause-effect relationships that evoke basic emotions (i.e., happiness, sadness, fear and anger). More specifically, they are as able as sighted children to identify such emotions as they occur typically in specific situations, from their own perspective (e.g., How do you feel when you receive a new gift?) (Roch-Levecq, 2006) and from the perspective of others (e.g., Susan is given a new bicycle for her birthday? What will Susan feel?) (Dyck, Farrugia, Shochet, & Holmes-Brown, 2004). Moreover, Dyck et al. (2004) reported that, when asked explicitly to explain the meaning of emotions (e.g., What does the word ‘angry’ mean?), the semantic knowledge of children with VI even exceeded the knowledge of the sighted controls. However, both studies found that in the task which required children to represent mental states more implicitly the children with VI were not as proficient. Whilst being able to explain the meaning of basic emotions, the children with VI studied by Dyck et al. (2004) were less able than their sighted peers at recognizing vocal intonations specific to different categories of emotion. A similar difficulty among children with congenital VI with recognizing vocally expressed emotions has been reported by others; this was in comparison to recognizing environmental sounds in school-aged children (Minter, Hobson, & Pring, 1991).

Research suggest that the facial expressions of children and adults with VI are less florid than sighted counterparts. When asked to voluntary mimic emotional expressions on their faces Galati and colleagues (Galati, Miceli, & Sini, 2001) found that the same groups of muscles were activated to imply expression, but in a less marked way than sighted children. Their research showed that both spontaneous and voluntary expressions were more ambiguous to sighted observers, probably because they lack experienced-based support and feedback. Gallese (2003) has suggested that perceived actions in others are internally simulated or replayed automatically via motor, cognitive and emotional representations. A number of brain systems may be involved in such a process but a candidate neural network is the mirror neuron system. It is interesting to speculate on the importance of the mirror neuron system and internal simulations in development and indeed to consider what the impact of an impairment to such a system might mean, for example in autism (Oberman & Ramachandran (2007), or indeed, in the case of blindness.
3.10 Theory of Mind

Hobson (e.g. 1993) has been the most influential in recognizing and trying to explain the importance of vision for early development of relationships and social understanding. His experimental studies and that of others have indicated the serious difficulties confronting children with VI in developing Theory of Mind understanding (e.g. McAlpine and Moore, 1995). Peterson, Peterson, & Webb (2000) for example assessed two groups of children with differing levels of VI and across differing ages (averaging six, eight and twelve years). The findings of the study showed that, while the majority of the six year olds failed all four false belief tasks, the false belief performance improved with age, although significant difficulties could be seen in some eight year olds and to a lesser extent the twelve year olds. Certainly, many children with congenital VI lag behind and then catch up with their sighted counterparts- some need to take as longs as 6 or 8 years, and a subset of children with VI have longer-term difficulties. Such findings were most recently supported by Roch-Levecq (2006) who also demonstrated that primary school aged children with congenital and profound vision loss who have normal intelligence have a significantly poorer false belief understanding than developmentally matched sighted controls.

While the majority of the studies on theory of mind in children with VI assessed the early belief understanding, Pring, Dewart and Brockbank (1998) used the Strange Stories paradigm (designed by Happé, 1994) to assess their more advanced theory of mind understanding. The task consisted of presenting children with a number of stories about everyday situations where the story protagonists say things that they do not literally mean (i.e., tapping advanced mental state elements, such as sarcasm, misunderstanding, persuasion, pretence and deceit). Pring et al. found that the children with congenital VI were poorer than age-matched sighted controls in predicting whether the protagonist’s statements were true and giving contextually-appropriate mental state justifications for these statements. This suggested that the previously observed socio-cognitive difficulties, based on the children’s false belief performance, persist into later childhood in children with congenital VI (i.e., age 9-12). The authors also reported a significant relationship between the children’s general intellectual levels and the frequency of their appropriate mental
state justifications, suggesting that children with VI who are intellectually more able may also be more able to compensate for difficulties in social cognition than children with lower intellectual levels.

The issue of the link between autism and blindness is a thorny one. However, there is increasing evidence that congenitally blind children are ‘at risk’ of presenting with autism or an autistic-like condition (ALC). It may be more parsimonious to refer to the condition as ALC because as yet we cannot say whether such children show the neurotypical profile consistent with autism. While co-morbidity is likely to be as prevalent as it is in the sighted population it is likely that vision-loss itself interferes very significantly with those aspects of development that are impaired in autism. Thus we see the triad of impairments in varying degrees in children with congenital profound or severe blindness. There is no doubt that IQ may be a protective factor, along with a pre-disposition to show strengths in social ability – the research work of Hobson and his group working within a strong theoretical framework are likely to continue to make a significant contribution to our understanding (e.g. Bishop, Hobson & Lee, 2005). At the same time the studies that provide overviews of groups of children with VI, broken down by diagnosis, severity of vision-loss as well as behavioral measures, also helps to elucidate the nature of the relationship (e.g. Mukaddes et al, 2007).

In terms of diagnosis it is useful to know that the autistic-like clinical features in children with congenital VI were initially observed in small groups of children with specific diagnoses such as congenital Rubella, Leber’s Amaurosis and retinopathy of prematurity. However, the prevalence found across different etiologies implies that such psychopathology in children with congenital VI is not confined to any specific ophthalmologic disease. Instead it is the severity of VI and brain damage, with its associated intellectual impairment that are seen as the most important mediating factors along with the recent report implicating cerebral palsy (see Mukaddes et a, 2007).
3.11 Social-Cognitive Development

There has been increasing interest in the process by which children acquire social understanding and develop social relationships. Mothers, siblings, best friends – early life involves from the outset interactions with others and these ‘others’ often provide the richest source of knowledge from which to learn about the world. Theory of Mind (ToM) understanding is the term used to encapsulate young children’s ability to understand the thoughts, beliefs and desires in another person's mind. We can predict behaviour because we know what people are thinking. The mind of a mother retrieving a ladder and a new light bulb, following a loud bang from the direction of a light fitting, can be completely transparent when ToM ability is acquired and incomprehensible if it has not. Sighted children of about 4/5 years can master simple Theory of Mind tasks in quite explicit ways. Their development in this respect seems very much to depend on vision and researchers have emphasised the roles of eye-gaze, pointing, and joint visual attention as the early important precursors of this ability. ToM deficits can have serious consequences for children – this is seen not least in autism, where it is a defining feature. A visual impairment restricts the chance to associate emotional and mental states with their behavioural correlates, since it is generally through watching others, and other situations, that such associations are learnt. This reasoning leads us to predict that children with VI may have difficulty with ToM development (see Pring, 2005 for a review).

3.12 Theory of Mind development and children without vision

The majority of children with profound visual impairment certainly have a delay in developing ToM, and this can mean that many do not show comparable ability to their sighted peers until about 12 years of age. A subset of such children with low verbal abilities may have longer-term difficulties when followed up individually and as a group (Peterson, Peterson & Webb, 2000; Green, Pring & Swettenham, 2003; Brown, Hobson, Lee & Stevenson, 1997).

Outcomes following this delay are uncertain and some of the potential risks include.
– social development and friendships may be harder to achieve,
– it may be harder to read and give social signals,
– personal style may be less empathic,
– play will be less likely to include pretence (this is because imaginative play may be dependent on understanding mental states),
– learning may be problematic at school, partly because of the literal interpretation of language, and because of difficulties in adjusting learnt behaviour to the context- see Rita Jordan (2005) for more about this and other educational implications.

Vision is not the only critical channel for ToM development. Tager-Flusberg (1993) suggests that the primary way in which children get to know the contents of other people’s minds is through language. Language can be seen as a mechanism for sharing attention. Thus in this context it explains why Harris (2000) saw the role of conversation as being so critical for socialunderstanding. Dunn’s work with young children and the content of their language has also provided a great deal of insight into these early sociallanguage mechanisms (e.g. Dunn, 2000; Cutting and Dunn, 1999; Hughes & Dunn, 1998; Brown, Donelan-McCall N & Dunn, 1996). Her research suggests that in some ways parent-child language interactions are not as critical for social understanding as child-child interactions, where more mental-state language is used. Caregivers’ language has a particular quality: ‘eat yourpeas’, ‘time for the bath’, while a child may mention ‘I wish…’, or ‘pretend you’re a princess!’ . So early social and conversational experiences in sighted children, even with members of the wider family, may have a positive impact on social understanding. Sibling conversations provide an enriched environment for children learning about others’ minds: friends playing in pairs and siblings use more imagination and mental state terms than do mothers and teachers. This effect is particularly true for children who are verbally less able. It is interesting to note that similar results have been found with children with hearing impairments, where ToM is delayed (e.g. Woolfe, Want and Siegel, 2003) and in this study, the quality of sibling relationship also had an impact. Clearly the quality of language input and language understanding is critical, as well as early social understanding, and this is being followed up in current research with Valerie Tadic (Tadic, Pring: Goldsmiths, London University; Dale & Salt: Developmental Vision Research team, UCL Institute of Child Health/Great Ormond Street Hospital London).
3.13 Summary

There are multifactorial reasons for children without sight to present with similarities and differential aspects of cognition and behavior when compared to the typical child. At one end of the continuum we can see significant advances in brain research demanding new ways of thinking about neural plasticity and brain functioning and at the other end we see how children’s social interaction is modulated by their experiences. There are some areas of research that are not mentioned here because they lead to many imponderable questions such as the impact of diagnosis on the infant – caregiver dyad. Additionally, there has been a conscious effort to focus primarily on developmental issues rather than sum up the all the literature concerned with the loss of vision itself. Methodological considerations are also critically important but exacting standards are hard to maintain in an area of research with such a rare population. The amount of sight is hard to assess and can change in the samples of populations that are often reported, and other factors and problems linked to the site of brain impairment has been discussed above, yet these are all important considerations. Finally, behaviors exhibited by children who are VI can be hard to understand for sighted parents and clinicians alike. The visual channel is so important in integrating the senses – those with sight accept it unthinkingly. So that some behaviors may be hard to understand on the basis of current knowledge, for example why finger movements and manipulation might be delayed in blind babies, whose fists are often balled in the early months. Other behaviors, especially in relation to the development of social understanding, may be more successfully understood by learning from the findings with typically developing children. Although language and other non-visual channels of information can compensate for much, it seems that sight-based knowledge, founded on the massively varied array of visual stimuli (including people) in the natural and man-made world, has a surprisingly critical influence on growing up. The degree of blindness suffered by an infant has a significant impact on their behaviors, and yet there are also reports to the contrary, of behavior comparable to sighted counterparts. No doubt this is where the interactive nature of development, and the multiple factors that mediate changes, have an effect. The vulnerabilities have been outlined in this chapter but there are precious few reports of the protective factors which lead to the most positive outcomes – it is to this that intervention and research studies need to turn their attention.
3.14 check your progress

1. Explain Neuropsychological profile
2. Describe various Social emotional functioning
3. Explain Early social functioning in typical development
4. Write note on following;
   A. Development in social understanding in VI
   B. Theory of Mind
   C. Language and verbal cognition
   D. Motor development
5. What is Social-Cognitive Development?

3.15 REFERENCES

Century-crofts.


Unit 4: Educational needs of the visually impaired and need for expanded core curriculum

4.1 Introduction

4.2 The Population Of Students Who Are Blind Or Visually

4.3 The Expanded Core Curriculum (Ecc).

4.4 Compensatory Skills.

4.5 Sensory Efficiency, Including Visual, Tactual And Auditory Skills.

4.6 Orientation And Mobility.

4.7 Skills In Using Assistive Technology.

4.8 Social Skills.

4.9 Independent Living Skills.

4.10 Recreation And Leisure Skills.

4.11 Career Education.

4.12 Self-Determination.

4.13 Instructional Time.

4.14 Instructional Accommodations/Modifications.

4.15 Accessible Instructional Materials.

4.16 Cultural And Linguistic Diversity.

4.17 Appropriate Educational Placements For Students With Visual

4.18 summary

4.19 Check Your Progress

4.20 Reference
4.1 Introduction

Maximizing lifelong success is the goal of education. Students with visual impairments have unique learning needs that must be addressed if they are to access the general education core curriculum and become independent, productive citizens. Recent data indicate that only approximately 28 percent of out-of-school youth with visual impairments are employed (Cameto and Nagle, 2007). Thus, educators face a significant challenge in providing educational services that will enhance successful post-school outcomes.

Making appropriate decisions about the development and implementation of programs and services for students with visual impairments requires a clear understanding of their unique learning needs and the interventions necessary to develop successful transition goals for adult independence. Administrators must have knowledge about specialized personnel, materials, equipment and educational settings to ensure appropriate individual educational program planning for this unique student population. See Section VI and Appendix A. The unique needs of students who are blind or visually impaired are listed in the outline below and in Appendix A. This information can be used as a general framework for assessing each student with a visual impairment and for planning and providing instruction and services to meet the assessed needs.

Assessment and provision of services are addressed in the following sections of these Guidelines. Students with visual impairments are a heterogeneous group. Some have mild vision impairments while others are totally blind. Some have visual impairment as their only disability, while others have additional sensory, cognitive and/or physical challenges. Some students were sighted at one time, while others have never had vision.

Of the many ways that impaired vision affects learning, the three that have the most impact on education are:

1. Need for experiential learning. Even before sighted babies learn to crawl, they watch and visually organize their world. They begin to categorize objects in their environment as large or small, same or different, rough or smooth. They attempt to find a way to come into contact with
objects out of arms’ reach. When a child has a vision impairment, he or she often depends on the intervention of parents, teachers, and others to experience objects that are not within reach. A system for organizing the environment can occur, but only with the assistance of knowledgeable parents and teachers.

I Development of alternative skills. Most areas of the public school curriculum have been developed with sighted students in mind. Modifications and accommodations, such as instruction in reading and writing through Braille, using optical devices with standard print, using auditory materials for learning, and reading tactual graphics, can be made so that students who are blind or visually impaired have access to the general curriculum.

I Learning to access information that is acquired casually and incidentally by sighted learners. In addition to the general education that all students receive, students with visual impairments, starting at birth, need an expanded core curriculum (ECC) to meet needs directly related to their vision disability (NASDSE, 1999). These expanded curriculum areas include instruction in such areas as social interaction skills, orientation and mobility (O&M) skills, and independent living skills. See Section VI for more information on ECC.

4.2 The Population Of Students Who Are Blind Or Visually Impaired

As provided in the federal and state regulations, a “visual impairment including blindness” means an “impairment in vision that, even with correction, adversely affects a child’s educational performance.

The term includes both partial sight and blindness.” 34 CFR 300.8(c)(13); 8 VAC 20-81-10. The term “blind and visually impaired” is used in this document to acknowledge that all individuals who are blind are visually impaired, but that all individuals with visual impairments are not blind.
“A student with deaf-blindness” is one who has been determined to meet the criteria for deaf-blindness. “Deaf-blindness” means “simultaneous hearing and visual impairment, the combination of which causes such severe communication and other developmental and educational needs that they cannot be accommodated in special education programs solely for children with deafness or children with blindness.” 34 CFR, §300.8(c)(2); 8 VAC 20-80-10.

In 2008, children and youth with visual impairments including blindness comprised less than 0.8 percent of those, ages 2 through 21, who received special education services in Virginia. Specifically, 567 students had visual impairment (VI) as their primary disability; 476 as their secondary disability; and 281 as their tertiary. Most (98 percent) of the 1,324 students categorized as VI attended regular public schools. Fifty-seven percent of Virginia’s students with visual impairments including blindness have at least one coexisting disability.

The population of students with visual impairments is very diverse. They:

1. may be totally blind or have varying degrees of low vision;
1. range from 2 to 22 years of age;
1. may be born with a visual impairment or may have acquired a visual impairment at a later time in their lives;
1. may or may not be learners on the academic level of their sighted peers;
1. may have a stable or degenerative visual impairment;
1. may have any number of other disabilities (mild to severe cognitive impairment, physical disabilities, mental health, emotional or behavioral problems, autism and/or learning disabilities) or have hearing impairments (deaf-blindness);
1. may have a visual impairment in any part of the eye structure due to neurological causes (such as cortical visual impairment);
1. may have families who speak a language other than English; or
1. may have additional medical needs and considerations.

Adaptation to vision loss is shaped by many factors such as (1) availability and type of family support; and (2) degree of intellectual, emotional, physical, and motor functioning. Therefore, in addition to the nature and extent of vision loss, a variety of factors needs to be
considered in designing an appropriate educational program for a child who is blind or visually impaired, and these factors may change over time (Riley, 2000).

4.3 The Expanded Core Curriculum (ECC).

For children who are blind or visually impaired, evaluations to document the present level of academic achievement and functional performance for the development of the IEP are required by IDEA 2004. The term ECC is used to define concepts and skills that are typically learned incidentally by sighted students and that must be sequentially presented to the student who is blind or has low vision. An ECC may include:

1 needs that result from the visual impairment to enable the student “to be involved in and make progress in the general education curriculum; and
1 other educational needs that result from the child’s disability.” 8 VAC 20-81-110 G.2.

The presence of a visual impairment requires that these skills be thoroughly evaluated and systematically taught to students by teachers with specialized expertise. Without specialized instruction, children with vision loss may not be aware of the activities of their peers or acquire other critical information about their surroundings (NASDSE, 1999). As the IEP is being developed, the following knowledge and skills related to the ECC should be considered:

4.4 Compensatory Skills.

Compensatory skills are needed to access the general curriculum.

m Access to literacy through Braille and/or print, handwriting skills and auditory skills is required by the regulations implementing IDEA 2004, which state that, “In the case of a student who is blind or visually impaired, [the IEP team must] provide for instruction in Braille and the use of Braille unless the IEP team determines, after an evaluation of the child’s reading and
writing skills, needs, and appropriate reading and writing media (including evaluation of the child’s future needs for instruction in Braille or the use of Braille), that instruction in Braille or the use of Braille is not appropriate for the child.” 34 CFR §300.324(a)(2)(iii); 8 VAC 20-81-110 F.2.c. Many students with low vision use regular print with magnification devices. Some students need both print and Braille. Students with multiple disabilities, including deaf-blindness, may use a tactile or object symbol system for literacy.

Communication needs will vary depending on degree of functional vision, effects of additional disabilities and the task to be done. Students with deaf-blindness and others may use alternative communication systems such as tactile sign language, symbol or object communication, or calendar boxes.

Specialized instruction in concept development may be of significant importance when visual observation is limited. It is essential to offer specific and sequential hands-on, sensory-based lessons to build a broad base of experiences. In higher grades, there are many mathematical, geographical and scientific concepts that must be taught with adapted materials and strategies for students unable to learn from pictures and visual diagrams. A child with little or no vision may have fragmented understandings of the world without systematic tactile exploration and clear, verbal explanations. Some concepts are totally visual, such as colors, rainbows, clouds, and sky. Some are too large to experience completely, such as a building, mountain ranges, and oceans. Other items are too tiny or delicate to understand through touch, including small insects, a snowflake, or an item under a microscope. Some items are inappropriate to explore through touch such as wild animals or toxic substances. Fragmented concepts can impede social, academic, and vocational development. For information on the DBVI education program, see http://www.vdbvi.org/EduServices.htm.

4.5 Sensory Efficiency, Including Visual, Tactual And Auditory Skills.
Students who are blind and students with low vision need systematic instruction to learn efficient use of their senses.
Instruction in visual efficiency must be individually designed and may include using visual gaze to make choices, tracking car movements when crossing the street, responding to visual cues in the environment, and/or using optical devices such as magnifiers and telescopes.

For most students with visual impairments, an increased reliance on tactual skills is essential to learning. These skills should be considered as part of IEP development. It takes more detailed “hands-on” interaction and repetition to tactualy understand a concept, such as relative size, that may be readily captured with a glance by sighted individuals.

Systematic instruction in auditory skills may be needed for successful mobility and learning. Students must learn to effectively use their hearing to respond appropriately to social cues, travel safely in schools and across streets, learn from recorded media, and use echolocation for orientation.

4.6 Orientation And Mobility.

Safe and efficient travel throughout the environment is a critical component in the education of students with visual impairments. O&M evaluation and instruction should begin in infancy with basic spatial concepts and purposeful and exploratory movement. Instruction should then progress through more independent, ageappropriate motor and travel skills in increasingly complex environments. Vision provides the primary motivation for infants to begin to move their bodies, to raise their heads to see people, to reach toward objects, to move through the environment, and to begin to play. Significant delays and differences in meeting motor milestones can impact overall development. A child who is blind needs to know how classrooms or other environments are arranged in order to independently move with confidence. Systematic orientation to a space may be needed before placement and function of furniture and objects are familiar. More advanced age-appropriate travel skills, such as orientation to all school facilities, street crossings, bus travel, and community experiences, are needed as the student gets older. For information on the DBVI orientation and mobility services, see http://www.vdbvi.org/OMServices.htm.
4.7 Skills In Using Assistive Technology.

Technology permits students with visual impairments to access the general curriculum, to increase literacy options, and to enhance communication. There are a variety of high- and low-tech assistive technology tools designed specifically for students with visual impairments that require specialized instruction. These devices include, but are not limited to, electronic Braille note takers, colored transparencies, tactile symbols, calendar systems, video magnifiers, screen reader software, screen enlarging software, Braille displays, auditory access to printed materials, and magnification devices.

4.8 Social Skills.

A visual impairment can socially isolate a student, impede typical social interactions, or limit social skill development. A student with a visual impairment who is not able to see facial expressions and subtle body language to participate in conversations and activities may experience awkward and confusing interactions. Social skills that sighted children are able to observe and imitate may need to be taught to a child with a visual impairment. See http://www.vdbvi.org/RTILS.htm.

4.9 Independent Living Skills.

Home living, self-determination, vocational goals, community access skills, and appropriate interpersonal/social skills are critical for successful transition from school to independent living and employment. Young children begin learning basic skills in independent living from visual observation and imitation. Most students with visual impairments, however, will need systematic instruction and adaptations to standard equipment, such as modifications to read oven markings and to cook independently and safely. Depending on the level of vision, intellectual ability, and other unique characteristics of a student, adaptations may range from minor highlighting to tactile clues for matching clothing. Students can learn to apply make-up and perform other grooming activities with magnifying lenses, specially marked containers, and highlighted dials on electric shavers. These skills are not typically evaluated or taught in a
sequential and systematic basis in general education settings. Family members may require assistance and guidance to implement the proper adaptations that will permit practice and mastery of new independence skills within the home. For information on the DBVI rehabilitation teaching/ independent living services program, see http://www.vdbvi.org/RTILS.htm.

4.10 Recreation And Leisure Skills.

Students with visual impairments need to be taught recreation and leisure activities that they can enjoy as children and throughout their lives. They are often not aware of the options or the possible adaptations that would allow them to participate in these activities. Such skills include both individual and organized group activities for students at all ages and levels. See www.vrcbvi.org.

4.11 Career Education.

Students with visual impairments need to be taught about the variety of types of work and career options that are available since they cannot casually observe people in different job roles. They need opportunities to explore their strengths and interests in a systematic, well-planned manner. Career exploration and subsequent training may include the acquisition of specialized skills and equipment and an understanding of how to request and develop natural supports in the workplace to compete in the job market.

Students must be prepared for a wide range of vocational choices and the adaptations, including technological devices, which make them attainable. It is important to have opportunities to job shadow for concrete experiences of different career choices and to learn about other persons with visual impairments who have successful vocational outcomes. For information on the DBVI vocational rehabilitation program, see http://www.vdbvi.org/VocRehabServices.htm.
4.12 Self-Determination.

Self-determination includes personal decision-making, self-advocacy, and assertiveness based on an understanding of one’s abilities and related needs. These skills lead to competence, as opposed components of positive self-esteem. Specialized instruction in developing self-determination skills can help students participate meaningfully in their educational and transition planning and make positive adult lifestyle, job, and other life choices upon graduation. See www.imdetermined.org for information on the VDOE’s self-determination project.

Ongoing assessment of each of the ECC areas is critical to measuring success and assuring independence. Instructional needs in the ECC areas can be addressed using a variety of service delivery models. Collaboration between professionals will ensure comprehensive services. Although the TBVI and the O&M specialist are the primary resources for instruction in the ECC, family members, occupational therapists, physical therapists, speech-language pathologists, classroom teachers, other division personnel, and DBVI staff members can also play important roles in providing the needed instruction.

4.13 Instructional Time.

It is difficult to find time within the typical school program for addressing all needed elements of the core curriculum and ECC. Flexibility within the school schedule may be required. The ECC may need to be addressed in many ways, including:

1 incorporation of ECC goals within the core content areas. See Appendix E;
1 extension of preschool (for children ages 2 – 5);
1 additional years in school and entitlement through age 21;
1 after-school enrichment programs sponsored either by school division or community agencies;
l summer enrichment programs, either locally, or offered by the Virginia School for the Deaf and the Blind at Staunton (www.vsdbs.org) and Virginia Rehabilitation Center for the Blind and Vision Impaired (www.vrcbvi.org);
l programs offered by DBVI (www.vdbvi.org); or
l for young children, intervention in the child’s home or natural environment through Part C services (www.infantva.org) or Part B preschool.

4.14 Instructional Accommodations/Modifications.

In addition to the specific areas of the ECC, students with visual impairments may need accommodations to access the same assignments as their peers. These accommodations may include extended time, specialized instruction, specialized materials, and environmental adaptations to reach the same levels of performance as sighted students. Individualized instruction for certain skills that may be difficult to learn in a large group setting may be needed for concepts such as map skills, advanced mathematical concepts, and spatial concepts. Specialized equipment and materials may also be needed, such as a braillewriter, dark and/or raised line paper, a long cane, an abacus, specialized software for computers, low vision aids, and electronic equipment for auditory access to print material. For most students, accommodations should be designed so that success in the general curriculum can be attained without lowering expectations. Some students may also need modifications to the general curriculum to develop an appropriate individual program.

4.15 Accessible Instructional Materials.

For many students with print disabilities, the limitations of print materials create barriers to access and therefore to learning. In 2004, Congress passed amendments to IDEA requiring printed textbooks, printed core materials, and other educational materials to be converted to alternate formats (Braille, large print, electronic text, and audio recordings) to meet the unique learning needs of students with print disabilities. The Accessible Instructional Materials Center of Virginia
(AIM-VA) assists the VDOE in implementing the National Instructional Materials Accessibility Standards (NIMAS) regulations under IDEA 2004.

The AIM-VA, part of the Helen A. Kellar Institute for Human Disabilities at George Mason University, produces and delivers accessible instructional materials for school divisions in Virginia who have students with an IEP indicating a need for alternate formats of printed materials. The AIM-VA also provides training and technical assistance to school divisions who order and use these accessible instructional materials. See www.aimva.org.

4.16 Cultural And Linguistic Diversity.

Increasing numbers of students in Virginia represent diverse cultural, ethnic, and religious groups, including students who are blind or visually impaired. Individual cultural groups may not share in the beliefs and practices of the majority population; therefore, educational personnel must be sensitive to cultural responses to disability and work with families to understand how their beliefs may differ with that of the school. For example, it may be necessary to alter the methods used in sighted guide techniques to conform to cultural expectations about appropriate touch.

4.17 Appropriate Educational Placements For Students With Visual Impairments

Children under the age of two or three are served through Part C early intervention services in the setting deemed most appropriate to each family situation. The most appropriate setting is determined as the placement supporting the family in achieving desired outcomes for their child with as little disruption as possible to daily routines and family life. Children who have their second birthday before September 30 may be served in the schools through Part B. For preschool and school-age students, IDEA 2004 and its federal and state implementing regulations guide placement. Part B regulations require public agencies to make available a continuum of alternative placements, or a range of placement options, to meet the needs of students with disabilities for special education and related services. The options on this
continuum, which may include regular classes, special classes, separate schools, and instruction in hospitals and institutions, must be made available to the extent necessary to implement the IEP of each student with a disability. 34 CFR §§300.115 and 300.116; 8 VAC 20-81-130 B and C.

The IEP team should determine an appropriate learning environment based upon each student’s individual educational needs. By law, the team must consider the least restrictive environment (LRE) for each student. LRE is typically interpreted to be the placement as close to the child’s home as possible in a setting with nondisabled peers and with an appropriate program to meet assessed needs of the individual child. Consideration should include both the core and expanded core subjects for a student with a visual impairment. The law requires the IEP team to first look at placement in general education with supplementary services, program modifications, and supports from school personnel as needed.

After considering educational needs in both the expanded core and general curricula, the IEP team must carefully select from an array of potential settings. Collaborative settings, itinerant teacher services, resource rooms, self-contained classrooms, and placement at such schools as Virginia School for the Deaf and the Blind at Staunton (www.vsdbs.virginia.gov) are all options to be considered by the IEP team. Students’ needs drive placement decisions. Any service delivery option may be appropriate for an individual student at any given time, and the appropriate placement option may change over time for a particular student. 34 CFR §300.116; 8 VAC 20-81-130 C; 8 VAC 20-81-140.

“For a child to become proficient in Braille, systematic and regular instruction from knowledgeable and appropriately trained personnel is essential. For blind and visually impaired children, including those with other disabilities, IEP teams must ensure that the instructional time allocated for Braille instruction is adequate to provide the level of instruction determined appropriate for the child.”
OSERS, 2000, p. 36589.

4.18summary

Students with visual impairments, including those with multiple disabilities and/or deaf-blindness, are a heterogeneous population. The small number of students may make it difficult
for any one school or program to have full knowledge and adequate resources to meet varied and intensive needs of this unique student population. This document was designed to provide guidance and resources for key components to be considered when planning for appropriate individual educational programs for students with visual impairments including blindness. Further information and support is available from the regional education coordinators from the DBVI, Virginia School for the Deaf and the Blind at Staunton, and the VDOE.

4.19 Check Your Progress

1. write note on The Expanded Core Curriculum (ECC).
2. explain Compensatory skills.
3. explain Sensory efficiency, including visual, tactual and auditory skills.
4. what is Orientation and Mobility.
5. describe various Skills in using assistive technology.

4.20 REFERENCES

Education.


Unit 5: Implications of low vision and needs of children with low vision

5.1 Introduction

5.2 Social Implications

5.3 Passing

5.4 Psychosocial Adjustment, Self-Concept Identity & Self-Esteem

5.5 Implications For Professionals And Parents

  Principle 1: Begin Motor Play Early
  Principle 2: Make Movement Enjoyable
  Principle 3: Attend To Intensity
  Principle 4: Integrate Movement Throughout The Day
  Principle 5: Help All Children Play
  Principle 6: Send Play Outdoors
  Principle 7: Advocate For Play To Support Learning

5.6 Summary

5.7 Check Your Progress

5.8 References
5.1 Introduction

Individuals who are blind or have low-vision must face the constant challenge of psychologically and socially adjusting to their disability. Tuttle (1987) defines adjustment as the process of responding to life’s demands and stresses. While there is no direct relationship between impairment and psychopathological disorders (Harrington & McDermott, 1993), the heterogeneous nature of eye-conditions and the possible differences in family life, education, social and economic status suggest that adjustment is idiosyncratic – it is personalised, peculiar and dependent on the individual and his/her experience. In the paragraphs that follow, several aspects of psychosocial adjustment to blindness and low-vision will be presented and the role of the family, peers and the society in general will be discussed in relation to the formation of a positive self-concept and the development of high self-esteem.

Throughout the discussion examples will be provided from the author’s research with students from Dorton College at the Royal London Society for the Blind (RLSB).

5.2 Social Implications

Man is a social being and a person’s sense of identity is dependent on the manner it is perceived by others. We adapt and live based on constant feedback from the family, the community and friends. Feedback allows for the control and organization of actions and provides checks on behaviour. The delivery of feedback is crucial and can have an important effect on one’s sense of identity, self-concept and esteem. Individuals who are blind or have low-vision must rely to a greater extent on auditory and tactile cues. While this type of information still allows for the discerning of moods, emotions and can help the individual make inferences about a person’s character and emotional state; it lacks the visual complement afforded by facial expressions. Morse (1983) observed that the blind are not very accurate at deducting and judging personal characteristics by voice alone. For this reason, communication must be clear, reliable and as redundant as possible.
In some individuals who are blind or have low-vision the normal appearance of the eyes can lead to a certain amount of confusion and in some cases lead to mistrust, suspicion or doubts about the degree of impairment. Roger, one of the author’s most extreme cases lived through his early teen years under scorn, disrespect and was often taken for a lazy, unmotivated and careless man. In his early teens, Roger complained to his mother that he could not see very well. Together they visited a series of ophthalmologists who failed to diagnose his condition, many of them saying that they could not find anything wrong with Roger’s sight. Roger’s performance at school declined and some of the teachers went as far as to say that he was lying about his vision to make up for his lack of interest in school activities and his low grades. In reality Roger could barely read from the blackboard! Roger was finally diagnosed with macular dystrophy but the absence of any blindisms, mannerisms and the fact the he was not required to use glasses perpetuated some of the prejudice from both his teachers and classmates. Roger went on to complete school and university with minimal assistance. He developed a series of techniques that in time included the use of low-vision aids such CCTV and other type of magnification tools. He now has a successful post at the department of transport.

Roger’s story is both shocking and a true example his mother’s trust and indefatigable persistence, staying by her son’s side until his condition was diagnosed and cared for. It also a reflection of Roger’s own character – his courageous and hardworking nature. Despite his impairment and years of shunning, Roger never gave up on his education and eventually was able to secure a good working post. Stories such as this are the exception rather than the rule. These days, ophthalmologists are quite efficient in detecting visual conditions and introducing technical aids. Nonetheless, low-vision continues to be filled with contradictions. The fact that an individual is not wearing eyeglasses, carrying a symbol or white cane or the fact that the eyes appear to be unimpaired from the outside can lead to some confusion.

Society must be educated – wisdom elevates. The way we are perceived however only partly reflects who we are. The visually impaired population is extremely heterogeneous. There are a variety of impairments each limiting different aspects of vision. The word limiting should not be taken lightly. Limit is related to vision not to behaviour in general. Morse (1983) notes that loss to the lower half of the visual field usually implies difficulties in mobility but does not
mean that the individual cannot watch television, do a crossword puzzle or work with a computer. Similarly, loss to the right field is associated with difficulties in reading (reading print in western countries requires a left to right eye scanning) but does not imply a lack of independence in terms of mobility or spatial awareness. Low-vision manifests itself in contradictory behaviours. It is not uncommon to see the student with low-vision who cannot read from a blackboard but is able to comfortably ride a bicycle or the individual who can watch television from a distance but continuously stumbles on a step or curve. This lack of understanding often balloons lowvision to total vision loss or at least leads to assumptions about general ability disproportionately discrediting the individual. We must seek to understand these limits and refrain from making false assumptions and generalizations that can have disabling effects.

The same is true for blindness where the uninformed assumes that those who are blind have more acute senses or that because of their loss there are incapable of independently coping with life in society. It is important to note that there are several strategies used by educators and orientation and mobility specialists that can be used to compensate for different types of conditions.

The manner in which people are labelled and classified can have important implications in their social and personal lives. At the heart of Durkheim’s sociology of knowledge (Durkheim & Mauss, 1963) is the notion that classification is social in origin and a categorization and extension of reality. Low-vision has often been described as a neither fishnor fowl phenomenon. Visual loss is many times perceived as an all or nothing occurrence. For some reason, blindness seems like an easier concept to grasp than low-vision. We can close our eyes; walk about the room and to a certain extent place ourselves in a situation of total visual absence and try to imagine some of the difficulties associated with it. It is much harder to conceive of a situation of partial visual loss – and even more so of the different conditions and types of visual loss. Blindness in this sense is understood and classified by contrast to seeing. Low-vision on the other hand falls in a sort “grey” and uncertain area.
An incorrect classification imposes an inaccurate reality. Classifying a person with lowvision as blind can have serious limiting effects as individuals become uncertain of the extent of their residual vision and overall abilities. People with residual vision are usually labeled as blind and many times act or convince themselves that they are blind. The inaccurate labelling of low-vision can also lead to wrong decisions on the part of parents and educators. Lack of knowledge regarding the condition can force parents of children with low-vision to adopt educational strategies that do not take advantage of residual/functional vision. It can also lead to a type of over caring where the parent spoils the development of the child hampering his/her independence. Sometimes children are placed in specialist schools solely based on their acuity level while their functional vision would still make them competent candidates for mainstream education.

5.3 Passing

Passing occurs when an individual with low-vision pretends to be blind or sighted in order to take advantage or cope with a situation. During his years at the RLSB the author had the opportunity to watch two cases of such theatrics whose relevance to this section make it worth reporting. The first case is that of Alex a teenager who enrolled as a registered blind student. When asked about his visual condition, Alex replied that he was blind and had no vision. He moved around with a white cane, used speech software in the computer and was learning Braille. He considered himself and was considered by others a blind student. Alex was eventually asked to participate in the author’s study and was screened to be part of the blind group. During one of the tasks, when the subject was asked to construct a tactile model of the RSLB campus using scaled cardboard pieces, the author noticed that instead of asking for the pieces to be handed to him Alex was actually grabbing them from their location on the table. This behaviour was very odd considering it was impossible for Alex to reach directly with such dexterity.

Alex was not blind. After inspection of his personal file, the author discovered that he was diagnosed with Leber’s optic neuropathy when he was fifteen. Many believed that Alex was passing as blind in order to claim a higher disability/incapacity living allowance. Free loading is not our primary concern especially if we consider that the actual claim difference is neither
substantial nor extravagant. What is particularly upsetting is the fact that when passing as blind, Alex was being educated as a blind person surrendering the functional aspect of his vision. Before the sudden onset of his condition Alex was a talented cartoonist but passing as blind forced him to give up almost completely his sketching. Alex was not discarded from the research but re-classified as severely visually impaired. His overall high performance in spatial tasks is further evidence of his ability to functionally use his residual vision. He is no longer viewed or considers himself a blind person and is currently working on strategies to make the best of his residual vision.

The transition from education to the workforce is perhaps one of the biggest challenges faced by individuals who are blind or have low-vision. That society discriminates should not come as a surprise especially in the labour market where the order of the day is the maximization of utility. Although the government intervenes and labour laws are constantly being updated; (most recently laws on ageism) preconceptions, presuppositions, biases and prejudices still have their way in the work domain. It is in such situations that passing may be beneficial.

David a former RLSB student spent almost six months applying for a variety of jobs. The only replies came from fast food joints and cleaning services. David automatically turned these down. Taking a job meant that he would have to give up his disability/incapacity allowance and as it turned out the wages offered were lower or on par with what he was already receiving. Although the author does not condone this type of action, it is at least demonstrative of the difficulties in transition and to some extent the cult of poverty that many times surrounds disability.

David was upset. Not a single company, office or factory replied and he began to doubt his skills. At that moment he decided to pass as sighted. The author would be lying if he said that the situation really improved. What did happen was that David was at least able to secure two or three interviews, one of these with British Telecom (BT). Unfortunately, after passing most aptitude tests with BT and at the verge of being offered a job as a repairman, David was turned down because he did not have a driver’s licence and could not travel independently to meet the customers. While it will never be known if passing is what secured the interviews it is at least clear from his experience with BT that as long as he was fully sighted and had a valid driver’s licence he was able to secure a job. Presently David is working as cook at a school’s canteen.
The irony lies that during his unemployed days the author hired David as his research assistant. He was trained, to interpret video data and to enter it in Geographic Information Systems (GIS) software, a somewhat advanced skill for a college graduate and something that would surely afford him a decent wage in the job market.

5.4 Psychosocial Adjustment, Self-Concept Identity & Self-Esteem

The overall psychosocial adjustment of individuals with disabilities has been a topic of much interest but of considerable disagreement. The adjustment to life in a world that is essentially visual is a complex feat. Adjustment is inevitably tied in with issues of independence, sufficiency and control and will vary from person to person influenced by their character, previous experiences and support network. Research on psychosocial adjustment has incorporated a variety of questions ranging from the impact of progressive or immediate visual loss, anxiety, the inability to work, avoidance and bullying to the role of support networks such as friends, families and charities. Morse (1983) reviewed several studies on the psychosocial adjustment of children with low-vision. He concluded that children with low-vision tend to be more unsettled by the limits of their vision, when compared to those whose handicaps are more severe. In addition parents of children with low-vision seem to be less understanding of the disability than those of blind children (Bateman, 1962). These results were echoed by Peadboy & Birch (1967) who found that children with low-vision tend to exhibit with more frequency underachieving behaviours and fatigue and are more prone to emotional problems.

More recently a study by Kef (2002) on the psychosocial adjustment and the meaning of social support for Dutch teenagers (aged 14 to 24) with visual impairments revealed that majority of these teenagers had high-self-esteem, were generally happy, did not feel lonely and that most had accepted the implications of their impairment. No significant differences were found between blind and individuals with low-vision (both severe and mild), although the scores for the severely visually impaired tended to be more negative. Interestingly, no significant differences were found between these groups and sighted adolescents. Sighted adolescents tended to have a
larger network of family and friends although individuals who were blind or had low-vision were satisfied and believed they received enough support from parents and peers.

An important aspect of psychosocial adjustment is the development of a positive self-concept. Self-concept can be defined as a set of attitudes individuals hold about themselves that help shape their identity, self-image, and esteem. Self-concept and is what conditions our expectations and motivates our behaviour and has important implications on our personal, professional and social lives. A positive self-concept is usually associated with the ability to cope and overcome the consequences of a disability. It gives an individual a positive outlook on life, satisfaction and commitment. Jake, another student who participated in the research, was diagnosed at birth with retinopathy of prematurity and lost his sight at the age of three.

His parents were divorced, and he lived with his mother who was unemployed and for the most part absent. It seemed as if Jake’s future was determined; his ability to flourish and overcome his disability hampered by his socioeconomic situation and his family’s lackadaisical neglect. Fortunately the opposite occurred. Jake’s situation forced him to become independent at a very early age. The lack of support meant that he had to learn how to fend for himself and quickly develop life-skills to cope with life in a sighted world. With a remarkable hunger for achievement, and a constant strive for superiority Jake attended mainstream education and was able to properly integrate. As it turned out Jake was one of the best performers in the author’s experiment. His ability to represent space and ease of movement was a true reflection of his audacity and confidence. His mobility officer having once remarked that “watching Jake move is like watching poetry in the making.” Jake left the RLSB two years ago and now lives with his partner and future wife who happens to be sighted.

Individuals differ in how they accept their disability. In some cases, the inability to cope leaves the individual feeling detached from the general society. In other situations, individuals detach themselves because they feel they cannot fit in or are being pitied by others. Negative self-concepts are usually associated with isolation, depression and mental and health problems (López-Justicia, 2006). The author had the unfortunate experience of dealing with two separate cases of students whose emotional state was so low that they were contemplating suicide. Details
are omitted in order to preserve teacher/student confidentiality. However, and without chancing any conclusion these individuals held several characteristics in common that were reflective of their negative self-concept. They were both blind from birth (retinopathy of prematurity), had few friends, preferred life at college than at home and tended to spend most of the time by themselves. They usually felt that they were not good enough and that the teachers and the “sighted society” communicated with them because they pitied them.

There is no general agreement as to whether the self-concept of individuals who are blind or have low-vision differs from that of the sighted. Results from several studies summarized in Morse (1983) vary as to the positive and negative attitudes the blind and visually impaired children and teenagers have towards themselves. Jervis (1959) concluded that there were no significant differences between the blind and the sighted, while Meighan (1971) found that the blind tend to view themselves extremely negatively and Bauman (1964) that the partially sighted have a greater degree of anxiety, insecurity and loneliness. More recently, Sacks (1996) found that individual with low-vision perceive themselves more negative, expressing feelings of isolation and unjust fault when compared to the blind or sighted and Freeman et al., (1991) found that in many cases individual with low-vision tend to reject services that would be beneficial because they did not want to be labelled as blind. Here it is worth noting that these all these experiments used different scales in their assessment of self-concept. López-Justicia et al., (2001) conducted several studies to determine whether Spanish children and adolescents with congenital low-vision had lower self-concepts than did their sighted peers. They found that children between 4-11 years of age with low-vision tended to score lower on all dimensions of self-concept when compared to the sighted children. Interestingly, differences were not significant in terms of family, physical appearance, self-worth and security. This lack of significance appears to be an indicator that these children are receiving and value the support from their family, classroom and peer networks. For children aged between 8-11 years, significant differences with the sighted were found in regard to the relationship with classmates and parents. While the relationship with classmates was viewed as more negative (difficulty in making new friends or feel valued by their friends) the relationship with parents was regarded as strong and empowering. Finally, results for the adolescent (aged 12-17) group revealed significant difference with the sighted only in terms of physical self-concept with individuals
with low-vision scoring considerably lower than their sighted counterparts. These results are somewhat expected as it is during this age that individuals begin to pay more attention to their physical appearance.

Love is not blind, at least for most part of the time. Our exterior appearance and the body language that usually accompanies it are responsible for many of the first impressions other have about us, and unfortunately first impressions tend to last. It is not uncommon to find among blind and visually impaired teenagers those who think of themselves as unattractive, because of their weight or a physical deformity. The author was faced with many situations where he had to counsel many of his students regarding their exterior appearance in an effort to boost their self-esteem. Self-esteem is one of the key components of self-concept as it relates to the value that individuals place on their own characteristics, qualities, abilities and actions (Griffin-Shirley & Nes, 2005).

Here again, results from past research on the self-esteem of individuals with low-vision and blind are contradictory. In a longitudinal study with visually impaired children, Shapiro et al., (2005) found significant gender differences on the perception of competence. Males were found to be more positive at the beginning of summer camp when compared to females. These difference however, tended to disappear across time with female perception of competence increasing at the end of camp. The improvement in the perception of competence, for both males and females, across times emphasizes the role of friendship and participation in the development of positive self-esteem. The fact that these children were at a summer camp and constantly interacting with camp counsellors is also further evidence that teachers and counsellors through their instruction, verbal praise and ongoing feedback can function as guides and role models. Rosenblum (2000) found that although many teenagers had negative feelings about their visual impairment, the extent of this negativity varied among individuals with some deliberately hiding their visual impairment while others expressing unhappiness but understanding it as a part of life. A study by Huurre et al., (1999) on the social support and self-esteem among Finnish adolescents with visual impairments found similar results. In addition, Griffin-Shirley & Nes (2005) found no significant differences in the level of self-esteem and empathy between sighted and visually impaired preadolescents. These authors argue that the lack
of difference may be related to recent trends in education and inclusion as well as greater awareness of the disability by the family. Sacks (1996) observes that in many cases low-vision devices can be used to help individuals use their functional vision and enhance their self-esteem. He notes however, that these should be carefully instituted as they are highly conspicuous and may draw unnecessary attention to the individual.

In the final chapter of his book Blindness and early childhood development, David Warren expresses his disappointment regarding the quality of past research on visual impairment. His dissatisfaction stems from the failure of researchers to account for the heterogeneous nature of the population. To understand behaviour we must be open to the idiosyncrasies of personality. There is much to learn by focusing on the individual and the specificities of selfadjustment.

During the last few years, researchers in psychology and geography have started to pay more attention to individual differences. This is evident from recent topics featured in specialized conferences (Spatial Cognition 2006 conference held in Bremen, Germany) and academic journals (Journal of Individual Differences, Learning and individual differences).

It remains however, for this knowledge to be mainstreamed – for society to be educated. This article is simply another attempt towards this. Addressing Instructional Needs of Students with Visual Impairment Specialized Instruction and the IEP. Special education means specially designed instruction to meet the unique needs of a child with a disability; related services support the child in benefitting from special education.

Specialized instruction provided by a teacher of the blind and visually impaired to students found eligible with “visual impairment including blindness” is special education; this service should be documented on the IEP as specialized instruction rather than as a related service. Regardless of whether it is his or her primary, secondary, or tertiary disability, a child with a visual impairment requires specially designed instruction to ensure access to the general curriculum. Ensuring access to the general curriculum by adapting or helping the general education teacher adapt instructional strategies and the curriculum is a special education service.
There is no federal or state definition of the term “vision services” despite its continued popular use. School personnel and IEP teams should be clear and specific about the services to be provided for a child from the TBVI and avoid use of the term “vision services.” Orientation and Mobility (O&M) training may be considered special education, or specially designed instruction, if it involves “travel training” of students who are blind or visually impaired provided by a professional certified in O&M. O&M may also be considered a related service. 8 VAC 20-81-10. to learned helplessness.

5.5 Implications For Professionals And Parents

What major conclusions can be drawn from this extensive and varied body of research? What are the most significant and practical implications for teachers, caregivers, and parents, suggested by such complex empirical and theoretical work? Seven overarching principles are offered as a conclusion to this review:

Principle 1: Begin Motor Play Early

The foundation for a healthy, active life begins at birth (and likely before). Movement in early infancy is no longer believed to be entirely involuntary and reflexive. Every kick, grasp, and wiggle is a remarkably complex action that involves the application of both obvious and more subtle physical skills, intellectual and perceptual processes, neurological organization, and an internal motivation to grow and develop. This integrated nature of movement suggests new goals and strategies for promoting infant motor development. Motor play activities should be planned to support some of the newly-discovered sub-skills that have been found in recent research to have an impact on development: “braking behaviors” when walking down slopes or step consistency when traversing varying surfaces, for example. Motor experiences should also address the cognitive and neurological aspects of movement in babies. Challenges can be posed that require infants to interpret the demands of their immediate environment—a highly cognitive process. Varying just one aspect of a motor task—the
size of an object, the height, slope, or texture of a surface—requires adaptation of
movements to conform to new environmental conditions. Offering play experiences that
require the coordination of two or more senses will promote the integration of diverse
brain centers responsible for perception. Providing activities that match the play
preferences of infants (which emerge at a surprisingly early age) will inspire children to
learn new skills and address emotional components of play such as the motivation to
move. A child emerging from infancy having experienced these multi-dimensional play
activities will be better prepared to meet the new physical, cognitive, and social
demands of the preschool years.

**Principle 2: Make Movement Enjoyable**

Research demonstrates the importance of mastery motivation in motor development. Most children from birth to age five show behavioral signs of this drive to accomplish motor
tasks and to learn skills: persistence at tasks, facial expressions of determination and delight at
accomplishment, or repeated attempts to solve a motor problem, even in the face of failure and
frustration. Such signs are exhibited by most young children in play.

Some infants, toddlers, and preschoolers do not acquire this internally motivated
desire for mastery. Parents and professionals sometimes erroneously assume that
external rewards and adult direction are the solution. In fact, research suggests that
poor mastery motivation may stem from a mismatch between a child's play interests
and activities provided. Studies suggest that altering experiences to be more engaging
and fun is a better approach. Variation and novelty in motor experiences and equipment
may also spark internal motivation. Providing socially-oriented games and experiences
will address some aspects of mastery motivation; object-oriented activities will support
others. A balance between types of play, materials and equipment, and settings will
inspire motivation to learn. Regardless of the types of activities provided, research
suggests they should be challenging. Mastery motivation is highest when children tackle
and overcome motor tasks and challenges that are just above their current level of
mastery.
Principle 3: Attend To Intensity

It is well documented in the literature that children do not spend enough time playing, either indoors or outside. Merely increasing time on the playground, while extremely important, will not ensure that children get the level of exercise they need for healthy development. Studies of both infants and toddlers suggest that movement activities need to be sufficiently intense to promote physical health, greater connections among neurons in the brain, and other developmental benefits. Researchers and professional organizations recommend that young children spend several hours in active play each day, and that at least an hour of this time be spent in moderate to vigorous physical activity (MVPA). This is activity that involves sustained movement and an increase in heart rate. To achieve this MVPA goal for preschoolers, researchers suggest at least a half an hour per day of structured, adult-guided motor activity to keep children moving. For infants, researchers suggest creating enticing play environments in the home and center, in which children can lie on their stomachs and move freely without the restriction of high chairs and playpens. Toddlers need space to walk and run, unencumbered by walkers and or other unnecessary equipment that restricts locomotion.

Adult engagement in the play of children of all ages is critical to achieving motor intensity. Teachers and caregivers should be as active on the playground as they are indoors in teaching skills and guiding play. One important role is to identify children who are sedentary and encourage them to move. Providing new equipment, suggesting games, and asking peers to invite quieter children to play are all important strategies to increase MVPA.

Principle 4: Integrate Movement Throughout The Day
Research has found that if children move throughout the day, not just during playground time or in physical education, they are more likely to meet recommendations for daily MVPA. Studies show that including movement in all activities of an infant or preschool classroom will not only promote motor skills and fitness, but will contribute to academic achievement and important learning processes. Movement can be included in a toddler story time by encouraging children to enact simple movements of animals in a children’s book. Preschoolers can move while learning about numbers by playing a game at group time that requires them to jump in and out of a circle the number of times indicated by a teacher. During transition times, children can be encouraged to hop, crab-walk, or walk backwards to lunch or balance blocks on their heads to put away at clean up time. These experiences will activate parts of the brain that would not have been used in quieter math or literacy lessons. Too, such integration of motor activity would significantly increase the number of minutes of MVPA over the course of a day.

**Principle 5: Help All Children Play**

Research on infants and preschoolers suggests that all children, regardless of disabilities, family stressors, or other challenges, want and need to move and play. Girls and boys are equally motivated to learn motor skills, as are most children with special needs. Every child will benefit from active, indoor and outdoor motor play. The key to engaging all children in movement is careful observation of individual needs and tailoring activities and interactions to address these. Research shows, for example, that children with a wide variety of disabilities are able to engage in active play when parents, teachers, and caregivers provide the right kinds of materials and equipment and give just the amount of support needed—no more and no less. Even children who have disabilities that can interfere with social processes, such as autism, are able to interact with peers in play if guided by adults.

To engage all children, adults should:
a.) Study the play interests of individual children and families and design motor activities around these.

b.) Observe and learn about the characteristics of children with disabilities or those whose families are in crisis and adapt environments and materials accordingly.

c.) Determine the motor skills of individuals and plan experiences that address specific deficits.

d.) Note the peer relationships of individuals—even toddlers—and facilitate greater social participation and conversation in motor play.

e.) Scaffold play—that is, provide much guidance when children are in great need of support and little or no guidance when they are achieving motor abilities or actively moving on their own. Most important, when children need only a little guidance—just a question, a hint, a prompt, modeling of a new skill, or simply close proximity—provide indirect support that enhances, but not interrupts, play.

Principle 6: Send Play Outdoors

Countless studies have shown that outdoor play from birth to age 5 produces developmental outcomes that simply can’t be achieved indoors. Not only does outdoor play foster more active movement, but also more frequent and coordinated peer interactions than play in indoor spaces. Is this because playground spaces tend to be larger and more open? Does the role of the teacher or the nature of peer relationships change on the playground? Is it simply exposure to sunlight and fresh air that leads to these positive results? Whatever the reason, the research is clear: Children should play outdoors for at least an hour each day.

Adults can enhance the effects of outdoor play in several ways. They can increase the number of moveable pieces of playground equipment and reduce (if possible) fixed play structures. Studies show this will increase motor activity and enhance motor skills. Spaces can be made completely safe so teachers are not required to interrupt play with countless warnings to “Be careful!” or “Stop climbing so high!” Children should be encouraged to engage in active pretend play when outdoors, but the common practice of providing books, art materials, and
dramatic play props during outdoor play time should be reconsidered. Although mandated by some state accrediting agencies, such practices could slow children’s activity level. Outdoor play should be active play time. For children with some disabilities, wider open spaces are likely to encourage more active play. One way to increase movement is to include elements from nature on the playground. One study found a strong association between the number of natural features in a play environment—e.g., grass, trees, hills, running water, and sand—and the activity level of children (Fjørtoft, 2004).

**Principle 7: Advocate For Play To Support Learning**

Child development professionals advocate for active motor play for physical and emotional reasons. That play enhances fitness, health, and emotional well-being should be enough to convince policy makers and school administrators that sit-still-and-listen programs are ill-advised. These arguments should induce legislators and other community leaders to commit to the creation of neighborhood playgrounds and community centers that promote motor activity, beginning in infancy. Sadly, not all educators and legislators are convinced. However, what may win over the skeptics is the irrefutable research finding that motor play enhances learning and student achievement. Even the most academic-oriented principal or parent may champion play if they come to understand this powerful body-mind connection.

Studies have demonstrated conclusively that cognitive abilities have their roots in the motor actions of babies. It is through active play with objects and people that infants acquire basic cognitive understandings, such as cause-and-effect and symbolic representation, which are necessary for later academic learning. In motor play they acquire communicative competence and language. Most important, play may lead to the organization and integration of parts of the brain required for perception, social understanding, and self-regulation. Preschool play, likewise, promotes brain growth and intellectual ability. Children who engage in frequent and high quality play—including active motor play on the playground—have been found to be advanced in memory, information processing, and other cognitive abilities necessary for learning (Piek,
Dawson, Smith, Gasson, 2008; Pellegrini & Bohn, 2005). Some research shows a direct connection between play and achievement in mathematics and reading in the elementary years (Castelli, Hillman, Buck, & Erwin, 2007). Such an argument should cause school personnel to rethink the strategy of reducing play to increase passive learning.

The argument that play enhances learning is a politically powerful one. How sad it is, however, that motor play must always be justified in this way. Play keeps children healthy and makes childhood joyful. These facts alone should inspire parents, educators, and policy makers to embrace and defend play as a crucial part of children’s daily lives, in and out of school.

5.6 Summary

Students with visual impairments, including those with multiple disabilities and/or deaf-blindness, are a heterogeneous population. The small number of students may make it difficult for any one school or program to have full knowledge and adequate resources to meet varied and intensive needs of this unique student population. This document was designed to provide guidance and resources for key components to be considered when planning for appropriate individual educational programs for students with visual impairments including blindness. Further information and support is available from the regional education coordinators from the DBVI, Virginia School for the Deaf and the Blind at Staunton, and the VDOE.

5.7 Check Your Progress

1. Explain Social Implications
2. Describe Psychosocial adjustment, self-concept identity & self-esteem
3. Describe various Implications for Professionals and Parents

Check Your Progress
9. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.9.1. Points for discussion

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Points for clarification
5.8 REFERENCES


Block 4: Identification and Assessment of Visual Impairment

Unit 1: Interpretation of clinical assessment of vision

Unit 2: Functional assessment of vision: Concept, need and methods

Unit 3: Tools of functional assessment of vision and skills: Functional skills inventory for the blind (FSIB), Low Vision Assessment by Jill Keeffe, Lea tests, and Portfolio assessment

Unit 4: Tools for psychological assessment of the visually impaired: Vithoba Paknikar Performance Test, A short Scale IQ measure for the visually impaired based on WISC-R, Adapted EPQ, Adapted Blind Learning Aptitude Test, Concept development for blind children, Reading Preference Test, Cornell Medical Index for Visually Handicapped Children

Unit 5: Report writing
Unit 1: Interpretation of clinical assessment of vision

1.1 Introduction

1.2 General Approach

1.3 How Is Vision Impairment Identified And Diagnosed?

1.4 How Is Vision Impairment Identified And Diagnosed?

1.5 Who Are Vision Care Professionals?

1.6 Clinical Clues Of Possible Vision Impairment: Physical Exam Findings

1.7 Clinical Clues Of Possible Vision Impairment: Visual Behaviors

1.8 Clinical Clues Of Possible Vision Impairment: Visual Behaviors

1.9 Clinical Clues Of Possible Vision Impairment: Visual Developmental Milestones

1.10 Eye Care Professionals – Where Does The Orthoptist Fit In?

1.11 Clinical Vision Assessment: Children With Complex Needs

1.12 Ophthalmic Exam: Components Of The Basic Exam

1.13 Ophthalmic Exam: Components Of The Basic Exam

1.14 Electrophysiological Assessment Methods

1.15 Summary

1.16 Check Your Progress

1.17 References
1.1 Introduction

Vision assessment method is broadly defined as any assessment test, measure, or procedure that can be used to identify or assess infants and young children with vision impairment. Vision impairment is the loss of some aspect of vision (sense of form, color, or light) that reduces a child’s ability to see. Vision impairments range in severity from mild vision loss to total absence of light perception. Severe vision impairment may be fairly easy to detect, but many vision impairments are not obvious.

Assessment methods include standardized and nonstandardized tests (often based on history, direct observations, and/or physical findings), as well as the use of sophisticated technology such as photoscreeners or imaging tests. Routine vision screening, as is usually administered to most infants and young children, can be effective for identifying many eye and vision problems, but there is no method that accurately identifies all young children with vision impairment.

Because vision plays such an important role in a child’s early development, it is important to identify children at risk for vision impairments as early as possible. Some vision impairments may be easily corrected with glasses, surgery, or other medical intervention, but others may not.

Early recognition of vision problems and appropriate early intervention may help to maximize the child’s general development and may promote better long-term functional outcomes for both the child and family.

1.2 GENERAL APPROACH

Identifying initial concerns about a possible vision impairment

It is important for professionals and parents to recognize that there are several ways children with vision impairment are first identified. These may include:

- Identification of risk factors (e.g., prematurity or perinatal problems)
- A parent’s concern about the child’s vision or some other aspect of the child’s development
- A health care provider’s or other professional’s concern about the child’s vision
Parental concern can often be a reliable indicator of a vision problem. Therefore, during a routine evaluation of children, it is recommended that health care professionals ask parents about the child’s vision (Table 7B, page 30). Examples of such questions include:

- Do you think the child sees normally?
- Do you have any concerns about the child’s vision?
- Does the child tend to close one eye in sunlight?
- Does the child tend to repeatedly hold his/her head in the same position?
- Does the child tend to object to one eye being covered?

1. General considerations for the assessment process

When assessing young children, it is important to understand the whole child and to consider any factors that may have an impact on the child’s performance during the assessment process. Such factors may include the child’s schedule, overall health status, the setting of the assessment, and the child’s mood and temperament (fatigue, illness, shyness, excitement) at the time of assessment.

It is recommended that the setting where the assessment is conducted be appropriate to the developmental stage of the child and be comfortable for both parent and child. It is also recommended that assessment materials and strategies be developmentally appropriate.

Infants with vision impairment often have delays in other developmental domains that need to be identified and addressed with specific interventions. Additionally, some vision problems are associated with other conditions, such as cerebral palsy or Down syndrome. Therefore, there may be many different professionals involved in an ongoing process of assessment and intervention.

2. Considerations for professionals

It is important for health care professionals to understand typical visual development in young children in order to:

- Facilitate recognition of potential vision problems
• Make appropriate observations about the child’s development
• Initiate appropriate methods for ongoing monitoring (developmental surveillance)
• Give accurate information to parents and families professionals ask parents about the child’s vision (Table 7B, page 30). Examples of such questions include:
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  • Do you have any concerns about the child’s vision?
  • Does the child tend to close one eye in sunlight?
  • Does the child tend to repeatedly hold his/her head in the same position?
  • Does the child tend to object to one eye being covered?

3. General considerations for the assessment process

When assessing young children, it is important to understand the whole child and to consider any factors that may have an impact on the child’s performance during the assessment process. Such factors may include the child’s schedule, overall health status, the setting of the assessment, and the child’s mood and temperament (fatigue, illness, shyness, excitement) at the time of assessment.

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Infants with vision impairment often have delays in other developmental domains that need to be identified and addressed with specific interventions. Additionally, some vision problems are associated with other conditions, such as cerebral palsy or Down syndrome. Therefore, there may be many different professionals involved in an ongoing process of assessment and intervention.

4. Considerations for professionals

It is important for health care professionals to understand typical visual development in young children in order to:

• Facilitate recognition of potential vision problems
• Make appropriate observations about the child’s development
Initiate appropriate methods for ongoing monitoring (developmental surveillance)

Give accurate information to parents and families

Surveillance for vision problems for infants and young children usually includes an inspection of the eyes, tests for ocular motility (movement) and eye muscle imbalance, ophthalmoscopic examination, and tests for visual acuity as appropriate for the age of the child. Surveillance for pre

1.3 HOW IS VISION IMPAIRMENT IDENTIFIED AND DIAGNOSED?

Methods of detecting possible vision impairments are not designed to arrive at a formal diagnosis but rather to identify children who have an increased likelihood of vision impairment and therefore need further assessment.

Some risk factors for possible vision impairment may be identified at birth. These risk factors include extreme prematurity and low birth weight, family history of blinding eye conditions (infantile cataracts, retinoblastoma, infantile glaucoma, or hereditary corneal dystrophy), and maternal intrauterine infections (Table 6, page 28).

Eye examinations during routine health surveillance may yield findings that heighten concern about possible vision impairment. Sometimes, conditions such as congenital cataracts or congenital glaucoma are present at birth and can be recognized.

Parental concerns about the child’s vision can help identify risk factors. Sometimes, suspicion does not arise until the child demonstrates delays or disorders in motor or cognitive development. Some vision impairments are not discovered until a child reaches school age and is unable to do tasks requiring discrimination of fine details.

In an effort to identify children with vision impairment before they attend school, some vision screening programs have been implemented for preschool children. These screening programs are generally designed to detect amblyopia and risk factors for amblyopia. Children who do not pass the screening are referred for appropriate ophthalmic follow-up. Although many children who are referred for further assessment will turn out to have normal vision at the follow
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- Parental concerns about the child’s vision can help identify risk factors. Sometimes, suspicion does not arise until the child demonstrates delays or disorders in motor or cognitive development. Some vision impairments are not discovered until a child reaches school age and is unable to do tasks requiring discrimination of fine details.

In an effort to identify children with vision impairment before they attend school, some vision screening programs have been implemented for preschool children. These screening programs are generally designed to detect amblyopia and risk factors for amblyopia. Children who do not pass the screening are referred for appropriate ophthalmic follow-up. Although many children who are referred for further assessment will turn out to have normal vision at the follow-up, environment is often a major concern for children with vision impairment. Therefore, interventions often focus on orientation and mobility, and approaches to promote the child’s interaction with the environment using what vision they have (residual vision) or other senses. The intervention process begins with assessing the needs of the child and family. The assessment process determines interventions and establishes baseline information. Components of the assessment process usually include:

- A functional vision assessment of how the child uses vision
- An assessment of the developmental impact of the vision impairment
- Assessment of the child’s orientation and mobility needs
• A health evaluation to determine whether the child has any associated health or developmental conditions, including hearing loss
• A learning media assessment to document how the child uses senses to gather information, comprehend, and learn
• Assessment of the family strengths and needs

A functional vision assessment is not a measurement of visual acuity or refraction but rather of how the child uses vision to interact and function with objects and people. Functional vision assessments are usually conducted prior to a developmental assessment so that the tests and testing materials can be adapted, if necessary, to accommodate a child’s vision impairment.

Developmental issues may be compounded if the vision impairment is associated with another developmental disability. This is an important consideration because vision impairment is a relatively common occurrence in children with other disabilities.

Regardless of the interventions, parental involvement is an important component of promoting the developmental abilities of the child.

1.5 WHO ARE VISION CARE PROFESSIONALS?

Vision care professionals who may be involved in assessment and/or treatment for children with vision impairment include the following:

• **Ophthalmologists** are medical doctors (MD) who specialize in eye problems. They diagnose and treat eye conditions; test for visual acuity, visual field, and other aspects of visual status; prescribe glasses, low vision aids, and medications; and perform surgery. Pediatric ophthalmologists specialize in children’s eye problems and vision.

• **Optometrists** are doctors of optometry (OD). Optometrists diagnose eye conditions; test for visual acuity, visual field and other aspects of visual status; prescribe glasses and low vision aids, and can prescribe topical medications (medications applied directly to the eye such as eye drops or ointments) for the treatment of eye conditions (the limitations on therapy vary from state to state). Optometrists do not perform surgery. Pediatric optometrists specialize in
children’s eye problems and vision. Low vision optometrists specialize in rehabilitation related to visual impairments.

- **Opticians** make glasses as prescribed by the ophthalmologist or optometrist. Opticians are not eye doctors nor do they examine eyes.

- **Orthoptists** are specially trained to measure eye muscle imbalance and provide specific treatment options for patients with strabismus and amblyopia. Orthoptists generally work under the supervision of a physician.

- **Ocularists** make artificial eyes.

- **Orientation and Mobility Specialists** (O&M specialists) specialize in the instruction of safe and efficient independent travel skills for individuals with visions impairments. They assess children’s ability to use residual vision, or nonvisual compensatory techniques, to determine their location in space, plan how they will get somewhere, and move safely through their environment. O&M specialists provide direct instruction in travel-related skills. The long white canes used by the visually impaired are recommended by O&M specialists.

- **Teachers of the Visually Impaired** (TVI) work with children with visual impairments and their families on preacademic and academic skills. They assess a child’s need for adaptive reading materials, provide support and instruction in preeducational and educational settings, and assist the family with school-related issues. A TVI is specially trained to teach Braille.

- **Rehabilitation Teaching Specialists** (RT) are teachers who specialize in teaching adapted daily living skills. They assess a child’s ability to function in everyday activities such as dressing, eating, personal hygiene, and organization, and provide direct instruction in adapted techniques. They often work in conjunction with an occupational therapist.

Other professionals such as occupational and physical therapists, speech language pathologists, etc., may also be involved in the assessment and intervention process depending on the strengths and needs of the individual child and family.

**1.6 Clinical Clues of Possible Vision Impairment: Physical Exam Findings**

**Physical Exam Findings**

- Abnormal head posture
Abnormal craniofacial features (e.g., microcephaly, ptosis)
Abnormal pupil response
Abnormal red reflex
Asymmetrical Bruckner test
Afferent pupil response
Absence or abnormality of optokinetic nystagmus (OKN) after age 6 months
Coloboma
Corneal opacification or congenital cataracts
Asymmetrical corneal light reflex
Direct observation of an eye turn
Delayed, absent, or abnormal visual fixation/following
Absence of any fixation at birth
Has not developed good fixation (saccade) by 6-9 weeks
Has not developed good following (pursuit) by 2-3 months
Iris abnormalities
Albinism (findings of albinism such as transillumination)
Aniridia (absence of the iris)
Nystagmus (other than reflex nystagmus such as OKN)
Strabismus

1.7 Clinical Clues of Possible Vision Impairment: Visual Behaviors

Visual Behaviors

Information about visual behaviors that may indicate a possible vision problem can be obtained from observation of the child, from expression of parental concern about the child’s vision, or from information provided by the parent(s) in response to specific questions. Examples of clinical clues of a possible vision problem include:

- Photophobia (avoidance of bright light/squints in bright light/preference for dim light)
- Stares at bright lights
- Closes one eye
- Nondirected or “roving” eye movements
- Does not seem to respond to parent’s face
• Does not seem to imitate parent’s facial expression
• Does not seem to follow movement of objects or people
• Does not reach for bottle when presented quietly
• Does not seem to show interest in toys/objects within reach
• Does not seem to show visual interest in television
• Does not seem to show interest in books
• Seems to have limited interest in different kinds of toys
• Does not seem to recognize colors or shapes
• Bumps into objects
• Visual self-stimulatory behaviors (e.g., eye rubbing, pressing, or poking)

1.8 Clinical Clues of Possible Vision Impairment: Visual Behaviors

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• Visual self-stimulatory behaviors (e.g., eye rubbing, pressing, or poking)

1.9 Clinical Clues of Possible Vision Impairment: Visual Developmental Milestones

By 36 months:
• Smiles, face brightens when views favorite objects and people (20-24 months)
• Likes to watch movement of wheels, egg beater, etc. (24-28 months)
• Watches own hand while scribbling (26-30 months)
• Visually explores and steers own walking and climbing (30-36 months)
• Watches and imitates other children (30-36 months)
• Begins to keep coloring on the paper (34-38 months)
• “Reads” pictures in books (34-38 months)
• Vision assessment – clinical and functional
  • Orthoptists and QTVIs are both involved in the assessment of children’s vision but from very
different perspectives. Orthoptists normally see children in the eye clinic, although some may
carry out vision screening in school. The orthoptist’s clinical assessment aims to establish visual
• acuity, checks for strabismus (squint), amblyopia (lazy eye) and examines ocular
motility status
• (eye movements).
• The QTVI establishes how a child uses their vision in everyday situations (functional vision
• assessment). With very young children or those with complex needs, this can be an ongoing
• process as visual skills can change and develop. Children will be seen by the QTVI regularly
• (depending on their needs), with a focus on the child’s access to the school curriculum.
1.10 Eye care professionals – Where does the orthoptist fit in?

Orthoptists are part of health services and work alongside an ophthalmologist (a doctor who specialises in eyes and vision). Some orthoptists may also see children for vision screening in community clinics.

Other professionals in eyecare include:
1 opticians, who dispense glasses and lenses
1 optometrists (formally called ophthalmic opticians) prescribe and dispense glasses and some may specialise in detecting eye disease
1 ophthalmic nurses and technicians
1 low vision therapists
1 eye clinic liaison officers (ECLOs).

At the hospital eye clinic, children are examined by the ophthalmologist. As part of the assessment they will see the orthoptist. If the child has a squint or needs treatment for amblyopia (see explanation below), follow up appointments may be with the orthoptist only. The ophthalmologist may continue to see the child annually to check eye health and refraction (this is the ability of the eye to bend light so that an image is focused on the retina more commonly known as a “glasses test”).

In the community, children may see an orthoptist for vision screening. They are also seen by an orthoptist in the eye clinic, often following referral by a health visitor or other professional. Some orthoptic services offer screening in special schools.

The orthoptist has responsibility for:
1 investigation of visual acuity
1 investigation and diagnosis of ocular motor (eye movement) disorders or nystagmus (involuntary eye tremor)
1 investigation and diagnosis of ocular deviation, such as a squint, where an eye may turn in (convergent squint) or turn out (divergent squint), occasions where one eye may be higher or lower than the other
Investigation and diagnosis of amblyopia, sometimes referred to as a lazy eye (this is when one or both eyes don’t see as well as they should due to the presence of a squint, a significant glasses prescription in one or both eyes, or other problems such as cataract)

Assessment of binocular vision – both eyes working effectively together to achieve 3D vision

Treatment of amblyopia, eg by patching therapy

Management of glasses wear and regular refraction appointments

Referral back to the ophthalmologist (if necessary), low vision services, QTVI of the local authority (LA) visual impairment service and ECLO (eye clinic liaison officer).

When assessing a very young child or a child with additional needs in the orthoptic department, an acuity measurement will always be attempted, and as part of that some functional testing may be carried out, eg observation of the child’s reaction to light, faces, objects etc. Children attending a specialist paediatric department or assessment centre may have a more detailed functional assessment.

Acuity is assessed using age and ability appropriate tests. Examples include “preferential looking” (see below), Cardiff Acuity Test (often referred to as Cardiff Cards), Kay Pictures, and Keeler (letter matching). These tests, in addition to the cycloplegic refraction* carried out by the ophthalmologist, can identify refractive error,
amblyopia and other eye conditions, and will be used to monitor a child’s condition and treatment.

*The ophthalmologist focuses a beam of light onto the eye’s retina to check for long or short sightedness. Different lenses are used to measure the degree of refractive error. Eye drops to dilate the pupils are administered prior to this procedure.

1.11 Clinical vision assessment: children with complex needs

Children who have complex needs can be difficult to assess. Most test materials rely on the child being able to co-operate and understand what is required. The orthoptist can enable a child to match symbols or pictures if they cannot say what they see. Alternatively the child may indicate recognition of the symbols, eg using signs, gestures or sounds.

When the child cannot recognise or match images, a preferential looking test may be used. This type of test is used to assess very young children, who are naturally inclined to look at a pattern or picture rather than a blank space. Some preferential looking tests are based on “gratings” – a series of rectangular cards displaying stripes on one side and plain grey on the other. As the stripes become narrower, a point is reached where the eyes can no longer detect the difference between the pattern and the grey. At this point the child will stop looking towards the pattern, and an acuity score will be estimated. Cardiff Cards work in the same way, but rather than stripes there are pictures with thick bold outlines reducing to very fine ones (see image above).

This type of test has proved suitable for some children with complex needs. However, others may have motor-control difficulties, delayed responses, roving eye movements, “absence” seizures or other issues that can affect the result.
Even when clinical assessment has been relatively successful, the outcome may not be
straightforward. Some children may have a “normal” result in clinical tests but have significant visual problems at home or school. Conversely, children who have significant problems seeing symbols on the test cards, sometimes manage everyday tasks surprisingly well.

**Noah**
Noah has retinal dystrophy (a disorder of the eye which causes damage to part of the retina). He achieved a surprisingly good result with the Kay Pictures acuity test. However in a functional situation, at home and in school, he does not see low contrast objects or images and his vision is severely impaired in reduced light. This is where the QTVI can contribute.

**1.12 Ophthalmic Exam: Components of the Basic Exam**

**Examination of the interior of the eye**
An ophthalmic examination involves dilating the pupil and using a magnifying instrument called the ophthalmoscope to look at the interior of each eye.

**Biomicroscopy** (slit lamp examination) Biomicroscopy provides a highly magnified view of the various structures of the eye. This procedure is used to identify and localize lesions, evaluate trauma, examine for inflammation of the iris, and diagnose metabolic diseases.

**Refraction**
Refraction is the optical focusing of the eye. The refractive state of the eye and the amount of correction needed can be measured by retinoscopy, which is an objective technique that involves projecting light into the eye and measuring the reflected light rays. Because no subjective judgments are required, retinoscopy can be used in children of any age.

In young children, eye drops are usually administered when performing retinoscopy. The drops dilate the pupil and prevent the pupil from contracting.

In young children, there are three types of refractive errors:
- In nearsightedness (myopia), the light rays come into focus in front of the retina. Objects in the distance are blurred.
• In farsightedness (hyperopia), the light rays encounter the retina before they are in focus. This is a normal condition in young children, and most are able to compensate for normal levels of hyperopia.

• In astigmatism, there is blurring or distortion of vision at all distances due to the aspheric (oval rather than round) curvature of the cornea or lens. Astigmatism may be present alone or combined with myopia or hyperopia.

**Tonometry**

Tonometry is a procedure that measures intraocular pressure. It may be performed in several different ways and may require the child to be sedated. The purpose of this examination is to detect glaucoma, a disease characterized by increased intraocular pressure.

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As a gross assessment of visual status, TAC can provide a relatively accurate assessment of visual acuity in preverbal children as young as 4 months of age. However, TAC tend to be better at identifying children with normal vision than identifying children with abnormal vision.

TAC scores provide information about how the child is doing at the time of the test. It is recommended that children who have TAC test results showing low visual acuity and have no other abnormal finding on the ophthalmic exam receive enhanced vision surveillance and periodic vision testing.

If a child is not able to respond to other tests, a modified TAC test using pointing may be useful for identifying amblyopia and obtaining a gross estimate of visual acuity.

Interpreting results from TAC is more subjective than some other tests because it requires interpretation of the child’s behavior. Interrater reliability is therefore an issue with TAC. It also is important to remember that other impairments, such as motor or cognitive impairment, may influence the child’s performance and the accuracy of the results.

*Random Dot E Stereotest*
Children with a normal response on the Random Dot E test have a high likelihood of having good visual acuity, good alignment (no strabismus), equally good vision in both eyes (no amblyopia), and good ability to use both eyes at the same time.

Random Dot E test can be used as an indicator of binocular vision status in preverbal children as young as 6 months. This test is a relatively good predictor when the results are normal. In preverbal children, this test can be conducted using preferential looking techniques.

The Random Dot E test may be useful as a test of binocularity, but it is recommended that it not be used as the only test. Some children with poor vision will be able to pass this test.

1.14 Electrophysiological Assessment Methods

**Neuroimaging**

Some vision impairments that occur in early childhood are the result of either brain injury or malformation of some part of the brain and can often be visualized with neuroimaging techniques. There are several ways to image the central nervous system:

- **Conventional x-ray of the skull** is generally not useful for detecting conditions related to vision impairment.
- **Ultrasound** can sometimes be useful for diagnosing certain conditions that may be associated with vision impairment, such as brain lesions. Ultrasound is most useful in the newborn period because it is inexpensive, portable, and gives an instant assessment.
- **Computerized Axial Tomography (CT)** can scan an entire brain in a few minutes. The patient needs to lie motionless for the procedure; however, sedation is rarely needed. It is expensive but far less expensive than Magnetic Resonance Imaging.
- **Magnetic Resonance Imaging (MRI)** is the most sophisticated method available to visualize the central nervous system. All areas of the brain and all lesions are visualized well. The patient is required to stay motionless for a prolonged period of time. Therefore, sedation is often required for the young or developmentally delayed child. The expense is considerable but is usually covered by insurance when there are clinical indications for its use.
Electrophysiologic tests

- **Electroretinogram (ERG)** is a record of the electrical impulses in the retina produced by visual or light stimuli. Certain retinal disorders give characteristic ERG results.
- **Evoked Potentials** are responses in the appropriate receptor area in the brain to the stimulating sensory organs (eyes or ears) or peripheral nerves. Responses are graphed using computerized averaging methods.

Visual Evoked Potential (VEP)

Because of its limited usefulness, it is recommended that VEP be ordered only after the child has had an eye exam, and only for children who seem to have a normal eye exam administered by an eye care professional.

It is important to recognize that:

- Results from VEP in the first 6 months are difficult to interpret because of maturational changes that usually occur in the child’s nervous system
- A normal VEP can be a good predictor of normal neuromotor outcome, but an abnormal VEP result is not necessarily predictive of poor prognosis
- For infants who have normal eyes on examination but who are apparently blind or severely visually impaired, a normal VEP is an indicator of likely improvement in vision. However, an abnormal VEP does not necessarily indicate a poor prognosis.

Clinical observation of **Visual symptoms and reading performance.**

Clinical observation indicates that visual astenopic symptoms are frequently associated with reading for long periods of time. We investigated the relation between visual symptoms and standard measures of reading performance in 78 university students. The number of asthenopic complaints increased during the reading phase of the experiment and decreased during the relaxation phase.
Overall, a weak but significant negative correlation was found between number of symptoms and reading rate on the Nelson-Denny reading test. The most symptomatic subjects scored lower on vocabulary and comprehension than the least asthenopic subjects. A limited retrospective analysis revealed no reading performance differences between subjects having normal binocular vision and those showing a minimum binocular dysfunction; however, the dysfunctional subjects reported more visual symptoms. This study suggests that visual symptoms are a factor in reducing reading performance, particularly in very symptomatic individuals.

1.15 summary

Good communication between the QTVI and eye clinic is essential, especially when dealing with children who have complex disabilities. Some local authorities recognise this, and hold a regular joint assessment clinic for these children. Unfortunately in other areas QTVIs and orthoptists report that co-operative working is difficult to achieve. However, in the interest of the child, we should always seek improved communications.

Where good partnerships exist, everyone benefits. Problems are readily identified and referrals made; information shared to provide a comprehensive assessment result; and families and schools supported to help children manage patches, glasses and low vision aids. With co-operative working the orthoptist and QTVI have a great capacity to achieve the “best of both” for children with impaired vision.

1.16 check your progress

1. How is vision impairment identified and diagnosed?
2. How is vision impairment identified and diagnosed?
3. Who are vision care professionals?
4. Write note on following;

   A. Clinical clues of possible vision impairment: physical exam findings
B. Clinical clues of possible vision impairment: visual behaviors

C. Clinical clues of possible vision impairment: visual behaviors

D. Clinical clues of possible vision impairment: visual developmental milestones

5. Eye care professionals – where does the orthoptist fit in?
6. Write note on electrophysiological assessment methods

Check Your Progress
10. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.10.1. Points for discussion
Points for clarification
1.17 References

1 Low Vision Services Consensus Group (1999) *Low vision services: recommendations for future service delivery in the UK.*


5 Access Economics (2009) *Future Sight Loss UK 1: Economic Impact of Partial Sight and Blindness in the UK adult population.* RNIB.

7. Emerson, E. & Robertson, J. (2011) *Estimated prevalence of visual impairment among people with learning disabilities in the UK.*


Unit 2: Functional assessment of vision: Concept, need and methods

2.1 Introduction

2.2 Assessment Of Visual Function

2.3 General Components Of An Assessment Of Visual Function

2.4 How To Use The Functional Vision Assessment Checklists

2.5 Assessment Of Functional Skills In The Educational Environment
   Instructions

2.6 Functional Vision Assessment (Fva): The Qtvi’s Role

2.7 Co-Operative Problem Solving

2.8 Visual Functions Vs. Functional Vision

2.9 Functional Vision And Quality Of Life (Qol)

2.10 Importance Of Functional Vision Assessment

2.11 Functional Vision Assessment Equipment List

2.12 Summary

2.13 Check Your Progress

2.14 Reference
2.1 Introduction

Vision is the key to learning, communication and movement. People with learning disabilities are 10 times more likely to have serious sight problems than other people. Unidentified sight problems can seriously undermine people’s quality of life and lead to avoidable sight loss and increased dependency. Often very little may be known about how much a person with learning disabilities can actually see, therefore making it very difficult for carers to know how to support the person to make the best use of their vision. This is particularly important for people with profound and multiple learning disabilities who may find it difficult to communicate to others what they are able to see.

This Functional Vision Assessment was created by SeeAbility. It is intended to be used by supporters of people with learning disabilities who know that person well, such as family carers and support staff. This Functional Vision Assessment is an observational tool that can be used to recognise how a person with learning disabilities might be using their sight. It can give an indication of what a person might not see, or have difficulty seeing.

Many people with learning disabilities may not be able to tell others if they have a sight problem. A Functional Vision Assessment can be an effective way of recognising the sight difficulties people with learning disabilities might be experiencing. A Functional Vision Assessment is an excellent starting point for supporting someone to have a potential sight problem recognised by an eye care professional. The information gained from an assessment should be shared with the person’s optometrist and with specialist workers for the visually impaired. Sharing information helps the person get the best support and advice.

2.2 Assessment of Visual Function

An assessment of visual function assesses how the child uses vision to interact with the environment. This is an important component of the assessment process for young children with vision impairment. Areas addressed in such an assessment usually include optical and optical/perceptual discrimination, recognition and identification, visual memory, spatial perception, and visual-motor coordination.
The assessment of visual function relies on a written description of the child’s use of vision rather than on a standardized test. Examples of published checklists and protocols to assess functional vision include:

- **Vision Assessment and Curriculum Reference** (Utah School for the Blind)
- **Peabody Model Vision Project: Functional Vision**
- **Look at Me: A Resource Manual for the Development of Residual Vision in Multiply Impaired**
- **Individualized Systematic Assessment of Visual Efficiency (ISAVE)** (American Printing House for the Blind)

It is important to conduct the visual function component before assessing other developmental domains such as cognition and sensorimotor development. This will allow the evaluator doing the developmental assessment to present items they know the child can understand and position the child and materials in a way that optimizes the child’s visual potential.

It is, however, important to consider the child’s cognitive, communication, and sensorimotor development level when assessing visual function. This is important because the ability to use vision is related to cognitive development and delays in other areas of development can impact the child’s ability to respond to assessment items. It is important to consider this information when assessing visual function and when planning intervention strategies.

### 2.3 General Components of an Assessment of Visual Function

An assessment of visual function typically includes the examiner’s qualitative observation or parent’s report of:

- Fixation (the ability to hold a stationary object in gaze)
- Gaze shift
- Scanning (the ability to search an area visually)
- Tracking (the ability to hold a moving object in gaze)
• Visually directed reach and grasp
• Eye movements
• Separation of eye and head movements
• Spatial awareness (awareness of placement of self in relation to other things in the environment)
• Awareness of visual field (visual perception in all quadrants of the visual field)
• Depth perception
• Observation of detail
• Matching and identification of objects and pictures (including shape, size, color)
• Visual motor (e.g., midline hand play, object manipulation, bead stringing, etc.)
• Eye preference
• Figure-ground discrimination
• Convergence and eye tearing skills (the ability of the eyes to aim, move, and work as a coordinated team)

2.6 How to use the Functional Vision Assessment Checklists

• In Section A there are seven checklists covering different areas of vision and eye health. We recommend that you view all seven sections on-line and then print off from www.seeability.org the individual sections of the Assessment that you wish to complete.
• Once you have completed all of the checklists go to the summary in Section B which will explain what to do with the information you have gathered. The Functional Vision Assessment checklists included in this pack are:

• Checklist 1 Appearance of the eyes– the appearance of a person’s eyes may raise concerns about their eye health

• Checklist 2 Behaviour– a person’s behaviours may be related to poor vision or other eye care needs

• Checklist 3 Poor central vision– this is when a person cannot see straight ahead very well
• Checklist 4 Poor peripheral vision– sometimes a person has difficulties seeing to the sides and up and down

• Checklist 5 Sensitivity to light– some people experience difficulties because their eyes are very sensitive to light

• Checklist 6 Poor colour vision (or contrast sensitivity)– some people do not see colours very well and can find it difficult to see objects clearly against a background

• Checklist 7 Poor vision in one eye– some people have poor vision in one eye only

2.7 Assessment of Functional Skills in the Educational Environment

Instructions
To assist in providing a free appropriate public education (FAPE) for students with disabilities, occupational and physical therapy are related services provided to enable the student to benefit from his or her education. This assessment is designed to provide information about the student’s overall functional ability within the school environment, with a focus on what is expected of the student in his/her natural educational environment in comparison with same-age peers. This functional assessment can be used to assist in establishing the need for therapeutic intervention when a student has been initially referred for therapy or as part of an assessment to determine need for continuation or discontinuation of occupational therapy and physical therapy services.

The occupational therapist and/or physical therapist completes each section. It is the components of the task, not the task itself, that are considered differently by each discipline. Information may be obtained through observation or consultation with other professionals. Reporting sources should be noted.

Definitions or explanations are provided for items that require clarification.
The first portion of this evaluation includes evaluation type, demographic information, and medical history. Information about previous therapy interventions and concerns should be clearly stated.

**General Directions**

When another therapist is scoring a section, or when the student is not expected to be able to perform any of the tasks in that section due to developmental age, physical limitations, or cognitive ability, check “Assessment in this area is not indicated at this time.”

Use the codes provided on the first page of these instructions to record the student’s ability levels in the section marked “Code.” The Comments section may be used to include information about the type of device used to accomplish the task, equipment needed, support provided by adults, etc. Occasionally, a clarifying prompt may be given to indicate the content of the comments. Whenever an item is scored as anything other than functional, an explanatory comment should be written in the comments section.

For items that contain two separate tasks, the code boxes are divided by a slash. Record the student’s performance on the first task above the slash, and on the second task below the slash.

Summarize each section by identifying those factors that interfere with the student’s ability to perform functionally in that area.

1. Section I. Learning Environment

Each therapist assessing the student completes this section.

*The Occupational Therapy Practice Framework: Domain and Process*, 2nd Edition (AOTA, 2008) describes how environments and contexts may support or inhibit the child’s ability to successfully participate in educational activities. Gathering information about the student’s ability to function in all aspects of the learning environment is an important part of the assessment process.
This section considers the student’s performance in his/her learning environment, including the classroom, computer and science labs, community-based instruction (CBI) sites, and any other areas for which the primary use to the student is instructional, including the home environment for students who receive hospital/homebound services.

The following are examples of clarifying statements for the table in the Learning Environment section of the assessment tool:

- The chair height is appropriate if the student’s feet rest on the floor when the hips, knees, and ankles are flexed to approximately 90 degrees.
- The desk height is appropriate if the desk surface is two inches above the bent elbow when the student is seated with feet flat on the floor.
- The desk location is accessible if the student’s access to the desk is unobstructed.
- The desk location is functional if the student is able to focus on the teacher and teaching materials and/or receive prompts or cues.
- Storage is accessible if the student is able to get to it without difficulty and can locate, retrieve, and replace materials with ease.

Adaptive positioning equipment is functional when it allows the student to focus and access his educational environment.

- Assistive technology is functional when it allows the student to access his educational environment.
  - Low-tech assistive technology devices include pencil grips, slant boards, reachers, visual schedules, highlighters, and adaptive activities of daily living (ADL) equipment
  - High-tech assistive technology devices include electronic page-turners, laptop computers, electronic or voice output communication devices, voice recognition computer software, etc.

- Student support includes such things as an adult pushing a student in a wheelchair, behavioral reward systems, and individual or small group assistance for any area of learning.
- Accommodations include enlarged materials, shortened assignments, flexible schedule, flexible response mode, use of a calculator, etc.
2. Section II. Personal Care

This area addresses self-help skills that are necessary in the educational environment.

A. Eating/Feeding Skills

Describe any special diet for the student, such as gluten-free or milk-free, and indicate whether the student eats table food (AOTA, 2009).

Definitions:

Chewy foods: Includes raisins, many types of meats, licorice, and any other foods that provide some resistance. These foods must be chewed several times in order to be soft enough to be swallowed.

Chopped foods: Must be cut into very small pieces to minimize the need for chewing. Examples include tiny bits of fruits, vegetables, or meats.

Crunchy foods: Includes raw carrots, crackers, potato chips, nuts, and any other foods that must be chewed several times in order to be soft and moist enough to be swallowed.

G-tube: Is a tube or button into which liquids that go directly to the stomach are put.

Mashed foods: Are processed until smooth, but may contain small lumps.

Pureed foods: Are processed until smooth, but are primarily liquid.

Soft foods: May be swallowed without being chewed. Examples include yogurt, gelatin, and applesauce.

Thickened liquids: Includes milkshakes and some creamy soups. Some liquids are thickened by adding a thickening powder.

Thin liquids: Includes water, milk, nonpulpy fruit juices, and broth.

Note any unusual food preferences, including foods the student always eats or always avoids and whether the student drools while eating.
The following are examples of clarifying statements for the table in the Personal Care section of the evaluation tool:

- Meal set-up includes opening milk cartons, utensil containers, lunch box, plastic bags or containers, and thermos.
- Meal clean up includes closing food containers, fastening the lunch box, throwing trash away, and returning the tray to its proper location.

**Hygiene**

This area addresses the students’ ability to attend to the cleansing of his/her body and access the necessary tools in the educational environment. Assessment in this area included both bladder and bowel control. Information will most likely be obtained from the teacher (AOTA, 2008; Coster et al, 1998).

*Definitions:*

- On toileting schedule: The student is on a toileting schedule and is sent to the bathroom on a set schedule, such as every two hours.
- Toilet trained: The student independently anticipates the need and uses the bathroom.
- Wears diapers: The student wears diapers as a primary method of toileting.

If the student uses a catheter to empty the bladder, indicate whether he/she does so independently or with assistance.

The following are clarifying statements for the table in the Hygiene section of the evaluation tool:

- Fastener manipulation includes buckling and unbuckling, snapping and unsnapping, buttoning and unbuttoning, zipping and unzipping, etc.
- Managing clothing includes pulling pants, shorts, and underpants up and down; keeping the shirt out of the way; tucking the shirt in; and straightening clothing, etc.
- The type of handle on the faucet and water fountain is noted or should be included in the Comments section.
List any adaptive equipment or modifications the student currently uses for toileting, such as a raised seat, step stool, grab bars, reacher, etc. Note placement of the devices in the Comments section.

3. Section III. Mobility

This area addresses functional movement (transfers and transitions) and the ability to navigate architectural barriers within the educational environment, including community-based instruction (CBI) sites (American Academy of Pediatrics [AAP], 2008; Bluth, 2009; Coster et al, 1998; Rehabilitation Engineering Research Center on Wheelchair Safety and University of Michigan Transportation Research Institute University of Michigan Health System, 2009).

4. Section IV. Gross Motor

This area addresses functional gross motor skills and postures students need to participate in educational activities (AOTA, 2008; Bruinincks & Bruininks, 2006).

The following are clarifying statements for the table in the Gross Motor section of the evaluation tool:

- In evaluating the student’s ability to localize sight or sound by turning head, note in the Comments section any delay in initiating the orienting response and whether the student alerts to stimuli presented on both sides as well as in front of and behind him/her.
- If the student is not fully mobile, record his/her ability to roll to change positions. Note in the Comments section whether the rolling is in one or both directions, performed segmentally, etc.
- Note any increase in tone or drooling with movement.
- Note the floor positions favored by the student and whether the position is functional.
• Note the student’s use of a chair back, arm supports, toilet grab bars, or other adaptations for sitting in a chair, using the toilet, or accessing playground equipment.

• Use the Comments section to record the student’s balance during various gross motor activities. Is the balance functional, precarious, emerging, etc.?

Be sure to complete the section requesting information about any abnormal movement patterns of fixed postures, whether the student receives adaptive physical education, and/or any adaptations used.

5. Section V. Fine Motor/Visual Motor

This area addresses visual tracking, visual-perceptual skills, functional fine motor skills, and visual-motor skills needed for functional school performance (Case-Smith & Pehoski, 1992; Erhardt, 1990; 1999).

A. Visual Tracking

Assess the student’s ability to track the eyes in all directions. Hold a target, such as a brightly colored eraser on a pencil, approximately 12” from the student’s eyes. Tell the student to keep his/her head still while maintaining visual contact with the stimulus. Move the target vertically, horizontally, diagonally, and in circular motions, minimizing arm movements as much as possible. Note the smoothness of movement in each direction, inability to disassociate head and eye movements, any midline difficulties, or lack of symmetrical eye movements. Mark those planes (vertical, horizontal, diagonal, and circular) in which the student smoothly tracks the target.

Assess the student’s ability to refocus (find one’s place) between the board/display screen and a paper on the desk and between the paper and a book in front of the student. Also note the student’s ability to scan objects on an assistive device. Check “Yes” if the student can easily
find his/her place between the two surfaces; check “No” if there is a delay in finding his/her previous place or the student focuses on an incorrect place.

B. Visual-Perceptual Skills

To complete this section, you must determine what is age-appropriate for the student by consulting with the teacher or comparing the student’s work to that of his/her same-age, nondisabled peers. Record the student’s performance on only those items that are age-appropriate.

Note in the Comments section any visual field deficits, difficulties if the objects were oriented in a different or unusual plane, etc. In addition, indicate if an unusually long period of time was required to perform any of these tasks.

The following are clarifying statements for the table in the Visual Perceptual Skills section of the evaluation tool:

• For students in second grade and above, record the ability to form letters, numbers, and words without reversals. In the Comments section, list the reversals noted in the student’s writing.

• In the assemble puzzles area, identify what types of puzzles (formboard, non-interlocking, interlocking, knobbed, adapted) and the number of pieces the student can assemble independently.

• Determine the student’s ability to distinguish between the following positional terms: in/out, top/bottom, over/under, and left/right. Include in the Comments section whether the demonstrations involved objects or the body.

• A 4–4½-year-old student is expected to be able to draw a person with three body parts, whereas a 5–5½-year-old is expected to draw five or more body parts. List those body parts the student drew and any unusual orientation or placement of the body parts in the drawing.
C. Functional Fine Motor Skills

To complete this section, you must determine what is age-appropriate for the student by consulting with the teacher or comparing the student’s work to that of his/her same-age, nondisabled peers. Record the student’s performance on only those items that are age-appropriate.

Observe the student’s spontaneous use of the hands to determine which is the preferred or dominant hand. Indicate whether this preference is emerging (frequent use) or established (consistent use).

- Emerging: Hand is used frequently.
- Established: Hand is used consistently.

In the Comments section, record any unusual use of the hands, positioning of the fingers, use of external support, etc.

D. Visual Motor Skills

To complete this section, you must determine what is age-appropriate for the student by consulting with the teacher or comparing the student’s work to that of his/her same-age, nondisabled peers. Record the student’s performance on only those items that are age-appropriate.

The following codes are used on this portion of the evaluation.

C The student copied a design that was already made in each of the pre-writing strokes. I The student imitated the examiner or another adult in reproducing each of the pre-writing strokes. U The student is unable to perform the task.

Indicate whether the student copied a design already made or imitated the examiner or another adult in reproducing each of the pre-writing forms.

The following are clarifying statements for the table in the Visual Motor Skills section of the evaluation tool:
• Use age-appropriate material as needed.
• For each of the items in the table, record the student’s ability to copy material from near point (book or other piece of paper close to the student) and from far point (board/display screen or wall, approximately 3–6 feet away).
• Note the number of units (letters or words) the student wrote before returning to the original.

When describing the pencil/crayon grip, consider the following:
• Does the grasp vary with time?
• Is the grasp immature but functional for the student?
• What modifications (such as a pencil grip, weighted pen, raised line paper, color-coded paper, etc.) is the student using to complete written work?

Note the type of scissors used. Use the descriptors below in addition to describing the student’s ability to use scissors: Functional Age-appropriate Emerging The student demonstrates beginning scissors use, but may need physical assistance Unable The student is not able to use scissors without maximum assistance Smooth cuts Jagged edges and curves are rounded Choppy Jagged edges, cuts extend beyond the cutting line If the student is able to cut with scissors, check the types of lines/shapes the student cuts: straight line, angled line, curved line, circle, triangle, square, or simple picture.

Note the accuracy and size (width and/or length) of lines/shapes cut and the weight of the paper. Include in your comments whether the student holds the scissors proximally (at the base of the fingers) or distally (between the distal interphalangeal [DIP] and proximal interphalangeal [PIP] joints of the fingers). Also indicate whether the student’s forearm is pronated or supinated when cutting. Record any unusual behaviors, such as stabilizing the arm against the trunk, keeping the paper on the table while cutting, using associated movements, showing inability to rotate paper while cutting, etc.
6. Section VI. Sensory Processing

This area addresses tolerance of sensory stimuli, play/work skills, and praxis abilities needed to function in the school environment (AOTA, 2003; AOTA, 2008).

A. Tolerance of Sensory Stimuli

Mark “Yes” or “No” as appropriate in the table. If assessment of this skill is not applicable or is addressed by another discipline, place an “N/A” in the Y/N column. In the Duration/Reaction column, document pertinent information regarding the length of time the student could tolerate the particular type of stimulation and/or any unusual reactions to the sensory stimulation.

The following are clarifying statements for the table in the Sensory Processing section of the evaluation tool:

- Wet sensory materials include shaving cream, finger paints, and glue.
- Dry sensory materials include rice, sand, sandpaper, and macaroni.
- Indicate any difficulties in determining if a student transitions easily between activities, including any actions the student uses to avoid the transition. Be sure to indicate the length of time for the student who is having difficulty. (Also note if any activities when transitioning to and from the activity are consistently a problem.) Indicate any unusual amount of force used by the student to determine if appropriate pressure is used in play. Include the activity and/or object involved during which an inappropriate amount of force was used. Be sure to record the student’s affect.
- When observing playground activities, note if the student seeks only one particular type of movement or avoids all playground equipment. Document any brief or prolonged use of particular pieces of equipment and the student's atypical reaction to any movement experiences.
- Document any self-stimulating behaviors in which the student engages, and indicate the times they are most likely to occur.
- Describe any sensory activities that the student seeks, such as fidgeting, putting nonfood objects into the mouth, smelling objects, twirling his/her hair, constant humming, etc.
• Describe any sensory activities that the student avoids, such as being messy, having his/her feet off the ground, etc. Document the behaviors in which the student engages to avoid these activities.

• **Play/Work Skills**
  • Solitary play: The student plays only by him/herself and may move away if others approach.
  • Parallel play: The student plays by him/herself in close proximity to a peer. The play may involve using similar toys or sharing materials.
  • Group play: The student engages in play involving rules so that all the players share a basic understanding of the rules of the game. This may involve games in which a standard set of rules applies, or in which the players make up the rules, as in role-playing or fantasy play.

• **Attention and Motor Planning**
  Use the codes provided on page 10 to record the student’s ability to perform both the attention and motor planning components of each task. In the Duration/Reaction column, note any unusual behaviors observed during the course of any of the activities listed. Examples may include a delay before responding, talking to oneself, and the type of assistance needed to perform the task. If the student is unable to complete the task, indicate the length of time the student engaged in the activity. In recording the student’s ability to complete a multi-step task, note the maximum number of steps the student can complete independently. Indicate whether the level is appropriate for the situation.

*Definitions:*

• Attention: The ability to focus on the task.
• Motor planning: Includes the conception, organization, and execution of a task.

**2.6 Functional vision assessment (FVA): the QTVI’s role**

With children who are difficult to assess in the clinic, the QTVI has an advantage as they can observe the child’s visual behaviour over a period of time, and in different situations.
Working in the home or school provides opportunities to discuss the child’s vision with parents or teachers.

Knowing their own children well, school staff and caregivers can describe any difficulties or unusual “looking behaviours” that they might have observed. One of the first things a QTVI will investigate when meeting a new child, is the way he or she uses vision in everyday situations. This information enables the QTVI to advise parents and teachers of ways they can make play and learning activities more accessible to the child. FVA also helps in planning a programme to optimise and develop a child’s visual and compensatory skills.

FVA investigates a wide range of visual skills including:
1 visual awareness; fixation; eye contact; tracking; and visually switching from one stimulus to another
1 visual field
1 visually directed reach and hand-eye co-ordination
1 contrast sensitivity – ability to see low-contrast objects and images
1 figure-ground discrimination – seeing objects against complex backgrounds
1 recognition – of objects, faces, pictures, symbols, shapes, colours
1 perception of depth/3D
1 mobility and orientation
1 the effect of environmental factors – lighting, glare, contrast, visual crowding, extraneous noise.

**Megan’s story**

Three-year old Megan was referred to the vision impairment service by her orthoptist following a visit to the eye clinic. Born at 28 weeks, Megan has epilepsy and global developmental delay. Electrodiagnostic tests indicated a degree of cortical damage which was likely to affect her vision.
At the clinic, Megan turned to the light from the window but did not respond to any of the items used to attract her attention. She became very distressed and wouldn’t let the ophthalmologist look at her eyes. Her mum was upset at Megan’s lack of response. She realised that Megan was not as visually responsive as other children but had seen her reach for certain toys on the floor. She wanted to discuss Megan’s vision with the consultant but felt she needed to get Megan out of the clinic as she was becoming inconsolable. Sue, the QTVI, went to meet Megan and her mum at home.

Megan played on the floor, while Sue asked mum some questions about Megan’s general development, interests and visual responses. Sue noticed Megan reach for toys but only when they were on the plain carpet. She didn’t seem to notice them on her patterned blanket. Having located a toy, Megan would then search the area with her hands before grasping it. Sue showed Megan her pen with a light-up star on the top. Megan noticed it, but lost visual contact when the light moved. When Sue offered her a choice between her favourite yellow rabbit and a white brick, Megan handled each one before grasping the rabbit, indicating possible difficulty with visual recognition. Sue observed that when Megan was distracted by a noise, she stopped playing and listened.

These observations indicated that Megan had some visual issues, but not necessarily those that could be easily identified in a clinical vision assessment.

2.7 Co-operative problem solving

Megan’s mum was apprehensive about the next eye clinic visit. Last time Megan became very distressed when the nurse put drops in her eyes. They had to wait quite a long time for the drops to take effect, then Megan screamed throughout the examination. Mum came away with lots of unanswered questions that she felt unable to ask.

Sue contacted the clinic and explained Megan’s difficulties. The consultant agreed that the eye drops could be administered by her mum at home, and luckily for Megan the first patient of the day had cancelled, so her appointment was brought forward.
Sue had been able to answer some of mum’s questions following Megan’s last clinic visit and described some of the assessments and procedures that might happen at future clinics. She explained why the eye drops were necessary and how Megan’s vision might be affected for a few hours afterwards. Sue accompanied Megan and her mum to the clinic and submitted a copy of her own report describing Megan’s functional vision and progress. The clinic visit was much less stressful this time and Megan’s eyes were successfully examined. Sue received a copy of Megan’s clinical assessment. Megan was found to be short-sighted and was prescribed glasses. The clinical and functional assessments together provided a much clearer picture of Megan’s vision. Sue was able to support Megan in wearing her glasses and give feedback to the orthoptist regarding their success.

1. David

David attends a special school for children with severe learning difficulties. At his eye clinic appointment the orthoptist tried Kay Pictures to assess his visual acuity. David was unable to match or name the pictures. Sometimes he thought the duck was a fish or the house was a car. He was more successful with the preferential looking test, but this did not give such an accurate result. The orthoptist contacted the QTVI at David’s school and asked if she could help. The QTVI lent Mum a copy of the Kay Pictures to take home and helped David practise matching and naming them. She was able to assess his near and distance vision in school using the Kay tests. At his next clinic visit David had a successful acuity test and the results were consistent with his test in school.

These two case studies illustrate ways that the orthoptist and QTVI together can achieve a full clinical and functional assessment of a child’s vision. Other co-operative working between the QTVI and orthoptist includes follow-up treatment for amblyopia, glasses-wear, and the use of low vision aids as illustrated in the following examples.

2. Nicky

Nicky is a wheelchair user and needs a low vision aid. He can’t hold or move it himself. His orthoptist and low vision therapist found the best solution was a magnifier attached to his
wheelchair using a double ended clamp and flexible arm. Under the advice of the orthoptist and low vision therapist, Nicky’s QTVI helped him to use his low vision aid effectively in school.

3. Millie

Millie found wearing her glasses with her new hearing aid very difficult and would often throw off her glasses. Millie’s QTVI arranged an appointment with the orthoptist, who following a discussion with the optometrist and audiologist, was able to attach her hearing aid to the arm of her glasses to reduce the irritation of wearing both behind her ear. Millie now wears both her glasses and hearing aid happily.

2.8 VISUAL FUNCTIONS vs. FUNCTIONAL VISION

Visual Functions describe how the eyes and the basic visual system function. With few exceptions, they can be measured for each eye separately. One can have an impairment (e.g. due to a cataract or a retinal scar) in one eye, but normal function in the other eye.

Functional Vision, on the other hand, describes how the person functions. The concept cannot be applied to one eye. A person cannot be disabled in one eye and not in the other eye.

Tests of Visual Functions are a mainstay of ophthalmology. They are performed by varying the stimulus, one variable (such as size, illumination, contrast) at a time, in a controlled environment, until the subject reaches a fixed threshold performance.

Tests of Functional Vision, on the other hand, are performed by presenting a standardized task and assessing the variable performance of the subject. The task must simulate a real-life environment, where multiple parameters may vary simultaneously and in unpredictable combinations. Furthermore, we are interested in sustainable performance, rather than in threshold performance. There is a substantial safety margin or comfort margin between threshold and sustainable performance [8]; often the difference is a factor 2x or 3x. The 2006 report on driver’s license requirements pointed out that vision requirements for driving indeed define a safety margin, not a scientifically determined threshold.
Although the measurement of Visual Functions can provide a statistical estimate of Functional Vision, it can never replace the direct, individual assessment of Functional Vision.

**Visual Function tests** can be strictly limited to visual parameters. In tests of Functional Vision, non-visual factors may influence the outcome. E.g.: reading print is primarily a visual task, but it also requires literacy and understanding of the topic and the language, which are non-visual skills.

### Table 2 – VISUAL FUNCTIONS vs. FUNCTIONAL VISION

<table>
<thead>
<tr>
<th>Examples</th>
<th>Measured</th>
<th>Method</th>
<th>Tests</th>
<th>Criteria</th>
<th>Involves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual acuity, field, contrast, dark adaptation, color vision, etc.</td>
<td>For each eye separately</td>
<td>Variable stimulus; fixed, threshold performance</td>
<td>Single variable, under controlled conditions</td>
<td>Threshold performance</td>
<td>Visual parameters only</td>
</tr>
<tr>
<td>Orientation and Mobility, Daily Living Skills, Communication, Sustained near activities</td>
<td>For the person as a whole</td>
<td>Standardized task; variable performance or difficulty</td>
<td>Multiple variables, under complex, real-life conditions</td>
<td>Sustainable, supra-threshold performance</td>
<td>May also reflect non-visual factors</td>
</tr>
</tbody>
</table>

#### 2.9 FUNCTIONAL VISION and QUALITY OF LIFE (QoL)

Since the introduction of the NEI-VFQ [9], interest in the last column of Table 1 has increased significantly. This is often described as “Quality of Life”; although a clear definition of the concept has often been lacking [10].

Assessment of Quality of Life essentially remains a subjective assessment. “Satisfaction” may be the best term to describe the balance between self-defined expectations and self-assessed performance. A farmer may feel lost in a big city; a city dweller may feel equally lost in a rural community. Both will say that their Quality of Life has decreased.

Table 3 lists items that can be assessed under each of the three aspects. The three lists are very different and require very different methods of assessment. We note that most visual
functions can be measured fairly accurately, since threshold performance can be objectively
defined. The assessment of functional vision contains more “soft” elements. Quality of Life
assessment, finally, is the most subjective; yet, if the Quality of Life is not improved, the
ultimate goal of either medical or rehabilitative interventions is not achieved.

Many questionnaires combine questions from all three columns under the single heading
of Quality of Life. When processing such questionnaires or surveys, a better separation should be
made between the different categories. For rehabilitation the column of visual skills in Table 1 is
most important. The rehabilitation plan for any individual must consider factors to the left as
well as to the right. They must be based not only on the mere presence of organ deficits on the
left, but also consider the individual needs and the relevance of tasks and objectives on the right
[11]. Based on these factors, individual goals must be set, against which the rehabilitative
outcomes can be measured. As indicated in Table 1 and at the bottom of Table 3, rehabilitative
outcomes require criteria that are different from those for medical or surgical outcomes.

<table>
<thead>
<tr>
<th>Table 3 – INVENTORIES for different aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE ORGAN</td>
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<tr>
<td>Etiology</td>
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<tr>
<td>Items</td>
</tr>
<tr>
<td>Acuity</td>
</tr>
<tr>
<td>Searching, fixation</td>
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<tr>
<td>Contrast</td>
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<tr>
<td>Glare</td>
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<tr>
<td>Visual Fields</td>
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<tr>
<td>Kinetic, static</td>
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<td>Color vision</td>
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<tr>
<td>Dark adaptation</td>
</tr>
<tr>
<td>Etc.</td>
</tr>
<tr>
<td>Dimension</td>
</tr>
<tr>
<td>Assessment</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Accuracy</td>
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<tr>
<td>Outcomes:</td>
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<td></td>
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</tbody>
</table>
2.10 Importance of Functional Vision assessment

Assessment of Functional Vision can be used for different purposes.

**Prediction of potential performance problems** is needed for licensing, such as for a driver’s or a pilot’s license. It is also needed to determine the eligibility for disability benefits.

Often these tests consider only visual functions, because the measurement of visual functions is easier, faster and often more objective than the assessment of functional vision. It should be realized, however, that while there may be a statistical correlation between visual functions and functional vision, individual performance may be better or worse than the statistical average. This is illustrated in Table 1a, taken from the 2006 ICO report on driving. This report recommended that driving license requirements should recognize a gray zone for borderline cases, where a test of on-the-road test performance should provide the ultimate basis for denying or awarding a, possibly restricted, driver’s license.

When determining disability benefits, visual function measurements (most often visual acuity) are often preferred, because they are more objective and more likely to show the same result from different examiners.

In **Medical and Surgical Outcome studies**, measures of visual functions, such as visual acuity, usually provide the *primary outcome measure*. They may be augmented with *secondary outcome measures* of vision-related skills and *tertiary outcome measures* of Quality of Life. Many questionnaires exist that focus on the results of cataract and refractive surgery. As the options in this field have increased, surgeons are increasingly realizing that patient satisfaction depends on more than letter chart acuity. Patient and procedure selection based on the patient’s goals, objectives and personality is increasingly recommended.
The NEI-VFQ and similar questionnaires were developed to be less disease-specific, so that they can be used for a wider variety of conditions and interventions. Their broader scope may be an advantage when used as a tertiary outcome measure. For measuring specific outcomes, as prescribed in a rehabilitation plan, their global nature is a disadvantage.

**Vision Rehabilitation** is the area where better assessment of Functional Vision is the most urgent, since for vision rehabilitation outcomes the assessment of vision-related skills and abilities is the *primary outcome measure*, not a secondary one as it usually is for medical and surgical interventions.

In this context three levels of questions can be distinguished.

One or two *very simple questions* are needed as part of each general eye exam to determine whether further exploration of rehabilitation issues is warranted.

If the initial answer is yes, then a *broader* list of *more detailed questions* is needed, to explore the patient’s goals, problems and priorities. Based on these questions, an individual *rehabilitation plan* needs to be defined, with specific goals. Practical experience unfortunately shows that even in specialized rehabilitation services intake interview are often conducted ‘by the seats of the pants’, rather than in a structured way.

At the conclusion of the rehabilitation plan, the results need to be assessed with a list of *focused questions*, relating to the specified goals.

At a time that evidence-based outcome research is demanded in all areas of medicine, the proper and consistent documentation of results in vision rehabilitation is often still unsatisfactory. Yet the recent publication of what probably is the first *randomized controlled study* of the effectiveness of a specific vision rehabilitation protocol [12] gives hope for the
future. This study showed dramatic effect size differences between the treated individuals and those on a waiting list; more details are discussed later.

2.11 Functional Vision Assessment Equipment List

This is a list of items which can be used in a Functional Vision Assessment. They are mostly everyday items which should be readily available in the person’s home. When you carry out the assessment, you may think of other useful things to use – this is fine if it helps you to find out more about what the person can see!

- Anything bright or sparkly
- Biscuits / sweets e.g. smarties / hundreds and thousands
- Cups – bright and neutral colours
- Different coloured trays
- Different coloured straws
- Examples of print or symbols in different sizes
- Favourite personal items
- Meals (for observation)
- Paints and craft materials
- Penlight or maglite torches
- Pens and pencils for writing or drawing
- Pictures / photos
- Plates – good and poor contrast
- Sunglasses / peaked baseball cap / sun visor
- Tennis balls, rubber balls or similar
- Television or computer screen

2.12 Summary

—Significant improvements in clinical, functional, and perceived vision are obtained by cataract surgery. The improvements in objective measures of functional vision found in this study support previous findings of improvements in patients’ perceived functional vision. In
addition, these data provide support to the necessity of second eye surgery in some patients to improve certain aspects of visual function to age matched normal levels.

2.13 check Your Progress

1. Explain general components of an assessment of visual function
2. How to use the functional vision assessment checklists?
3. Explain assessment of functional skills in the educational environment instructions
4. Write note on functional vision assessment (fva): the qtví’s role
5. Difference between visual functions vs. Functional vision
6. What is functional vision and quality of life (qol)?
7. Explain importance of functional vision assessment

Check Your Progress
11. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.11.1. Points for discussion
2.14 REFERENCES


Delhi: Kanishka Publication.


Unit 3: Tools of functional assessment of vision and skills: Functional skills inventory for the blind (FSIB), Low Vision Assessment by Jill Keeffe, Lea tests, and Portfolio assessment

3.1 Introduction
3.2 Completing The Assessment
3.3 Educational Implications – Functional Vision Assessment
3.4 Skills Inventory
3.5 The Professional Preparation Portfolio
3.6 Summary
3.7 Check Your Progress
3.8 Reference
3.1 Introduction

The Functional Vision Assessment (FVA) assesses the student’s functional acuities, visual field loss, eye motor control, and eye-hand coordination, as well as, reading, writing, functional life skills, and processing in all school settings. A FVA is closely associated with a Learning Media Assessment (LMA) and helps to determine the student’s learning style and appropriate teaching strategies and accommodations.

Although it is important for each student with a suspected visual impairment to receive comprehensive and ongoing clinical assessments by an ophthalmologist or low vision specialist, an essential role of the Teacher of Students with Visual Impairments is the functional assessment of the student’s visual skills. How an individual student is using his or her vision within his/her daily tasks and environments may differ significantly from the visual conclusions derived from clinical assessment. Clinical assessments occur within controlled environments to optimize the accuracy of the results and offer educators an informational tool to frame their assessments. Daily tasks within the classroom, home, or other environments, however, generally occur under less than optimal conditions. Factors such as glare, distance from tasks and print size may compromise a student’s ability to see and process visual information. Classroom and environmental noises may inhibit access to spoken directions, ability to orient oneself in space, and/or efficient processing of auditory information. The evaluator needs to assess both how the student has or has not learned to accommodate for visual impairment, and/or the compensatory skills the student needs in order to participate as effectively as possible across all learning situations.

A Certified Orientation and Mobility Specialist (COMS) can also use a Functional Vision Assessment (FVA) to analyze how a student uses vision for orienting and moving through space in familiar and unfamiliar areas.

As a result of a FVA, specialized instruction may be recommended for the student with visual impairment. The FVA results may also recommend consultation with the family and educational team regarding effective strategies to enhance the student’s learning and ensures access to the curriculum.
3.2 Completing the Assessment

A qualified individual, such as a Teacher of Students with Visual Impairments conducts a Functional Vision Assessment as a recommended assessment under the “Assessment in All Areas Related To Suspected Disability(ies)” section of the Evaluation Consent Form (N1A).

3.3 Educational Implications – Functional Vision Assessment

The following educational implications are designed to follow the outline of the Functional Vision and Learning Media Assessment. In addition to this, all students need an assessment of the subject areas covered by the Expanded Core Curriculum for Students with Visual Impairments (Hatlen, 1996)

1. Appearance of Eyes

Abnormalities in appearance of the eyes may indicate a need for treatment and/or counseling in regard to possible stares and adverse comments by peers and adults.

2. Behavioral Abnormalities

Some students who are severely visually impaired may exhibit mannerisms such as light gazing, rocking and moving the hands or fingers in front of eyes. The substitution of meaningful activities and replacement behaviors may help to decrease such behavioral abnormalities.

3. Eye Responses and Eye Movements

Blink Response: The blink response, a protective movement of the eyelids in response to an object approaching the face, is an indication of the presence of some degree of vision and depth perception. Students without a protective blink response may be more prone to eye injuries.

Pupillary Response: If the pupils of a student are sluggish in responding (contracting) to a light source from a penlight, the student may have difficulty in adjusting to changes in lighting. If the pupils are of unequal size, the student may have difficulty in accommodating while reading.
Pupillary Reflection: Normal eyes will show a reflection of light in the middle of each pupil showing that the eyes are properly aligned. If the eyes are not properly aligned from birth to about age seven, the brain will suppress vision in the weaker eye causing amblyopia. Amblyopic students may be helped by proper seating. For example, if a student has very poor vision in the right eye, it might be best to seat him/her in the right side of the room.

Visual Attention: Students may not respond to visual stimuli due to neurological damage. They may need to be taught to use their remaining senses. Students with inconsistent responses to visual stimuli and poor fixation skills may benefit from specific visual skills training and environmental adaptations.

Convergence: Students who have convergence problems (inability of the two eyes to bring their visual axes to focus on a near object) may have eye fatigue from reading and near vision activities. Frequent rest periods may be needed, and more emphasis on listening activities may be required.

Eye Movements: Poor eye movements (shift of gaze, scanning, and ocular pursuit) can be the result of a variety of conditions. This may cause the student to exhibit more head movements, and to read slower than normal. Training in systematic eye movements may be appropriate for some students.

Eye Dominance: Students with mixed dominance (e.g. lefthanded and righteyed dominant) may have difficulties with activities that require them to line up a target with their dominant eye. The TVI may recommend seating and placement of materials that would accommodate a strong/better eye preference.

Peripheral Field of Vision: Traveling can be adversely affected by limitations in the visual field. Students may need to be taught to move their heads and scan before moving across an area. The physical education teacher should be advised of the need to modify activities due to the student’s peripheral field limitations.
Color Discrimination: The classroom teacher may need to be made aware of students with color deficiency. Modifications of activities may include: providing good lighting, using bright, contrasting colors, labeling crayons and avoiding color-coded texts, graphs and diagrams. Activities such as labeling clothing and learning how to interpret traffic lights and signs may also be needed.

Light Sensitivity and Preference: Some students perform better in dim light (e.g., children with albinism) and some perform better in bright light (e.g., children with optic atrophy and optic nerve hypoplasia). The lighting requirements may be noted on the eye doctor’s report. Generally, students should not face windows or glare.

Some students may need to be seated away from windows, and some may need a desk lamp for additional lighting.

4. Visual Perception Skills

Assessment of visual perception skills is appropriate for preschool and primary level students who have not learned to read or write or students with multiple impairments causing cognitive delays. Such skills as visual discrimination, visual memory, figureground perception, eye-hand coordination, visual closure and visual sequencing may need to be provided by the TVI using a developmental vision curriculum, e.g., *Program to Develop Visual Efficiency and Visual Functioning* (Barraga & Morris, 1980).

5. Near Vision

Students with limited near visual discrimination skills may need to be taught by pairing tactual learning with near vision activities. Systematic search patterns with extra time for locating objects may be necessary. Sometimes tactual learning may need to be considered as the primary learning mode.

6. Learning Media

Current Print Functioning: A number of factors can affect a student’s print functioningsuch as near visual acuity, age of onset, cause of impairment, parental expectations,
experience with printed materials and concept development. Students who have the same visual acuity and eye condition may differ greatly in their ability to use printed materials. The TVI should consult with the regular classroom teacher and parents in recommending the media of instruction and learning. Some students may be able to read regular print, some may need a low vision device, some may prefer large print, some may need to rely on listening, and some may rely on tactile or braille materials.

Other students may find that combinations of these media work best for them in their instructional programs.

Writing Functioning: Students who have difficulty in copying print may be helped by using adaptive materials such as boldlined paper. Assignments may need to be shortened or additional time may be needed to enable the student to complete writing activities. Alternative methods of responding, such as multiple choice or word banks, rather than writing answers fully, may be used to shorten the writing task. Systematic instruction in handwriting, and keyboarding may be required for the student with low vision.

7. Depth Perception

Students with depth perception problems may need special instruction to help in the development of eyehand or eyefoot coordination and in recognition of objects at a distance. The TVI should consult with the physical education teacher and suggest modifications as needed.

8. Distant Vision

Distant Visual Discrimination: Students who have difficulty with distant visual discrimination may need preferential seating or positioning for viewing classroom activities such as experiments and demonstrations. Chalkboard activities, overhead projection and map reading may require preferential seating for students with limited distant vision. The TVI may need to recommend the student be given that copies of class notes. The classroom teacher may be asked to verbalize everything written on the chalkboard. The TVI may need to consult with the classroom teacher on ways to make viewing most meaningful.
Orientation and Mobility: Orientation and mobility skills may be noted throughout the functional vision assessment process. Special instruction may be needed in trailing, protective and search techniques, and in familiarizing the student with common areas of the school building. A thorough evaluation of orientation and mobility may be needed.

3.4 Skills Inventory

Cognitive

1. Birth - 1 Year
   - alerts to daily tactial/visual/auditory/movement stimulation
   - bats at toys suspended above crib in order to see or hear something interesting
   - touches new objects inquisitively
   - plays with own hands or feet
   - anticipates some familiar daily events based on sensory cues
   - combines three or more behaviors when exploring a toy (e.g., shakes, mouths, pats)
   - indicates desire to continue a familiar activity shared with adult by movement and/or vocalization
   - puts down one object deliberately to reach for another
   - plays with toys by taking advantage of the best characteristics of each: rolls ball, shakes bell, crumples paper
   - removes object from container by reaching inside
   - moves (scoots or crawls) to obtain object when given a visual or auditory clue
   - puts one object into another (discovers the concept of containers)

2. 1-2 Years
   - puts many objects into a container before removing any
   - opens container with lid to find sound-maker (ticking clock, music box)
   - touches 1-3 body parts on request (e.g., nose, mouth, tummy)
   - shows anticipation of events when verbal cue is provided (hears “let’s go outside” and goes to coat closet)
   - shows preference in choice of toys
shows curiosity about a new toy

demonstrates concept of up/down by moving self or object (“put the spoon down” or “hold your hand up high”)

gives or touches 5 specific objects on request

demonstrates cabinets and drawers in own home

selects, from group of 3, object identical to given object (eg., shoes, spoons, cups)

3. 2-3 Years

demonstrates simple problem-solving (eg., uses tool to obtain object which is out of reach)

demonstrates the use of familiar objects on request (hairbrush, crayon)

matches big/little objects (identical in every other way)

finds/touches big/little objects on request

matches shapes (circle, square, triangle)

Cognitive (cont’d)

understands and gives “just one”

finds object when function is described (“show me the one you brush your teeth with”)

demonstrates the concept of two

matches smaller body parts (fingers, thumb, toes) on request

touches body part when function is described (“show me what you hear with”)

tells age verbally, or holds up fingers

names 2-3 familiar musical toys and instruments by their sound

names one color when asked (names, not recognizes or matches)

sorts 3 kinds of dissimilar objects

sorts similar objects by size, shape, or color

4. 3 - 4 Years

names 10 body parts

turns to face an object/person on request

touches top, bottom, front, back, and sides of an object on request
identifies common environmental features indoors/outdoors (chairs, stairs, door, window, sidewalk, lawn)
names object not present when function is described
matches sound containers (beans, rice, marbles)
names objects as same/different
tells which objects go together (shoes/socks, spoon/plate)
touches 3 named shapes on request (circle, square, triangle)
names shapes
arranges 3 items horizontally in order by size
tells if object is heavy or light
tells if object is long or short
matches 1:1 (1 plate, 1 napkin, 1 child, 1 cookie)
tells how many objects in a set (1-3) after counting
matches simple sequence or pattern of 5 blocks, beads or pegs

5. 4 - 5 Years

tells own age
comprehends concepts of today, last night, yesterday, tomorrow when discussed with adult
identifies weather as rainy, sunny, snowy, warm, cold
tells whether sound is loud/soft, high/low, long/short
touches own complex body parts on request (wrist, shoulder, ankle, waist)
moves body planes in relation to flat surface (“put your back against the wall”)
touches and names left/right on own body
places objects over/above, under/below, upon/inside, through, and away from other objects on request
sorts similar household objects (silverware, clothing)

Cognitive (cont’d)
arranges objects into at least 3 groups (things to eat, wear, or play with)
identifies picture/object which does not belong in group
- identifies objects as long/short, hard/soft, rough/smooth
- places 5 objects in horizontal arrangement by size
- rote counts to 10
- counts objects from 1-10
- gives no objects when asked for zero
- touches first, middle, last items in a row
- finds matching symbol (printed/raised outline) of geometric shapes
- tells whether 2 symbols are the same or different
- recognizes own name in print or braille
- puts 5 objects in pattern from memory (using alternating colors or shapes)

6. 5 - 6 Years
- states full name, address, and phone number
- states full name of at least one parent
- states month and date of own birthday
- names 10 colors (“tell me all the colors you know”) item does not require vision
- identifies penny, nickel, dime
- names days of the week in order
- answers which is longer, a minute or an hour? A day or a week?
- places objects across from, next to, beside, behind, in front of, to the side, left and right of self on request
- places objects across from, next to, beside, behind, in front of, to the side, left and right of other objects facing in the same direction of self
- arranges 4-5 objects in sequence by length, width, or height
- identifies half and whole objects
- creates sets of objects of up to 5
- names numerals 1 to 10 when presented
- matches numerals with same quantity of objects, 1 to 10
- names ordinal position of objects (first, second, third)
- names numerals 11 to 20 when presented
- write numerals (print or braille) 1 to 20 in proper sequence
- rote counts to 100
- identifies sets containing more/less
- using real objects, adds and subtracts combinations up to 3
- states letters of the alphabet in order
- finds symbol that is different in a line of like symbols
- reads own first and last name
- identifies letters of the alphabet when presented (upper case, lower case, upper/lower mixed)
- reads 5-10 simple words

**Cognitive (cont’d)**
- names object beginning with given consonant sound
- gives consonant sound of selected letters
- copies upper and lower case letters from flashcards (print or braille)
- copies two short words
- writes letters from dictation (upper and lower case)

### 3.5 The Professional Preparation Portfolio

Successful completion of a Professional Preparation Portfolio is required of all teacher education candidates at SMSU in order to be recommended for initial certification to teach. This portfolio is a graphic anthology of a student’s progress and performance in all coursework, practicum placements and student teaching experiences. The Professional Preparation Portfolio is also a medium by which the academic programs are evaluated for accreditation by the Missouri Department of Elementary and Secondary Education and the National Council for the Accreditation of Teacher Education.

Teacher education students will receive guidance throughout their program from the instructors of their courses to help answer questions and maintain quality of the portfolio. There are three checkpoints scheduled throughout the sequence of courses taken in the teacher education program. The checkpoints are individual conferences held between students and instructors to assure that everything is in order and progressing satisfactorily toward meeting the
Missouri Standards for Teacher Education Program (MoSTEP) quality indicators and subject area competencies.

The first checkpoint occurs in SEC 302, PED 200, or MUS 200. The second will occur during the special methods courses or designated point in the degree program. The third and final checkpoint occurs during the student teaching semester. At that time the portfolio will be reviewed to determine if there is sufficient evidence to meet MoSTEP quality indicators and subject area competencies.

1. **Portfolio Checkpoint 1: ELE302/SEC 302/PED 200/MUS 200*  
These artifacts are required and must be included within the portfolio at checkpoint 1:

   • Professional Resume  
   • Clinical Placements Log  
   • Artifacts with cover sheets as assigned – minimum of lesson plan and appropriate artifact cover sheet  
   • Evaluation of uploaded materials by faculty

2. **Portfolio Checkpoint 2: Special Methods Courses or Designated Point in Program**  
A summary of general expectations for Portfolio Checkpoint 2 follows:

   • Artifacts and artifact cover sheets required by the specialty area that reflect knowledge, skills and professional dispositions aligned with standards  
   • Professional Resume further developed  
   • Clinical Placement form completed to reflect additional experiences and outcomes  
   • Educational Philosophy

3. **Portfolio Checkpoint 3: Supervised Student Teaching**  
Artifacts may be required and reviewed by the specialty area faculty, University Student Teaching Supervisor and cooperating teacher. A summary of expected content follows:
• Additional artifacts and artifact cover sheets as required in order to meet MoSTEP quality indicators and subject area competencies
• Professional resume completed
• Clinical placement form completed to reflect culminating experiences and outcomes
• Complete section IV of your portfolio (Student Teaching Evaluations)

Portfolio Sections

Section I. Introduction
Section I contains the professional education candidate’s:
· Educational Philosophy
· Resume
· Log of Clinical Placements assigned during the program (downloadable form)

Section II. Professional Practice
Section II includes artifacts that represent performances aligned to the Conceptual Framework (CF) MoSTEP and specialty area standards. Download a copy of the Portfolio Guide (replaces the old Table of Contents) specific to your area of study. The Portfolio Guide should be kept in Section II of the portfolio with artifacts reflecting the required standards placed after the guide. Candidates are expected to monitor progress toward standards on the Portfolio Guide (downloadable form).

Artifacts that reflect the SMSU (CF) Learner Outcomes, the MoSTEP Standards and the specialty area standards will be placed in Section II of the portfolio. Artifacts must be accompanied by an Artifact Cover Sheet that documents the nature of the project as well as performances related to standards. (See downloadable forms to access the Artifact Cover Sheet and corresponding Directions for the Artifact Cover Sheet.)
Section III. Showcase

Section III is the student Showcase Section. This is optional for students who elect to include items that will further illustrate their experiences in the professional education program as well as showcase mastery of professional standards and the Conceptual Framework general outcomes.

Section IV. Field Evaluations

This section should include practicum and student teaching field evaluations. See your program faculty for guidance regarding practicum materials and evaluations. For student teaching, include the evaluation of the cooperating teacher and the University supervisor of all placements in the student teaching semester.

Jill E Keeffe
Director, World Health Organization
Collaborating Centre for Prevention of Blindness at CERA.

Our recent survey1,2 found that low vision services were often inaccessible to large numbers of people in low- and middleincome countries.

Based on the findings of this research, we suggest three areas for action: human resources, sustainability of services, and advocacy. However, it is important to keep in mind that these strategies must be adapted to suit your situation.

Human resources

• Integrate low vision into existing ophthalmic and optometric curricula and include it in the practical training of education and rehabilitation workers
• Offer informal low vision workshops and courses for eye care workers who have not received formal training.
• Delegate tasks to less specialised health workers where possible. For instance, instead of the optometrist doing the simple refraction and basic low vision care, a trained vision technician could do these tasks.
• Build on the skills of existing staff. For example, in areas where there are no ophthalmologists or optometrists, refractionists, ophthalmic nurses, and opticians can be trained to take on additional low vision tasks appropriate to their skills and experience.

Sustainability
Strengthen community-based rehabilitation and outreach services.
• During outreach, you could explain or show how the home environment can be adapted and make timely referrals to district level care. Through outreach, people can be followed up to ensure they are still able to use their low vision devices, and you can give refresher lessons to those who need it. In addition, children with poor vision can be detected and supported early.
• Outreach services should be carried out on a regular basis, although the frequency may vary, depending on need.
• Integrate low vision services into existing education, rehabilitation, and eye care systems. Establish appropriate and healthy collaborations between the government and the private sector.
• Non-governmental organisations must work together with the private sector and government to support and fund low vision services. However, for this to work in the long term, the government must take the lead and take ownership of programmes and services.

Advocacy
We recommend two strategies:

1 Use strong research evidence on which to formulate policy.
2 Encourage NGOs and all stakeholders with an interest in low vision to come together under one umbrella organisation, i.e. a national VISION 2020 or prevention of blindness committee. The group can then deliver the policy message with one clear voice.
Once advocacy and lobbying have started, more detailed planning must be done at the implementation level. For instance, encourage local government and policy makers to include low vision in their district VISION 2020 or eye care plans.

3.6 Summary

Students with visual impairments, including those with multiple disabilities and/or deafblindness, are an extremely heterogeneous population. The small number of such students makes it difficult for any one school or program to have full knowledge and adequate resources to meet varied and intensive specialized needs of this unique student population. This document was designed to provide a guideline into key components for appropriate individualized education program planning for these students and critical resources available to schools and families. The document references the impact of visual impairment and key areas for delivery of quality educational services for students with visual impairments as outlined in the Goal Statements of the National Agenda for the Education of Children and Youths with Visual Impairments, Including Those with Multiple Disabilities.

Further information and support is available from the Texas regional Education Service Centers, Texas School for the Blind and Visually Impaired, and local vision professionals.

3.7 Check Your Progress

1. Write note on Educational Implications – Functional Vision Assessment
2. Explain following
   A. Skills Inventory
   B. The Professional Preparation Portfolio

Check Your Progress

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12. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others
1.12.1. Points for discussion

Points for clarification
3.8 REFERENCES


Unit 4: Tools for psychological assessment of the visually impaired: Vithoba Paknikar Performance Test, A short Scale IQ measure for the visually impaired based on WISC-R, Adapted EPQ, Adapted Blind Learning Aptitude Test, Concept development for blind children, Reading Preference Test, Cornell Medical Index for Visually Handicapped Children

4.1 Introduction
4.2 Vithoba Paknikar Performance Test
4.3 Definition Of Intelligence
4.4 Credibility Of Wisc-Iv Results
4.5 Reading Preference Test
4.6 Emergent Literacy Acquisition And Delays In Language Development In Visually Impaired Children
4.7 Development Of Tests For Children Who Are Blind
4.8 Summary
4.9 Check Your Progress
4.10 Reference
4.1 Introduction

Psychometric tests are part of the basic toolkit available to psychologists to assess the personality, knowledge, skills and attitudes of individuals with reference to a standard population. They are used in many areas, including education, therapy, recruitment, academic achievement, and counseling. As the vast majority of psychometric assessment tools rely on the visual modality, their usability in persons with visual impairment (i.e., those who are totally blind, legally blind or have low vision) still provokes controversy (see Reid, 1994, 1995). Several American surveys (Bauman & Kropf, 1979; Hannan, 2007; Miller & Skillman, 2003) have quantified the use of and satisfaction with measures of cognitive abilities applied to visually impaired individuals. These studies concluded that there is considerable dissatisfaction among professionals with current assessment procedures, with doubts being expressed as to their appropriateness for use with visually impaired children and adults. In the UK, Atkins (2011) recently reviewed a range of psychometric tests that have been developed for use with visually impaired people in the education and employment fields, the majority based on tests for sighted people (e.g., Wechsler intelligence scales). According to Atkins, visually impaired individuals are potentially disadvantaged by the use of these tests, the nonverbal aspects of the tests being particularly problematic, owing to their reliance on visual images, and the limitations or difficulties of adapting the visual material using haptic models.

Haptics (i.e., tactilo-kinesthetic perception) plays a key role in our cognitive and perceptual development (Hatwell, Streri, & Gentaz, 2003). Tactilo-kinesthetic perception results from the stimulation of the skin, together with the muscles, joins, and tendons, due to active exploratory hand movements (Hatwell et al., 2003; Revesz, 1950). Haptic perception usually occurs under conditions of active touch, when the subject’s hand or skin contacts an object (see Gibson, 1966). Therefore it is common to equate haptics with the sense of active touch. Note however that in some very specific cases, haptic exploration can also occur under conditions of passive touch, when the subject’s hand or skin is guided by an external agency (a machine or the experimenter) across an object (see e.g., van Doorn, Dubaj, Wuillemin, Richardson, & Symmons, 2012). Haptics is the first sense to develop in the womb (see Heller & Schiff, 1991; Heller & Gentaz, 2013), and an important modality used by infants and young children to acquire information about their environment (Bushnell & Boudreau, 1991).
Haptics is also fundamental to the development of children with visual impairments, allowing them to gain knowledge about the outside world and function as independently as possible in their everyday lives (Hatwell, 2003; Withagen et al., 2010). In both children and adults, this modality is particularly effective in the perception of the material properties of threedimensional (3D) objects as well as in their manipulation (Gentaz, 2009; Hatwell, et al., 2003; Lederman & Klatzky, 2009). But it can also be used to process two-dimensional (2D) raisedline materials, such as diagrams and graphics (e.g., Lederman & Campbell, 1983), maps and plans (e.g., Espinoza & Ochaita, 1998), shapes and geometric patterns (e.g., Bailes & Lambert, 1983; Picard, Lebaz, Jouffrais, & Monnier, 2010), or pictures of common objects (e.g., D’Anguilli & Kennedy, 1998; Picard, Albaret, & Mazella, 2013; see also Picard & Lebaz, 2012 for a literature review). Haptics therefore represents an alternative modality to vision for the psychometric assessment of cognitive and perceptual-motor abilities, and may be specifically suitable for assessing visually impaired individuals whose “perceptual experience is haptic rather than visual” (Ballesteros, Bardisa, Millar, & Reales, 2005, p. 11).

So far, however, tests based on haptics have not been specifically reviewed, thus limiting our understanding of how the sense of active touch has been used as the assessment modality for cognitive and perceptual-motor abilities. Unlike most previous studies, which have either undertaken surveys (on the use of and satisfaction with tests for blind people), or else examined psychometric tools in general (with no specific focus on haptics), the present study was intended to provide a quantitative review of haptic psychometric tests. We defined haptic tests as tests that are performed in the haptic (or tactilo-kinesthetic) modality, with no reliance on vision, and which are therefore potentially usable in the case of visual impairment.

More specifically, the aim of this literature review was to identify the main characteristics of the haptic test landscape (i.e., what has been done thus far), and to discuss possible avenues for future research and for the design of haptic tests aimed at visually impaired persons (i.e., what should be done next).
4.2 Vithoba Paknikar Performance Test

Baseline neuropsychological evaluations were done before starting SCRT and at 6 and 24 months follow up after the completion of treatment (21). Patients undergo yearly assessments thereafter as per the required protocol. An age-appropriate neuropsychological battery was administered for each patient.

Intelligence quotient (IQ) was measured by an age-adjusted and validated Wechsler Intelligence Score Chart (WISC) to give verbal quotient (VQ), performance quotient (PQ) and full-scale quotient (FSIQ). For patients more than 16 years, memory quotient (MQ) measured by Wechsler memory scale (WMS) was done instead of verbal quotient. In blind patients, specialized Vithoba Paknikar performance test battery for assessments were used. Cognition was also measured by the Lowenstein Occupational Therapy Cognitive Assessment (LOTCA) battery (max value:119), which assesses seven major areas including orientation, visual perception, spatial perception, motor praxis, visuomotor organization, thinking operations and attention concentration (22). We also measured anxiety levels in children by the State-Trait Anxiety Inventory for Children (STAIC). In patients aged more than 16 years, anxiety and depression were measured by Hamilton anxiety rating scale (HARS; for adults) and Hamilton depression rating scale (HDRS) respectively.

There is a relative paucity of data employing conformal techniques in childhood brain tumours to demonstrate their safety in terms of acceptable local control and minimization of treatment related morbidity. We recently evaluated our preliminary experience in one twenty eight children with low grade/benign brain tumours treated with focal conformal radiotherapy and neuropsychological evaluation was done using neuropsychological battery (23). As many as 69 (64.3%) of the 128 evaluable patients had FSIQ values below normal expected levels before starting RT, although overall mean VQ (85.7), PQ (85.6), and FSIQ (83.4) were only slightly less than expected values. Patients with moderate/severe hydrocephalus (p=0.087) and with impaired hormone axis (p=0.014) had significantly lower IQ score. However, performance status (KPS), type of surgery, economic and educational status of the patient had not shown to effects pre-RT IQ score. Among 28 patients treated with SCRT and had at least 2 year follow up, a third of patients did show a >10% decline in FSIQ as compared to pre-SCRT
assessment. Logistic regression analysis demonstrated patients <15 years of age had a significantly higher chance of developing >10% drop in FSIQ than older patients [53% vs. 10%, p=0.03]. Dosimetric comparison showed that patients receiving >43.2 Gy to >13% of volume of left temporal lobe were the ones to show significant drop in FSIQ (p=0.048). RT doses to other normal structures including supra-tentorial brain and right temporal lobe did not reveal any significant correlation.

A significantly high proportion of patients had showed severe anxiety (score more than 30) in the state C1 form (19/41 evaluable patients, 46%) than in the trait C2 form (14 patients, 34%) (p=0.008). In the LOTCA battery, proportion of patients with less than expected scores was seen significantly more in the visual (p=0.007), orientation (p<0.001) and spatial perception (p<0.001) than visuomotor, motor praxia, thinking and attention domains (22).

In 38 low grade glioma patients treated with SCRT mean total modified Barthel’s ADL score (Barthel’ Index, BI) before staring SCRT was 94.5; at 2 and 3 year follow up mean BI was maintained to 97.1 and 99 respectively (24). At pre-SCRT assessment, patients with impaired visual function and with low performance status (KPS<70) had significantly lower BI than those with normal vision (p=<0.001) and with good performance status (p=0.001). On follow up, maximum improvement in individual BI was seen in the ambulation related domain in patients with impaired visual function (p=0.027), low KPS (p=0.015) and age <13 years (p=0.103). Before starting SCRT, baseline endocrinologic evaluation revealed that 41 out of 67 patients (61%) had hormone deficiency in at least one axis (25). Hormone dysfunction was significantly more in sellar/suprasellar tumors (p=0.005) and tumors close to hypothalamic pituitary axis (HPA) (p=0.019) than tumors located in other sites. Hormonal dysfunction was seen more in growth hormone axis (48%) and thyroid axis (46%) than corticosteroid (28%) and sex hormone axis (2%). At 2 and 3 year follow up, 8/34 (24%) and 4/27 (15%) patients developed additional hormone axis deficit. A short Scale IQ measure for the visually impaired based on WISC-R

Overview

The Wechsler intelligence scales were developed by Dr. David Wechsler, a clinical psychologist with Bellevue Hospital. His initial test, the Wechsler-Bellevue Intelligence Scale,
was published in 1939 and was designed to measure intellectual performance by adults. Wechsler constructed the WBIS based on his observation that, at the time, existing intelligence tests for adults were merely adaptations of tests for children and had little face validity for older age groups.

Since 1939, three scales have been developed and subsequently revised, to measure intellectual functioning of children and adults. The Wechsler Adult Intelligence Scale-III (WAIS-III) is intended for use with adults. The Wechsler Intelligence Scale for Children-IV (WISC-IV) is designed for children ages 6 - 16, while the Wechsler Preschool and Primary Scale of Intelligence-III (WPPSI-III) is designed for children age 4 - 6 1/2 years.

**4.3 Definition of Intelligence**

Wechsler defined intelligence as an individual's ability to adapt and constructively solve problems in the environment. It is significant that Wechsler viewed intelligence not in terms of capacity, but rather, in terms of performance. That is, the Wechsler scales are not purported to measure one's quantity of intelligence, but instead measures one's intellectual performance. The rationale for conceptualizing intelligence as a performance variable is that it does not really matter how much intelligence one has, in order to adapt to the environment. What matters is how well one uses his/her intelligence. Also, since intellectual capacity cannot be seen nor its existence concretely verified, it cannot be reliably measured. Performance can be measured and, thus, should be the focus of the test. Although Wechsler has written much to support this position, other intelligence developers have taken essentially the same position regarding the nature of intelligence. Most major intelligence tests, such as the Stanford-Binet, the Peabody Picture Vocabulary Test, and the Guilford Intelligence Scales, are grounded in the view of intelligence tests as performance measures.

The Wechsler scales, like the Binet and other tests, measure intellectual performance as a multidimensional construct. This means that, rather than conceptualizing intelligence as a single characteristic, the tests contain numerous scales assessing qualitatively different types of intellectual functioning. The notion of multidimensional intelligence is certainly not new in
cognitive psychology; in the 1920s, Thurstone and Spearman viewed intelligence as consisting of several components. However, in contrast to earlier multidimensional views, current intelligence tests view intelligence not as specific abilities emanating from a "general" intellectual capacity (e.g., general S with many specific "s" factors), but as different types of intelligence, each type being of equal adaptive importance.

4.4 Credibility of WISC-IV Results

How do we know the WISC-IV is a reliable measure of intelligence? Standardized intelligence tests are constructed according to strict guidelines to ensure reliability and validity. Reliability refers to the consistency of a measure over time and across the content (i.e., the item responses) of the test. A test is considered reliable if we are able to get the same/similar result repeatedly. For example, if a test is designed to measure intelligence, two of the same form of test (say, Part A and Part B) should bear very close results when administered to a subject. Having said that, it is almost impossible to calculate reliability accurately, but there several different ways to estimate reliability (there are a lot of internet resources on this subject). In this case, the WISC-IV is believed to be a reliable measure of intelligence. A test is considered valid if the scores accurately and consistently describe a child's intellectual performance and adaptation in day to day life.

Among other reasons, testing is done when one has some concerns about a child's learning needs and wants to determine the child's learning potential and placement in certain programs (usually gifted programs). Apart from providing IQ scores, the WISC-IV also provides essential information and critical clinical insights into a child's cognitive functioning. It also integrates current conceptualizations and recent research to provide the most essential information about a child's strengths and weaknesses. There is a lot of input from practitioners and experts in the field. Over time and several reviews, the WISC-IV (which is an update of the WISC-III) is concluded to represent significant advances in the understanding of cognitive abilities.

Administered in a time period between 65 and 80 minutes, the WISC-IV contains 10 core subtests and 5 additional subtests. These are summed to four indexes (the Verbal Comprehension
Index, the Perceptual Reasoning Index, the Working Memory Index and the Processing Speed Index) and one Full Scale IQ (FSIQ) which ranges from lowest 40 to highest 160 points. Subtests are given for additional examination of processing abilities. The age range for this test is between 6 years and 16 years 11 months. In terms of difference in scores, an individual who has taken the WISC-III, then retested with the WISC-IV may show a 5 point drop in FSIQ.

This is due to new aspects of the test, and the novelty of some of the new items and subtests. The following are the four main indexes of the WISC-IV and what they measure:

1. **Verbal Comprehension Index (VCI)**
   *Measure*: Verbal concept formation. Tests include Similarities, Vocabulary, and Comprehension. Optional tests are Information and Word Reasoning.
   Assesses children's ability to listen to a question, draw upon learned information from both formal and informal education, reason through an answer, and express their thoughts aloud. It can tap preferences for verbal information, a difficulty with novel and unexpected situations, or a desire for more time to process information rather than decide "on the spot."

2. **Perceptual Reasoning Index (PRI)**
   Optional test is Picture Completion.
   It assesses children's ability to examine a problem, draw upon visual-motor and visual-spatial skills, organize their thoughts, create solutions, and then test them. It can also tap preferences for visual information, comfort with novel and unexpected situations, or a preference to learn by doing.

3. **Working Memory Index (WMI)**
   It assesses children's ability to memorize new information, hold it in short-term memory, concentrate, and manipulate that information to produce some result or reasoning processes. It is
important in higher-order thinking, learning, and achievement. It can tap concentration, planning ability, cognitive flexibility, and sequencing skill, but is sensitive to anxiety too. It is an important component of learning and achievement, and ability to work effectively with ideas as they are presented in classroom situations.

4. Processing Speed Index (PSI)

*Measure*: Speed of Information Processing. Tests include Coding and Symbol Search. Optional test is Cancellation.

It assesses children's abilities to focus attention and quickly scan, discriminate between, and sequentially order visual information. It requires persistence and planning ability, but is sensitive to motivation, difficulty working under a time pressure, and motor coordination too. Cultural factors seem to have little impact on it. It is related to reading performance and development too. It is related to Working Memory in that increased processing speed can decrease the amount of information a child must "hold" in working memory. On the other hand, lower processing speed can impair the effectiveness of working memory by requiring the child to "hold" in working memory more information than the child can effectively process at a given time. As an analogy, one can think of the thinking brain like the front entrance to a Victorian style home. There is a porch, front door, a foyer and, of course, the rest of the house. Guests (information) knock at the door and "stand on the porch" (i.e., teacher presents concepts). The host (i.e., the brain) lets the "guest" come into the foyer (i.e., brain perceives the information and registers that it is there). The host helps the guests take off coat and boots (i.e., the brain organizes and clarifies the information for storage), and brings them into the house (i.e., encodes the information into longer term memory). If the host takes too long to perform "hosts tasks" and get the guests into the living room, some guests may become impatient and leave (i.e., some information is not encoded).

Based on new neurological models of cognitive functioning, there have a number of improvements in the WISCIV, namely:
*Betterment in assessing fluid reasoning
*Less reliance on speed for PRI - better differentiates PRI from PSI
* Better assessment of WM through changes made to one test and addition of a new subtest
*Improved subtest reliabilities, floors and ceilings from WISC-III
*Enhanced clinical validity, improved reliabilities and validities (updating of norms)
*Updated art
*Less cultural, SES or regional bias
*The integrated version that allows some multiple choice testing of children to see what they know but can not express

4.4 WISC-IV Subtests

**Word Reasoning** - measures reasoning with verbal material; child identifies underlying concept given successive clues. This measures a child's skills at understanding what words mean rather than simply seeing a "collection of letters."

**Matrix Reasoning** - The child is presented with a partially filled grid and asked to select the item that properly completes the matrix. The test measures fluid reasoning. Fluid reasoning describes a child's skill at grasping nonverbal concepts (i.e., shapes, designs, visuospatial patterns) such that s/he can identify missing or incorrect aspects of those concepts and complete or correct them. This skill also is known as whole to part to whole/part to whole organization, or one's skill at deducing the appearance of a thing by analyzing its part, and identifying what the individual parts of a thing look like by examining only the complete item. This skill is used in many activities where one must identify objects, locations, landmarks, and the like by shape. Fluid intelligence also is used in tasks where one must design a thing (e.g., machine parts) to satisfy certain requirements.

**Picture Concepts** - From each of two or three rows of objects, the child selects objects that go together based on an underlying concept. This test measures fluid reasoning, perceptual organization (i.e., the ability to organize nonverbal concepts in a way that they can be processed
most quickly and accurately), and categorization (i.e., skill at recognizing the common features of nonverbal concepts).

**Letter-Number Sequencing** - The child is presented a mixed series of numbers and letters and rearranges them such that numbers come first, from lowest to highest; then letters are next, in alphabetical order. The child also receives full credit if s/he organizes letters followed by numbers, if the letters and numbers are correctly ordered. The test measures working memory. Briefly, working memory describes one's skill at organizing and manipulating two or more somewhat different verbal concepts quickly and accurately. To perform LNS well, one must be able to remember the numbers and letters, then rearrange them in several rapid steps while remembering them.

**Cancellation** - Measures processing speed using random and structured animal target forms (foils are common non-animal objects). The child is asked to place a strike through selected targets interspersed among a much larger group of targets on two minutes.

**Arithmetic**: Arithmetic problems similar to those encountered in elementary math courses. Problems are administered orally and must be solved without paper and pencil. In addition to math knowledge, test measures concentration and systematic problem-solving ability.

**Coding-Digit Symbol**: Common shapes (Ages 6-7) or numbers 1 - 7 (ages 8 and older) are paired with symbols on a key presented to child. Child has 120 seconds to go through a grid of 90 numbers/shapes and place the correct symbol below each one. Measures visual-motor speed and complexity and motor coordination. There are two additional, optional extensions of the coding test that measure the child's skills in learning the coding process after completing the initial task.

**Similarities**: Items requiring child to describe how two given things are alike. Score on each item varies according to the degree to which the response describes a general property primarily pertinent to both items in the pair. Measures the child's skill in comparative reasoning. This is
one's skill in recognizing the similarities (and, by extension, the differences) between verbal ideas.

**Block Design**: Perhaps the butt of more jokes than any other Wechsler scale! Included in the test are nine red and white square blocks and a spiral booklet of cards showing different color designs that can be made with the blocks. The child must arrange the blocks to match the design formed by examiner or shown on cards. In addition to being scored for accuracy, each item is scored for speed as well. Measures spatial problem-solving and manipulative abilities, and fluid intelligence (specifically, whole to part/part to whole organization). Part to whole organization describes one's skills in mentally "putting together" complex objects by seeing and mentally manipulating its individual parts.

**Information**: Items on a variety of information adults have presumably had opportunities to acquire in our culture. No specialized or academic information included; however, some of the items cover quite sophisticated information.

**Comprehension**: Items that require child to explain what should be done in certain circumstances, the meaning of proverbs, why certain societal practices are followed, and so forth. The test measures practical judgment, common sense, and the ability to understand and adapt to social customs. Score on each item varies (0-2 pts) according to the degree to which the response describes the most pertinent aspects of the question.

**Similarities**: Items requiring child to describe how two given things are alike. Score on each item varies according to the degree to which the response describes a general property primarily pertinent to both items in the pair. Measures concrete, functional, and abstract concept formation.

**Digit Span**: Two parts, Digits forward and digits backwards. Child required to repeat 3 - 9 digits forward and 2 -9 digits backwards. Measures short-term memory, attention, and concentration.
**Vocabulary:** Words of increasing difficulty are presented orally and visually. Child required to define the words. Score (0-2) based on sophistication of definition. Measures verbal knowledge and concept formation.

**Picture Completion:** Several pictures, each having a part missing. Child must identify the missing part. Measures ability to observe details and recognize specific features of the environment (i.e., whole to part discrimination). Also measures performance in deliberately focusing attention on a task.

**Symbol Search:** The child is presented with several rows of items. On the right of the row, there are one or two symbols. On the left of the row are several symbols. The child must determine, as quickly as s/he can, if the symbol (or one of the two symbols) on the right also appears among the symbols to the left. This test is another measure of speed and accuracy with which the child processes nonverbal information.

**4.5 Reading Preference Test**

There is a growing body of evidence to support the belief that the critical components of emergent and early literacy for children with visual impairments do not differ markedly from those of their sighted peers. Infants and toddlers with visual impairments and blindness require lots of interactions and early life experience (Koenig, Farrenkopf, 1997), that support their oral language development, awareness of print or Braille, and opportunities to explore writing (Erickson, Hatton (2007a, 2007b).

But, children and youth with visual impairment (both blind and partially sighted) can present delays and difficulties in the language development in areas important for development of reading skills specific to this population and effect different areas of functioning (Corley, Pring, 1993, Tadić, Pring, Dale, 2010, Shankar, Evans, Bobier, 2007).

family, especially mothers, contributes to the growth and development of the blind child Gaston, Lucerga, Rodriguez de la Rubia (2005).

Many authors share the same opinion and stress out that team approach (Walthes, 2005), professional support, and additional activities in the family, help in reaching goals of the rehabilitation programs (Belyakova, 2005, Matok, 2002, Burger, 2005, Walter-Klose, 2005, Losada et al., 2005, Steinman et al., 2006, Stratton, 1996).

Emergent literacy extends from birth to the beginning of formal instruction in reading and writing (Koenig, 1992; Stratton, 1996), and many authors address areas of emergent literacy (Swenson 1999, Stratton, 1996, Rex, Koenig, Wormsley, Baker, 1994). Emergent literacy is pre-reading literacy and for visually impaired children, it is critical that these skills are nurtured in home environments (Day, McDonnell, Heathfield 2005). Reading stages, for both partially sighted children and blind children, tend to be similar to the reading stages children without visual impairment go through. Emergent Braille literacy includes establishing the experiential base for meaning, discovering the communication potentials of symbols and books, as well as acquiring the perceptual-motor skills for reading and writing (Drezek, 1999). To be able to decide on literacy media, some authors like Koenig, Holbrook (1991) explain that it is important to use diagnostic teaching approach is for determining the appropriate reading medium (print or Braille) of children with visual impairments. Fazzi et al. (2005) state that sensory experience from the external world can influence how the visual pathways wire themselves up after birth. Visual experience is crucial, and it is also crucial to help the child learn to integrate alternative sensory information. Sometimes, systematic programs of visual stimulation are not applied, and visually impaired children are usually not provided with accessible ways to be supported in the area of early literacy. Thereby, they are not having same learning opportunities as children without visual impairment. Even when attending literacy-rich (Braille rich, adapted material) preschool classrooms, opportunities are not the same, but have specific characteristics (Sköld, 2007, Drezek, 1999). Also, for those children whose primary communication media is not Braille, or approach with dual/total communication media (Fajdetic, 2009a) is being used, teachers and parents face many challenges in supporting emergent literacy of visually impaired child. Some authors challenge traditional approach toward literacy media for blind and integrate all
approaches towards Braille, as an outcome Braille is defined as a script for blind, rehabilitation program, primary educational and communication media and curriculum Fajdetić (2009b).

Delay in determining appropriate reading medium, or lack of real life experience may result in language delays in visually impaired children.

To prevent language delays some important considerations should be made: the delivering emergent literacy intervention within larger service of early intervention (Justice et al. 2007), how pre-reading program for visually impaired children is structured (Stanchfield, 1971, McComiskey, 1996) and is the literacy media selected in timely manner (Argyropulos, Sieridis, Katsoulis, 2008), which instructional strategies are being used (Koenig, Holbrook, 2002, Day, McDonnell, Heathfield, 2005), methodology toward parents of the visually impaired child implemented (Grinhuis, Woudenberg, 2002), organizational models of early intervention available (Walthes, 2005 according to Ludewig, 2002, Gwizdon, 2005).

4.6 Emergent literacy acquisition and delays in language development in visually impaired children

Different aspects of emergent literacy are addressed through contemporary research and professional publications (Sulzby, Teale, 1991 cited by Day, McDonnell, Heathfield, 2005, Drezek, 1999, Swenson 1999, Stratton, 1996, Rex, Koenig, Wormsley, Baker, 1994), developmental stages of reading process are found important (Steinman, LeJeune, Kimbrough, 2006) as well as understanding specifics of the language development Hall, Rodabaugh (1979). According to Sulzby, Teale (1991. cited by Day, McDonnell, Heathfield, 2005) emergent literacy can be viewed as skills that are precursors to later reading and or can be more broadly conceptualized as literacy acquisition that occurs along a developmental continuum. Children and youth with visual impairment (both blind and partially sighed) can present delays and difficulties in the language development in areas important for development of reading skills specific to this population. Visually impaired child is a future reader that needs to build the necessary pre-reading foundation.

As previously elaborated, visual impairment can affect future partially sighted or blind reader with a delay (Corley, Pring, 1993, Tadić, Pring, Dale, 2010, Shankar, Evans, Bobier,
2007) or some specific in functioning. Corley, Pring, (1993) found that in processing words partially sighted children, like fully sighted children, used both lexical and nonlexical processing, though perhaps in difference balance. Recognition and recall of pictures by the partially sighted children was as good as that of the fully sighted children. Fully sighted children performed better than partially sighted children when a preceding orienting question or a following elaborative sentence was provided. Results suggest that the partially sighted children had difficulty in integrating visual and verbal information which followed too closely. How visual impairment effects reading was the purpose of the research of Shankar, Evans, Bobier (2007) where emergent literacy skills in uncorrected hyperopic and emmetropic children were compared. In this pilot study, uncorrected hyperopic children, ages 4 to 7 years, show reduced performance on tests of letter and word recognition, receptive vocabulary, and emergent orthography and crowded VA, despite no difference in phonological awareness skills, visual cognitive skills, and other family variables known to affect the acquisition of literacy skills. The relationship between hyperopia and the poorer progress in emergent literacy is complex, and it is not clear if the relationship is causal, and whether the hyperopes will catch up to the emmetropes with time.

Visual impairment not only effects language acquisition, but effects child in the broader area of functioning, area affected with practical implementation of language skills such as socio-communicative skills. Tadić, Pring, Dale (2010) state that development of children with congenital visual impairment has been associated with vulnerable socio-communicative outcomes. In the research, compared to their sighted peers, and relative to their own good and potentially superior structural language skills, children with VI showed significantly poorer use of language for social purposes. Pragmatic language weaknesses were a part of a broader socio-communicative profile of difficulties, present in a substantial proportion of these children and consistent with the pattern found in sighted children with autism. So, conclusion was presented, where there are ongoing socio-communicative and pragmatic language difficulties in children with congenital VI at school age, despite their good intellectual abilities and advanced linguistic skills.

1. Emergent literacy – early life experience

It is important to have overall view and suggestions about creating individual visual and tactile experience for VI child, with aim to program adequate approach and support to pre-
reading development. Of course, most of children with visual impairment (both blind and partially sighed) have functional vision that has to be properly addressed in early childhood. Some structured programs like Program for development of functional vision (Barraga, N.), tend to aim older preschool children (age 5 or 6), but principles of the program can be applied much earlier as well (both for blind and partially sighted children).

Although these very young children are often delayed in developing emergent literacy understandings, the path of their development is consistent with emergent literacy development of sighted children Erricson, Hutton (2007).

Emergent literacy is important foundation both for blind and partially sighted children. Even though it seem emergent literacy should be different because different perception modalities will be used when starting formal reading and writing lessons, many activities overlap and apply for both populations. Both, Koenig, Farrenkopf (1997) and Stratton, Wright (1991) stay that firsthand and real life experience is important.

For example, Koenig, Farrenkopf (1997) realize the research and results of the study identified a repertoire of early-life experiences (global experience, supporting experience, specific words and concepts) to which young children with visual impairments need to be exposed to develop a foundation for literacy. When possible, experiences should be linked with literacy events, beginning in the home and later in formal school programs.

First, authors identify that the global experiences is very important. According to Koenig, Farrenkopf (1997) the most common *global experiences* included doing or making things. Results of this research show (after analyzing 254 stories), 42 (17%) involved activities, such as looking for something, making something, painting, digging a hole, and trying to do something, all of which were placed in the category doing or making things. Other common global experiences were experiences with friends or pretending (15%); working together, sharing, helping (10%); and looking for or finding something (10%). The analysis also yielded two areas that appeared distinct from the other ones: learning and content areas and understanding specific concepts. The global experiences in these two areas would be dependent largely on instruction,
usually in (pre)school programs, whereas the others would be gained by engaging in typical daily activities. Second, authors point out _supporting experiences_. Supporting experiences are those that would be necessary for understanding a story, but were not the main focus. For any given story, there could be a number of supporting experiences that a child would need to gain meaning. Results show that, out of the 2,698 supporting experiences that were identified, 219 (8%) involved nature, plants, and/or animals in some manner, while 207 (7.6%) involved living creatures, and 207 involved emotions or a sense of well being. Thirdly, authors point out that _specific words and concepts_ are important, and they explain that they are the most essential for gaining meaning from reading the stories. An interesting finding was related to the importance of understanding specific concepts. In this area, there were 912 instances (34% of the 2,698 supporting experiences) in the 254 stories in which understanding a concept was essential for gaining meaning from a story.

Stratton, Wright (1991) state, that it is a challenge to achieve enhancement in development with visually impaired children, in ways that form the foundations of literacy. Authors have stated, firsthand experiences are important in many ways. This assumption adds dimension in the context of literacy: building meanings into the stories. The second component of the foundations of literacy is language: learning words with meaning, extending word meanings, asking questions for information, and understanding the language in read-aloud stories. The third component of emergent literacy, reading aloud to children, is considered the most important way to prepare a child for successful reading. The fourth and final component of the foundations of literacy is scribbling or making a connection between writing and reading. Authors conclude that the development of literacy in young visually impaired children is a gradual process interrelated with development. Reading aloud to children is a primary component of literacy, along with language development, first-hand experiences, concept development, and enjoyable experiences with books. With the assistance of project advisory committee members, teachers, and parents, we have completed work on a handbook and tactile-visual storybooks designed to assist caregivers in providing, from birth, the experiences that form the foundations of literacy.
One of the most natural parent-child activities is book reading. Reese, Cox (1999) discusses about 3 styles of adult book reading for preschoolers' emergent literacy. A describer style focused on describing pictures during the reading, a comprehender style focused on story meaning, and a performance-oriented style introduced the book and discussed story meaning on completion. Forty-eight 4-year-olds were randomly assigned to receive 1 of the 3 reading styles over a 6-week period. Pre-tests and post-tests measured children's receptive vocabulary, print, and story comprehension skills. A describer style of reading resulted in the greatest overall benefits for children's vocabulary and print skills, but a performance-oriented style was also beneficial when children's initial skill levels were taken into account. To complement adult reading, picture books should be available for all children. Sköld (2007) describes how the Swedish production standards are set, and based on research about tactile perception and the ability of partially sighted persons to perceive colour. Accessible in the right way, these books can be enjoyed by totally blind children as well as children with partial sight. Also, the tactile picture is not a copy of the original as details which the haptic sense can't perceive must be reduced, and colours, shadows and perspective must be changed. Tactile picture books with Braille play an important role in supporting the development of reading skills. Drezek (1999) explains that print books can be adapted to support Braille Readiness in many ways. Books can be made interesting by emphasizing sounds, singing refrains, or adding actions. Meaning can be enhanced with activities, story boxes, sensory boxes, story pillows, object calendars, puppets, and play. Tactile skills can be reinforced by adding toys, models, portions of real objects, textures, and outlines.

For blind children with functional residual vision, usage of different new technologies can help in emergent literacy and language acquisition. Miller-Wood (1990) explains how closed-circuit television system can be used with a five-year old girl with severely limited vision to develop visual skills, especially skills related to concept formation. After the end of training, the girl, in this research, could recognize lines, shapes, forms, letters, numbers, and words and could read short sentences.
If, then, it is inappropriate to compare the performance of children who are blind on tests normed for sighted, it would seem there is a need to develop tests normed for children without sight. Because, however, this population is a relatively small, geographically scattered group and test development is so costly, few tests are available that have been developed specifically for use with students who are blind (Bauman & Kropf, 1979). Additionally, the variability in the age at onset of blindness, type of vision loss, and environmental opportunities available to these children make it difficult to develop tests appropriate for all visually impaired children (Warren, 1984).

Historically, intelligence tests have received the most efforts toward adaptation for the blind. The Hayes-Binet Intelligence Test for the Blind (Hayes, 1929), Interim Hayes-Binet Intelligence Test for the Blind (Hayes, 1942), and Perkins-Binet Intelligence Tests for Blind Children (Davis, 1980) have been developed from the early 1900's to recent years (Gutterman, Ward, & Genshaft, 1985). Swallow (1981) includes the Interim Hayes-Binet Intelligence Test, the Perkins-Binet Intelligence Test for Blind Children, and the Tactile Test of Basic Concepts (Caton, 1977) among those useful in the assessment of cognitive abilities of students who are blind. The Interim Hayes-Binet Intelligence Test has no standardization data available (Coveny, 1976) and is considered to be outdated for current use (Chase, 1977). The Perkins-Binet Intelligence Test for Blind Children is considered to be a further modification of the Binet tests, but it has been criticized for having questionable validity and reliability and is no longer available (Gutterman et al., 1985). The Tactile Test of Basic Concepts is a criterion-referenced test and an adaptation of the Boehm Test of Basic Concepts (Boehm, 1971). It was developed and studied under the auspices of the American Printing House for the Blind (Swallow, 1981).

Some intelligence tests, such as the Wechsler Verbal Scales, are administered orally and normed for oral administration, so have been assumed to be appropriate for use with children who are blind (Bauman & Kropf, 1979; Yarnell & Carlton, 1981). Chase (1977), Spungin and Swallow (1977), and Warren (1984) argue, however, that the verbal performance of children who are blind may not be equally compared to the verbal performance of sighted children, because the two groups have had differing life experiences and environments. To be most useful, tests should
be normed on special populations so that students who are blind are compared to their peers without vision, rather than to their sighted peers (Coveny, 1976; Swallow, 1981; Warren, 1984). Additionally, Warren (1984) emphasizes that performance on verbal intelligence tests only provides the examiner with an estimate of the verbal intelligence of children who are blind, and that performance aptitude is not represented by such testing. To better assess the performance and learning potential of children who are blind, Yarnell and Carlton (1981) suggest that the child be a) required to tactually explore figures to find one that does not belong in a group; b) allowed to explore one figure and select a similar one from a group of figures; and c) required to group items according to a common factor or relationship.

Efforts have been made to ascertain the relationship between intelligence tests and achievement tests in visually handicapped children. The Wechsler Intelligence Scales for Children-Revised (WISC-R), Verbal Scale (Wechsler, 1974) and the earlier Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1949) have been correlated with measures of achievement for visually handicapped children. Newland (1979) reports the correlations between the Stanford Achievement Test (SAT) and the Hayes-Binet and WISC, Verbal Scales for children who are blind. When comparing the Hayes-Binet with various subsections of the SAT, correlation values range from .70 to .88. Similarly, correlations between the WISC, Verbal Scales and SAT sections range from .66 to .91. Gutterman et al. (1985) reports a moderate correlation between the WISC-R, Verbal Scale and the Wide Range Achievement Test (WRAT). Norms for sighted children were used to score the WRAT, SAT, WISC and WISC-R Verbal Scales.

4.8 Summary

The purpose of this paper was to define (collect) and interpret existing literature (a body of recorded work) that has been produced by researchers and practitioners. The aim was to explain different aspects that affect emergent literacy of visually impaired children and can result with a delay in reading and language development. Interpretation of the relevant and up to date literature lead to the following conclusions:
(1) early intervention in the family of visually impaired child supports emergent literacy, but positive outcome can be under influence of the family values, dynamics, culture, religion, socio-economic status, etc.,

(2) emergent literacy of the child with visual impairment is strongly influenced by literacy media selection, that should be addressed with adequate literacy media approach,

(3) team approach and team work of the parents of visually impaired children, kindergarten teachers, VI teacher, early interventions and other professionals has significant role in supporting emergent literacy,

(4) not properly supported emergent literacy skills (pre-reading skills) of partially sighted and blind children, could result with poor skill acquisition and delay in language development; have impact on language related skills (socio-communicative skills),

(5) early life experience (global and supporting experience, and specific words and concepts) addressed through all perception modalities, help supporting emergent literacy in partially sighted and blind children,

(6) well applied methodology in supporting emergent literacy in early intervention (treatment targets, techniques and context), as well as procurable organizational models are inevitable elements in preventing delay in language development.

4.9 Check Your Progress

1. Write Vithoba Paknikar Performance Test
2. Explain Definition of Intelligence
3. Explain in detail Reading Preference Test
4. Write down Emergent literacy acquisition and delays in language development in visually impaired children
5. How to develop a Tests for Children Who are Blind

Check Your Progress
13. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.13.1. Points for discussion
Points for clarification
4.10 REFERENCES


Unit 5: Report writing

5.1 Introduction

5.2 Suggested Outline For Functional Vision And Media Report

5.3 Preferred Visual Acuity Notations

5.4 TABLE OF APPROXIMATE EQUIVALENT VISUAL ACUITY NOTATIONS

5.5 Error Analysis

5.6 RESULTS

5.7 Model Of Visual Impairment In The Six WHO Regions

5.8 Global Prevalence Of Visual Impairment

5.9 Cause Of Visual Impairment

5.10 DISCUSSION

5.11 Summary

5.12 Check Your Progress

5.13 REFERENCES
5.1 Introduction

In order to set policies and priorities and to evaluate global eye health, it is essential to have up to date information on prevalence and on causes of visual impairment.

As it previously did in 1995, 2002 and 2004 (1-3) the WHO Prevention of Blindness and Deafness Programme has carried out a systematic search and review of all available data to obtain a global estimate of visual impairment for 2010. Estimates of visual impairment have been derived at global level and in the six WHO Regions.

The major causes of visual impairment and of blindness have been determined. These estimates provide essential information for the prevention of visual impairment and the improvement of eye health globally.

5.2 Suggested Outline For Functional Vision And Media Report

The functional vision report must include identifying information about the student, a data review of school history and educational records, a summary of the student’s eye condition based on information from the eye report, a summary of the student’s clinical low vision evaluation (if appropriate), a summary of interviews and general observations of the student, a summary of the student’s visual functioning, educational implications, an eligibility statement, and recommendations for services.

In addition, the functional vision report should provide a summary of the student’s educational performance assessment in reading, mathematics, writing, and other areas of the core curriculum. It should specify the student’s current communication mode(s) based on the Functional Vision and Learning Media Assessment. A summary of the Expanded Core Curriculum Skills Assessment should include descriptions of current functioning and needed instruction in: compensatory skills, orientation and mobility, social interaction skills, independent living skills, recreation and leisure, career education, assistive technology, and visual efficiency.
Suggested components of a Functional Vision Report are listed below. However, school systems are encouraged to customize their reports based on the behaviors and characteristics of the children evaluated, as well as those listed here.

**Outline of Report Format**

1. Student identifying information
2. Educational history
3. Summary of medical eye report
4. Summary of clinical low vision evaluation (if appropriate)
5. Interviews and general observations
6. Summary of visual functioning
7. Educational implications
8. Statement of eligibility
9. Recommendations (including communication mode)
10. Present Level of Performance in CORE Curriculum
11. Present Level of Performance in Expanded CORE Curriculum
12. Recommendations
Eye Report for Children with Visual Problems

NAME OF STUDENT: ___________________________ SEX: _______ ETHNICITY: __________
(TYPE OR PRINT) (FIRST) (MIDDLE) (LAST)
ADDRESS: ________________________ D.O.B. / / ____________
(No. AND STREET) (CITY OR TOWN) (COUNTRY) (STATE)
GRADE: __________ SCHOOL: __________ SCHOOL SYSTEM: __________

I. HISTORY
A. Probable age at onset of vision impairment. Right eye (O.D.) (O.S.)
B. Severe ocular infections, injuries, operations, if any, with age at time of occurrence.
C. Has pupil's ocular condition occurred in any blood relative(s)? If so, what relationship?

II. MEASUREMENTS (See back of form for preferred notation for recording visual acuity and table of approximate equivalents)
A. Visual Acuity
   Distant Vision Near Vision
   Without Correction With Best Correction With Low Vision Aid
   Right Eye (O.D.) _______ _______ _______
   Left Eye (O.S.) _______ _______ _______
   Both Eyes (O.U.) _______ _______ _______

   B. If glasses are to be worn, were safety lenses prescribed: Plastic ☐ Tempered glass ☐ With ordinary lenses ☐

   C. If low vision aid is prescribed, specify type and recommendation for use:

   D. FIELD OF VISION Is there a limitation? ☐ Yes ☐ No If so, record results of test on chart on back of form
   What is the widest diameter (in degrees) of remaining visual field? O.D. _______ O.S. _______

   E. Is there impaired color perception? ☐ Yes ☐ No If so, for what color(s)?

III. CAUSE OF BLINDNESS OR VISION IMPAIRMENT
A. Present ocular condition(s) responsible for Vision impairment. (If more than one, specify all but underline the one which probably first caused severe vision impairment.)
B. Preceding ocular condition, if any, which led to present condition, or the underlined condition, specified in A.
C. Etiology (underlying cause) of ocular condition
   Primarily responsible for vision impairment,
   (e.g., specific disease, injury, poisoning, heredity or other prenatal influence.)

   If etiology is injury or poisoning, indicate circumstance and kind of object or poison involved:

IV. PROGNOSIS AND RECOMMENDATIONS
A. Is the student's vision impairment considered to be: Stable ☐ Deteriorating ☐ Capable of Improvement ☐ Uncertain ☐
B. What treatment is recommended, if any?
C. When is reexamination recommended?
D. Glasses: Not needed ☐ To be worn constantly ☐ For close work only ☐ Other (specify)
E. Lighting requirements: Average ☐ Better than average ☐ Less than average ☐
F. Use of eyes: Unlimited ☐ Limited, as follows:
G. Physical activity: Unrestricted ☐ Restricted as follows:

SEND EYE REPORT COPY TO:

Date of Examination __________________________ Name of Examiner __________________________
Signature of Examiner: __________________________ Degree: __________________________
Address: __________________________ No. and Street: __________________________ City: __________________________ State: __________________________ Zipcode: __________________________
If clinic case: Case number: __________________________ Clinic name: __________________________
5.3 Preferred Visual Acuity Notations

DISTANCE VISION: Use Snellen notation with test distance of 20 feet. (Examples: 20/100, 20/60). For acuities less than 20/200, record distance at which 200 foot letter can be recognized as numerator or fraction and 200 as denominator. (Examples: 10/200, 3/200). If the 200 foot letter is not recognized at 1 foot, record abbreviations for best distant vision as follows:

Hm Hand Movements Pll Perceives And Localizes Light In One Or More Quadrants
Lp Perceives But Does Not Localize Light
No Lp Lo Light Perception

NEAR VISION: Use standard A.M.A. notation and specify best distance at which pupil can read. (Example: 14 70 at 5 in.)

5.4 Table Of Approximate Equivalent Visual Acuity Notations

These notations serve only as an indication of the approximate relationship between recording of distant and near vision and point type sizes. The teacher will find in practice that the pupil’s reading performance may vary considerably from the
Estimates of causes of visual impairment

For the age groups 0 to 14 and 15 to 49 years the causes of visual impairment are based on previous estimates (2,3) For the age group 50 years and older the causes were calculated using
the causal attribution provided by the studies that were used to estimated the prevalence. Each cause was calculated as an average percentage of the total causes at regional level first and then at global level, by including all the regional values.

5.5 Error Analysis

Since only simple imputation using deductive methods was used and no regression analysis was conducted, the known errors on the regional estimates come from the reported uncertainties of the studies, which for the age group 50 years and older are around 10%, for the other ages around 20%. Additional uncertainties are due to data imputation: these can be assumed to be lower in regions with more numerous studies.

5.6 Results

Data sources

1, met the inclusion criteria for this study: details are found in Annex 1 and 2. The majority of the studies, 38, took place between 2005 and 2008, 15 between 2001 and 2004; the largest majority were rapid assessments of cataract surgical services or of avoidable blindness (12, 13), a minority were national studies for all ages, some were targeting specific age groups or settings.

Other studies not satisfying fully the inclusion criteria provided supporting evidence for the estimates developed by the model.
### 5.7 Model Of Visual Impairment In The Six WHO Regions

Visual impairment was estimated in each WHO Region with a model built using prevalence of blindness and countries' economic status from available data as described in Methods.

The African Region comprises 46 countries of which 40 are classified by the World Bank either as Low Income (LI) or Lower Middle Income (LMI) within a narrow range of PPP, representing 93.2% of the population in the Region. Five countries are classified as Upper Middle Income (UMI) and one as High Income (HI) representing 6.8% of the region population.

<table>
<thead>
<tr>
<th>WHO Region</th>
<th>Countries with studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African Region</strong></td>
<td>Botswana, Cameroon, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Mali, Nigeria, Rwanda, Uganda, United Republic Of Tanzania</td>
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<tr>
<td><strong>Region of the Americas</strong></td>
<td>Argentina, Brasil, Chile, Cuba, Dominican Republic, Guatemala, Mexico, Paraguay, Peru, Venezuela</td>
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<tr>
<td><strong>Eastern Mediterranean Region</strong></td>
<td>Islamic Republic of Iran, Oman, Pakistan, Qatar</td>
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<tr>
<td><strong>European Region</strong></td>
<td>Russian Federation, Turkmenistan</td>
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<tr>
<td><strong>South-East Asian Region</strong></td>
<td>Bangladesh, Democratic Republic of Timor-Leste, India, Indonesia, Myanmar, Nepal</td>
</tr>
<tr>
<td><strong>Western Pacific Region</strong></td>
<td>Cambodia, China, Papua New Guinea, Philippines, Viet Nam</td>
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</tbody>
</table>
on. 19 surveys from 12 countries, all classified as LI or LMI, were available for inclusion in the model for the region.

Given the similar economic status of these countries they were considered as a single cluster of PPP. The weighted prevalence of visual impairment and blindness from the 19 surveys was imputed to the whole Region.

In the Region of the Americas the 36 countries were divided into three clusters of PPP corresponding to the World Bank classifications: LMI (10 countries), UMI (20 countries), HI (6 countries). Data were available from three countries in the LMI cluster, and seven in the UMI cluster. The combined population in the 10 countries with available data in the LMI and UMI clusters represented 80% of the total population in these 30 countries. The weighted average of the prevalence of visual impairment and blindness was derived separately in the two clusters and imputed to the other countries in the same cluster. Recent data satisfying the inclusion criteria for this study for the HI cluster were not available: prevalence was derived from previous WHO estimates (2,3).

The 21 countries in the Eastern Mediterranean Region were sorted into two clusters of PPP. The first included 13 countries classified as LI and LMI, the second 8 countries classified as UMI and HI. Data from three countries in the LI/LMI cluster and from one in the UMI/ HI cluster were available for estimates.

In the European Region three economic clusters were defined, one including 25 HI countries, a second, 11 UMI countries and the third, 14 LMI and 3 LI countries. Data were available from one country each in the UMI and in the LMI /LI clusters. The data from a single country were imputed to the UMI cluster and analogously data from a single country to the LMI/ LI cluster. Recent data for this study were not available for the HI cluster and previous WHO estimates were used (2,3).

The estimates for the South-East Asian Region were derived for India and for the other countries in the Region separately. The prevalence for India was derived from 3 recent surveys
The other 10 countries in the Region are classified either as LMI or LI and given the similarity of PPP were all included in one single cluster. Data were available from 5 of the 10 countries comprising almost 80% of the population in the region (India excluded). The weighted prevalence estimated from the data in the five countries was imputed to the whole cluster.

The estimates for China were derived separately from the other countries in the Western Pacific Region and were based on recent surveys conducted in the rural areas combined with data from urban settings (see Annex 1 and 2). The other countries in the Region were sorted into 3 clusters: the first included 7 countries classified as HI and one as UMI; the second included all 15 Pacific Islands with 14 countries classified as LMI and one UMI; the third comprised 4 countries, 2 classified as LI and 2 as LMI. For the first cluster prevalence was derived from the previous estimates (2, 3). Data from one country were used for the second cluster and data from 3 countries for the third cluster (see Annex 1 and 2).

**5.8 Global Prevalence Of Visual Impairment**

The estimated number of people visually impaired in the world is 285 million, 39 million blind and 246 million having low vision; 65% of people visually impaired and 82% of all blind are 50 years and older (Table 2). The distribution of people visually impaired in the six WHO Regions is shown in Table 3 with the percentage of the global impairment shown in parentheses. Figure 1 shows the number of people visually impaired, with low vision and blind per million population in the six WHO Regions and in India and China separately.

**5.9 Cause Of Visual Impairment**

Globally the principal causes of visual impairment are uncorrected refractive errors and cataracts, 43% and 33% respectively. Other causes are glaucoma, 2%, age related macular degeneration (AMD), diabetic retinopathy, trachoma and corneal opacities, all about 1%. A large proportion of causes, 18%, are undetermined, (Figure 2A).
The causes of blindness are cataract, 51%, glaucoma, 8%, AMD, 5%, childhood blindness and corneal opacities, 4%, uncorrected refractive errors and trachoma, 3%, and diabetic retinopathy 1%, the undetermined causes are 21% (Figure 2 B).

5.10 Discussion

This study presents some limitations, the most significant are the following: the surveys in the last 10 years have been mostly Rapid Assessments for ages 50 years and older, and national studies for all ages with or without WHO Eye Survey Protocol have been few. As a consequence data could be limited in representation of countries and of ages. The imputation of prevalence for missing data can give errors that are difficult to estimate: clearly they could be high in regions with sparse data. In the Eastern-Mediterranean Region recent data were unavailable for most of the countries, hence the estimates were in large extent based on surveys from 1993-1998 (2,3) Data from HI countries were also missing or were dated as far back as 15
years. However it must be noted that in HI countries from available information there was no evidence of major changes in prevalence.

The combined effect of these uncertainties is possibly an over or under estimation of visual impairment and blindness of approximately 20%. The attribution of the causes of visual impairment and blindness is also prone to uncertainty. This is often the instance in surveys carried out in the field with limited diagnostic capacity, but it is particularly true in the case of rapid assessments whose aim is primarily to survey cataract surgical services for ages 40 or 50 years and older. The large percentages of undetermined causes is are also likely to be a reflection of these protocols.

The strengths of the estimates derive firstly from the fact that new data were available to replace previous extrapolations. Furthermore, to estimate the prevalence of visual impairment in countries missing data, a model was used based on the same economic parameters for all countries.

This is a new approach in producing estimates of visual impairment. The imputation process via a model is more transparent than using expert assumptions and it provides consistency between countries and regions. It also allows for adjustments and corrections as soon as new information becomes available and it could also be adapted for estimating trends. Because data available and methods used have changed, it is not possible to draw conclusions from differences in present estimates and previously published estimates. In areas where surveys were repeated with similar protocols for ages 50 years and older a reduction of visual impairment is shown despite the rapid growth of this age group. This decline fits with increased socio-economic development, but it is also the direct consequence of investments made by Governments and of interventions by international partners.

Posterior segment (retinal) diseases are a major cause of visual impairment worldwide, and likely to become more and more important, with the rapid growth of the aging population. The proportion of the total visual impairment and blindness from age related macular degeneration, glaucoma and diabetic nephropathy is currently greater than from infec-
The causes such as trachoma and corneal opacities.

This requires the urgent development of eye care systems that address chronic eye diseases with rehabilitation, education and support services.

5.11 Summary

Monitoring the magnitude of visual impairment is essential for policies aiming at the prevention and elimination of the avoidable causes. The global estimates have significant uncertainties that could be reduced with population-based studies from regions with limited or old data and with studies conducted at national level for all ages recording all causes of blindness. Particularly urgent is to determine the extent of posterior segment diseases as causes of visual impairment, since these require the development of eye care systems, including human resources and infrastructures.

5.12 Check Your Progress
1. Write a short note on following;
   A. Preferred visual acuity notations
   B. Table of approximate equivalent visual acuity notations
   C. Error analysis
   D. Model of visual impairment in the six WHO regions
2. Explain global prevalence of visual impairment
3. Describe cause of visual impairment

Check Your Progress
Points For Discussion And Clarification
After going through this Unit you might like to have further discussion on some points and clarification on others

1.14.1. Points for discussion

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Points for clarification
5.13 REFERENCES


Block 5:

UNIT 1: CONCEPT AND DEFINITION OF VIMD

UNIT 2: ETIOLOGY OF VIMD

UNIT 3: IMPACT OF VIMD ON LEARNING AND DEVELOPMENT

UNIT 4: SCREENING, IDENTIFICATION AND ASSESSMENT OF VISUALLY IMPAIRED CHILDREN WITH ASSOCIATED DISABILITIES

UNIT 5: MULTIDISCIPLINARY ASSESSMENT OF VISUALLY IMPAIRED CHILDREN WITH ASSOCIATED DISABILITIES
UNIT 1: CONCEPT AND DEFINITION OF VIMD

1.1 Introduction

1.2 FACTORS OF VIMD

1.3 ISSUES IN VIMD THEORY

1.4 ARGUMENTS AGAINST THE VIMD THEORY

1.5 BEGINNINGS OF WEB CONTENT

1.6 MAJOR CHARACTERISTICS OF VIMD

1.7 USAGE/APPLICATION

1.8 COMMERCIAL BENEFITS

1.9 SUMMARY

1.10 CHECK YOUR PROGRESS
1.1 Introduction

A concept is a abstraction or generalisation from experience or the result of a transformation of existing ideas. The concept is instantiated (reified) by all of its actual or potential instances, whether these are things in the real world or other ideas. Concepts are treated in many if not most disciplines both explicitly, such as in linguistics, psychology, philosophy, etc., and implicitly, such as in mathematics, physics, etc. In informal use the word concept often just means any idea, but formally it involves the abstraction component.

When the mind makes a generalization such as the concept of tree, it extracts similarities from numerous examples; the simplification enables higher-level thinking.

In metaphysics, and especially ontology, a concept is a fundamental category of existence. In contemporary philosophy, there are at least three prevailing ways to understand what a concept is:

- Concepts as mental representations, where concepts are entities that exist in the brain (mental objects)
- Concepts as abilities, where concepts are abilities peculiar to cognitive agents (mental states)
- Concepts as Fregean senses (see sense and reference), where concepts are abstract objects, as opposed to mental objects and mental states

Etymology

The term "concept" is traced back to 1554–60, but what is today termed "the classical theory of concepts" is the theory of Aristotle on the definition of terms. The meaning of "concept" is explored in mainstream information science, cognitive science, metaphysics, and philosophy of mind. In computer and information science contexts, especially, the term 'concept' is often used in unclear or inconsistent ways.

1.2 FACTORS OF VIMD
In a platonist theory of mind, concepts are construed as abstract objects. This debate concerns the ontological status of concepts – what they are really like.

There is debate as to the relationship between concepts and natural language. However, it is necessary at least to begin by understanding that the concept "dog" is philosophically distinct from the things in the world grouped by this concept – or the reference class or extension. Concepts that can be equated to a single word are called "lexical concepts".

Study of concepts and conceptual structure falls into the disciplines of linguistics, philosophy, psychology, and cognitive science.

In the simplest terms, a concept is a name or label that regards or treats an abstraction as if it had concrete or material existence, such as a person, a place, or a thing. It may represent a natural object that exists in the real world like a tree, an animal, a stone, etc. It may also name an artificial (man-made) object like a chair, computer, house, etc. Abstract ideas and knowledge domains such as freedom, equality, science, happiness, etc., are also symbolized by concepts. It is important to realize that a concept is merely a symbol, a representation of the abstraction. The word is not to be mistaken for the thing. For example, the word "moon" (a concept) is not the large, bright, shape-changing object up in the sky, but only represents that celestial object. Concepts are created (named) to describe, explain and capture reality as it is known and understood.

1.3 ISSUES IN VIMD THEORY

Kant declared that human minds possess pure or a priori concepts. Instead of being abstracted from individual perceptions, like empirical concepts, they originate in the mind itself. He called these concepts categories, in the sense of the word that means predicate, attribute, characteristic, or quality. But these pure categories are predicates of things in general, not of a particular thing. According to Kant, there are 12 categories that constitute the understanding of phenomenal objects. Each category is that one predicate which is common to multiple empirical concepts. In order to explain how a priority concept can relate to individual phenomena, in a manner analogous to an a posteriori concept, Kant employed the technical concept of the schema. He held that the account of the concept as an abstraction of experience is only partly
correct. He called those concepts that result from abstraction "a posteriori concepts" (meaning concepts that arise out of experience). An empirical or an a posteriori concept is a general representation (Vorstellung) or non-specific thought of that which is common to several specific perceived objects.

A concept is a common feature or characteristic. Kant investigated the way that empirical a posteriori concepts are created.

The logical acts of the understanding by which concepts are generated as to their form are:

1. comparison, i.e., the likening of mental images to one another in relation to the unity of consciousness;
2. reflection, i.e., the going back over different mental images, how they can be comprehended in one consciousness; and finally
3. abstraction or the segregation of everything else by which the mental images differ.

In order to make our mental images into concepts, one must thus be able to compare, reflect, and abstract, for these three logical operations of the understanding are essential and general conditions of generating any concept whatever. For example, I see a fir, a willow, and a linden. In firstly comparing these objects, I notice that they are different from one another in respect of trunk, branches, leaves, and the like; further, however, I reflect only on what they have in common, the trunk, the branches, the leaves themselves, and abstract from their size, shape, and so forth; thus I gain a concept of a tree.

**Embodied content**

In cognitive linguistics, abstract concepts are transformations of concrete concepts derived from embodied experience. The mechanism of transformation is structural mapping, in which properties of two or more source domains are selectively mapped onto a blended space (Fauconnier & Turner, 1995; see conceptual blending). A common class of blends are metaphors. This theory contrasts with the rationalist view that concepts are perceptions (or recollections, in Plato's term) of an independently existing world of ideas, in that it denies the existence of any such realm. It also contrasts with the empiricist view that concepts are abstract generalizations of individual experiences, because the contingent and bodily experience is
preserved in a concept, and not abstracted away. While the perspective is compatible with Jamesian pragmatism, the notion of the transformation of embodied concepts through structural mapping makes a distinct contribution to the problem of concept formation.

**Mental representations**

In a physicalist theory of mind, a concept is a mental representation, which the brain uses to denote a class of things in the world. This is to say that it is literally, a symbol or group of symbols together made from the physical material of the brain. Concepts are mental representations that allow us to draw appropriate inferences about the type of entities we encounter in our everyday lives. Concepts do not encompass all mental representations, but are merely a subset of them. The use of concepts is necessary to cognitive processes such as categorization, memory, decision making, learning, and inference.

**Classical theory**

The classical theory of concepts, also referred to as the empiricist theory of concepts, is the oldest theory about the structure of concepts (it can be traced back to Aristotle), and was prominently held until the 1970s. The classical theory of concepts says that concepts have a definitional structure. Adequate definitions of the kind required by this theory usually take the form of a list of features. These features must have two important qualities to provide a comprehensive definition. Features entailed by the definition of a concept must be both necessary and sufficient for membership in the class of things covered by a particular concept. A feature is considered necessary if every member of the denoted class has that feature. A feature is considered sufficient if something has all the parts required by the definition. For example, the classic example bachelor is said to be defined by unmarried and man. An entity is a bachelor (by this definition) if and only if it is both unmarried and a man. To check whether something is a member of the class, you compare its qualities to the features in the definition. Another key part of this theory is that it obeys the law of the excluded middle, which means that there are no partial members of a class, you are either in or out.

The classical theory persisted for so long unquestioned because it seemed intuitively correct and has great explanatory power. It can explain how concepts would be acquired, how we
use them to categorize and how we use the structure of a concept to determine its referent class. In fact, for many years it was one of the major activities in philosophy – concept analysis. Concept analysis is the act of trying to articulate the necessary and sufficient conditions for the membership in the referent class of a concept.

1.4 ARGUMENTS AGAINST THE VIMD THEORY

Given that most later theories of concepts were born out of the rejection of some or all of the classical theory, it seems appropriate to give an account of what might be wrong with this theory. In the 20th century, philosophers such as Rosch and Wittgenstein argued against the classical theory. There are six primary arguments summarized as follows:

- It seems that there simply are no definitions – especially those based in sensory primitive concepts.
- It seems as though there can be cases where our ignorance or error about a class means that we either don't know the definition of a concept, or have incorrect notions about what a definition of a particular concept might entail.
- Quine's argument against analyticity in Two Dogmas of Empiricism also holds as an argument against definitions.
- Some concepts have fuzzy membership. There are items for which it is vague whether or not they fall into (or out of) a particular referent class. This is not possible in the classical theory as everything has equal and full membership.
- Rosch found typicality effects which cannot be explained by the classical theory of concepts, these sparked the prototype theory.
- Psychological experiments show no evidence for our using concepts as strict definitions.

Prototype theory

Prototype theory came out of problems with the classical view of conceptual structure. Prototype theory says that concepts specify properties that members of a class tend to possess, rather than must possess. Wittgenstein, Rosch, Mervis, Berlin, Anglin, and Posner are a few of
the key proponents and creators of this theory. Wittgenstein describes the relationship between members of a class as family resemblances. There are not necessarily any necessary conditions for membership, a dog can still be a dog with only three legs. This view is particularly supported by psychological experimental evidence for prototypicality effects.\[^9\] Participants willingly and consistently rate objects in categories like 'vegetable' or 'furniture' as more or less typical of that class. It seems that our categories are fuzzy psychologically, and so this structure has explanatory power. We can judge an item's membership to the referent class of a concept by comparing it to the typical member – the most central member of the concept. If it is similar enough in the relevant ways, it will be cognitively admitted as a member of the relevant class of entities. Rosch suggests that every category is represented by a central exemplar which embodies all or the maximum possible number of features of a given category.

Theory-theory

Theory-theory is a reaction to the previous two theories and develops them further. This theory postulates that categorization by concepts is something like scientific theorizing. Concepts are not learned in isolation, but rather are learned as a part of our experiences with the world around us. In this sense, concepts' structure relies on their relationships to other concepts as mandated by a particular mental theory about the state of the world. How this is supposed to work is a little less clear than in the previous two theories, but is still a prominent and notable theory. This is supposed to explain some of the issues of ignorance and error that come up in prototype and classical theories as concepts that are structured around each other seem to account for errors such as whale as a fish (this misconception came from an incorrect theory about what a whale is like, combining with our theory of what a fish is). When we learn that a whale is not a fish, we are recognizing that whales don't in fact fit the theory we had about what makes something a fish. In this sense, the Theory-Theory of concepts is responding to some of the issues of prototype theory and classic theory.

Web content is the textual, visual, or aural content that is encountered as part of the user experience on websites. It may include—among other things—text, images, sounds, videos, and animations.
In Information Architecture for the World Wide Web, Lou Rosenfeld and Peter Morville write, "We define content broadly as 'the stuff in your Web site.' This may include documents, data, applications, e-services, images, audio and video files, personal Web pages, archived e-mail messages, and more. And we include future stuff as well as present stuff."

1.5 BEGINNINGS OF WEB CONTENT

While the Internet began with a U.S. Government research project in the late 1950s, the web in its present form did not appear on the Internet until after Tim Berners-Lee and his colleagues at the European laboratory (CERN) proposed the concept of linking documents with hypertext. But it was not until Mosaic, the forerunner of the famous Netscape Navigator, appeared that the Internet become more than a file serving system.

The use of hypertext, hyperlinks, and a page-based model of sharing information, introduced with Mosaic and later Netscape, helped to define web content, and the formation of websites. Today, we largely categorize websites as being a particular type of website according to the content a website contains.

The page concept

Web content is dominated by the "page" concept, its beginnings in an academic setting, and in a setting dominated by type-written pages, the idea of the web was to link directly from one academic paper to another academic paper. This was a completely revolutionary idea in the late 1980s and early 1990s when the best a link could be made was to cite a reference in the midst of a type written paper and name that reference either at the bottom of the page or on the last page of the academic paper.

When it was possible for any person to write and own a Mosaic page, the concept of a "home page" blurred the idea of a page. It was possible for anyone to own a "Web page" or a "homepage" which in many cases the website contained many physical pages in spite of being called "a page". People often cited their "home page" to provide credentials, links to anything that a person supported, or any other individual content a person wanted to publish.
Even though "the web" may be the resource we commonly use to "get to" particular locations online, many different protocols are invoked to access embedded information. When we are given an address, such as http://www.youtube.com, we expect to see a range of web pages, but in each page we have embedded tool to watch "video clips".

**HTML web content**

Even though we may embed various protocols within web pages, the "web page" composed of "HTML" (or some variation) content is still the dominant way whereby we share content. And while there are many web pages with localized proprietary structure (most usually, business websites), many millions of websites abound that are structured according to a common core idea.

Blogs are a type of website that contain mainly web pages authored in HTML (although the blogger may be totally unaware that the web pages are composed using HTML due to the blogging tool that may be in use). Millions of people use blogs online; a blog is now the new "home page", that is, a place where a personal can reveal personal information, and/or build a concept as to who this persona is. Even though a blog may be written for other purposes, such as promoting a business, the core of a blog is the fact that it is written by a "person" and that person reveals information from her/his perspective. Blogs have become a very powerful weapon used by content marketers who desire to increase their site's traffic, as well as, rank in the search engine result pages (SERPs). In fact, new research from Technorati shows that blogs now outrank social networks for consumer influence (Technorati’s 2013 Digital Influence Report data).

Search engine sites are composed mainly of HTML content, but also has a typically structured approach to revealing information. A Search Engine Results Page (SERP) displays a heading, usually the name of the search engine itself, and then a list of websites and their web addresses. The list of web addresses are listed by their order of relevance according to the search query. Searchers typically type in keywords or keyword phrases to find or search what they are looking for on the web.
Discussion boards are sites composed of "textual" content organized by HTML or some variation that can be viewed in a web browser. The driving mechanism of a discussion board is the fact that users are registered and once registered can write posts. Often a discussion board is made up of posts asking some type of question to which other users may provide answers to those questions.

Ecommerce sites are largely composed of textual material and embedded with graphics displaying a picture of the item(s) for sale. However, there are extremely few sites that are composed page-by-page using some variant of HTML. Generally, web pages are composed as they are being served from a database to a customer using a web browser. However, the user sees the mainly text document arriving as a webpage to be viewed in a web browser. Ecommerce sites are usually organized by software we identify as a "shopping cart".

A wider view of web content

While there are many millions of pages that are predominantly composed of HTML, or some variation, in general we view data, applications, E-services, images (graphics), audio and video files, personal web pages, archived e-mail messages, and many more forms of file and data systems as belonging to websites and web pages.

While there are many hundreds of ways to deliver information on a website, there is a common body of knowledge of search engine optimization that needs to be read as an advisory of ways that anything but text should be delivered. Currently, search engines are text based and are one of the common ways people using a browser locate sites of interest.

Content is king

The phrase can be interpreted to mean that – without original and desirable content, or consideration for the rights and commercial interests of content creators – any media venture is likely to fail through lack of appealing content, regardless of other design factors.

Content can mean any creative work, such as text, graphics, images, or video. "Content is King" is a current meme when organizing or building a website\[^1\] (although Andrew Odlyzko in
"Content is Not King" argues otherwise). Text content is particularly important for search engine placement. Without original text content, most search engines will be unable to match search terms to the content of a site.

Quality content

Quality content is a very common phrase used to describe content which aren't focused to increase the clickbait culture but rather to help those who get through it. Websites considered as content farms manipulate keywords to attract search engines to their website, but are considered to have content of poor quality. Quality content promises lower bounce rates as users find that content helpful and stay for a longer time. In contrast, content farms have higher bounce rates, as users tend not to stay after finding that the content is focused solely on fooling search engines. Several companies fill their web pages with a very high density of keywords and use techniques like LSI to make the page SEO-friendly. The over-use of these techniques are flagged as black-hat SEO techniques by Google algorithms.

Content management

Because websites are often complex, a term "content management" appeared in the late 1990s identifying a method or in some cases a tool to organize all the diverse elements to be contained on a website.[5] Content management often means that within a business there is a range of people who have distinct roles to do with content management, such as content author, editor, publisher, and administrator. But it also means there may be a content management system whereby each of the different roles are organized to provide their assistance in operating the system and organizing the information for a website. A business may also employ various content protection measures, which are typically technologies used to attempt to frustrate copying without permission.

Even though a business may organize to collect, contain, and represent that information online, content needs organization in such a manner to provide the reader (browser) with an overall "customer experience" that is easy to use, to be sure the site can be navigated with ease, and that the website can fulfill the role assigned to it by the business, that is, to sell to customers, to market products and services, or to inform customers.
Geo targeting of web content

Geo targeting of web content in Internet marketing and geo marketing is the method of determining the geo location (the physical location) of a website visitor with geo location software and delivering different content to that visitor based on his or her location, such as country, region/state, city, metro code/ZIP code, organization, Internet Protocol (IP) address, ISP, or other criteria.

Tutorial class

In British academic parlance, a tutorial is a small class of one, or only a few students, in which the tutor, a lecturer, or other academic staff member, gives individual attention to the students.¹

The tutorial system at Oxford and Cambridge is fundamental to methods of teaching at those universities, but it is by no means particular to them; Heythrop College (University of London), for instance, also offers a tutorial system with one-on-one teaching. It is rare for newer universities in the UK to have the resources to offer individual tuition; a class of six to eight (or even more) students is a far more common tutorial size. At Cambridge, a tutorial is known as a supervision.

In Australian, New Zealand, and South African universities, a tutorial (colloquially called a tute or tut) is a class of 10–30 students. Such tutorials are very similar to the Canadian system, although, tutorials are usually led by honours or postgraduate students, known as 'tutors'.

At the two campuses of St. John's College, U.S. and a few other American colleges with a similar version of the Great Books program, a "tutorial" is a class of 12–16 students who meet regularly with the guidance of a tutor. The tutorial focuses on a certain subject area (e.g., mathematics tutorial, language tutorial) and generally proceeds with careful reading of selected primary texts and working through associated exercises (e.g., demonstrating a Euclid proof or translating ancient Greek poetry). Since formal lectures do not play a large part in the

Tutorial Schools
There are also specialized schools for tutoring such as, Kumon and EduHub. These supplemental hands-on learning programs are especially popular in Asia.

**Conference Tutorials**

Offered as a service or deliverables to its members, conference tutorials are one example of a continuing education activity sponsored by a technical and professional association.

**Internet**

Internet computer tutorials can take the form of a screen recording (screen cast), a written document (either online or downloadable), interactive tutorial, or an audio file, where a person will give step by step instructions on how to do something.

**Tutorials usually have the following characteristics:**

- A presentation of the view usually explaining and showing the user the user interface
- A demonstration of a process, using examples to show how a workflow or process is completed; often broken up into discrete modules or sections.
- Some method of review that reinforces or tests understanding of the content in the related module or section.
- A transition to additional modules or sections that builds on the instructions already provided. Tutorials can be linear or branching.

While many writers refer to a mere list of instructions or tips as a tutorial, this usage can be misleading.

**Computer-based tutoring**

In computer-based education, a tutorial is a computer program whose purpose is to assist users in learning how to use parts of a software product such as an office suite or any other
application, operating system interface, programming tool, or video game. There are three kinds of software tutorials: 1) video tutorials that the user views, 2) interactive tutorials where the user follows on-screen instructions (and—in some cases—watches short instruction movies), whereupon he/she does the tutorial exercises and receives feedback depending on his/her actions; and 3) webinars where users participate in real-time lectures, online tutoring, or workshops remotely using web conferencing software.

**Categorization**

Multimedia may be broadly divided into linear and non-linear categories. Linear active content progresses often without any navigational control for the viewer such as a *cinema presentation*. Non-linear uses *interactivity* to control progress as with a *video game* or self-paced *computer based training*. *Hypermedia* is an example of non-linear content.

Multimedia *presentations* can be live or recorded. A recorded presentation may allow interactivity via a *navigation system*. A live multimedia presentation may allow interactivity via an interaction with the presenter or performer.

**1.6 MAJOR CHARACTERISTICS OF VIMD**

The term is also applied, often disparagingly, to films that are pitched and developed almost entirely upon an engaging high-concept premise with broad appeal, rather than standing upon complex character study, cinematography, or other strengths that relate more to the artistic execution of a production. Extreme examples of high-concept films are *Snakes on a Plane* and *Hobo with a Shotgun*, which indicate their entire premise in the title.

While nearly every production can be described in a briefly stated high-concept synopsis, a movie described as being 'high-concept' is considered easy to sell to a wide audience because it delivers upon an easy-to-grasp idea.[3] This simple narrative can often be summed up with a single iconic image, such as the theme park logo from *Jurassic Park*. Along with having genre and aesthetics, high-concept films have marketing guidelines known as: "the look, the hook and the book."[4]
The look of the film is simply how visually appealing it is to the public, usually before its release. Jurassic Park would show the world dinosaurs as they had never been seen before.

The hook is the story the film is trying to sell to its audience. Everyone wanted to know how dinosaurs could walk the Earth again after being extinct for 65 million years and how they would coexist with people.

The book can be labeled as all the merchandise made to help promote the film. The merchandise in Jurassic Park was destined to sell well, with people wanting the t-shirts and lunch boxes that were shown everywhere throughout the movie, and they can be purchased at Universal Studios.

Multimedia presentations may be viewed by person on stage, projected, transmitted, or played locally with a media player. A broadcast may be a live or recorded multimedia presentation. Broadcasts and recordings can be either analog or digital electronic media technology. Digital online multimedia may be downloaded or streamed. Streaming multimedia may be live or on-demand.

Multimedia games and simulations may be used in a physical environment with special effects, with multiple users in an online network, or locally with an offline computer, game system, or simulator.

The various formats of technological or digital multimedia may be intended to enhance the users' experience, for example to make it easier and faster to convey information. Or in entertainment or art, to transcend everyday experience.

Enhanced levels of interactivity are made possible by combining multiple forms of media content. Online multimedia is increasingly becoming object-oriented and data-driven, enabling applications with collaborative-end-user innovation and personalization on multiple forms of content over time. Examples of these range from multiple forms of content on Web sites like photo galleries with both images (pictures) and title (text) user-updated, to simulations whose coefficients, events, illustrations, animations or videos are modifiable, allowing the multimedia "experience" to be altered without reprogramming. In addition to seeing and hearing, Haptic
technology enables virtual objects to be felt. Emerging technology involving illusions of taste and smell may also enhance the multimedia experience.

**History**

The term multimedia was coined by singer and artist Bob Goldstein (later 'Bobb Goldstein') to promote the July 1966 opening of his "Light Works at L'Oursin" show at Southampton, Long Island. Goldstein was perhaps aware of an American artist named Dick Higgins, who had two years previously discussed a new approach to art-making he called "intermedia."

In the intervening forty years, the word has taken on different meanings. In the late 1970s, the term referred to presentations consisting of multi-projector slide shows timed to an audio track. However, by the 1990s 'multimedia' took on its current meaning.

In the 1993 first edition of McGraw-Hill's Multimedia: Making It Work, Tay Vaughan declared "Multimedia is any combination of text, graphic art, sound, animation, and video that is delivered by computer. When you allow the user – the viewer of the project – to control what and when these elements are delivered, it is interactive multimedia. When you provide a structure of linked elements through which the user can navigate, interactive multimedia becomes hypermedia."

The German language society, Gesellschaft für deutsche Sprache, decided to recognize the word's significance and ubiquitousness in the 1990s by awarding it the title of 'Word of the Year' in 1995. The institute summed up its rationale by stating "[Multimedia] has become a central word in the wonderful new media world."

In common usage, multimedia refers to an electronically delivered combination of media including video, still images, audio, text in such a way that can be accessed interactively. Much of the content on the web today falls within this definition as understood by millions. Some computers which were marketed in the 1990s were called "multimedia" computers because they incorporated a CD-ROM drive, which allowed for the delivery of several hundred megabytes of
video, picture, and audio data. That era saw also a boost in the production of educational multimedia CD-ROMs.

**Word usage and context**

Since media is the plural of medium, the term "multimedia" is used to describe multiple occurrences of only one form of media such as a collection of audio CDs. This is why it's important that the word "multimedia" is used exclusively to describe multiple forms of media and content.

Multiple forms of information content are often not considered modern forms of presentation such as audio or video. Likewise, single forms of information content with single methods of information processing (e.g. non-interactive audio) are often called multimedia, perhaps to distinguish static media from active media. In the Fine arts, for example, Leda Luss Luyken's ModulArt brings two key elements of musical composition and film into the world of painting: variation of a theme and movement of and within a picture, making ModulArt an interactive multimedia form of art. Performing arts may also be considered multimedia considering that performers and props are multiple forms of both content and media.

The Gesellschaft für deutsche Sprache chose Multimedia as German Word of the Year 1995.

**1.7 USAGE/APPLICATION**

Multimedia finds its application in various areas including, but not limited to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial temporal applications. Several examples are as follows:

**Creative industries**

Creative industries use multimedia for a variety of purposes ranging from fine arts, to entertainment, to commercial art, to journalism, to media and software services provided for any of the industries listed below. An individual multimedia designer may cover the spectrum throughout their career. Request for their skills range from technical, to analytical, to creative.
Commercial uses

Much of the electronic old and new media used by commercial artists and graphic designers is multimedia. Exciting presentations are used to grab and keep attention in advertising. Business to business, and interoffice communications are often developed by creative services firms for advanced multimedia presentations beyond simple slide shows to sell ideas or liven-up training. Commercial multimedia developers may be hired to design for governmental services and nonprofit services applications as well.

Entertainment and fine arts

In addition, multimedia is heavily used in the entertainment industry, especially to develop special effects in movies and animations (VFX, 3D animation, etc.). Multimedia games are a popular pastime and are software programs available either as CD-ROMs or online. Some video games also use multimedia features. Multimedia applications that allow users to actively participate instead of just sitting by as passive recipients of information are called Interactive Multimedia. In the Arts there are multimedia artists, whose minds are able to blend techniques using different media that in some way incorporates interaction with the viewer. One of the most relevant could be Peter Greenaway who is melding Cinema with Opera and all sorts of digital media. Another approach entails the creation of multimedia that can be displayed in a traditional fine arts arena, such as an art gallery. Although multimedia display material may be volatile, the survivability of the content is as strong as any traditional media. Digital recording material may be just as durable and infinitely reproducible with perfect copies every time.
In education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books like encyclopedia and almanacs. A CBT lets the user go through a series of presentations, text about a particular topic, and associated illustrations in various information formats. Edutainment is the combination of education with entertainment, especially multimedia entertainment.

Learning theory in the past decade has expanded dramatically because of the introduction of multimedia. Several lines of research have evolved (e.g. Cognitive load, Multimedia learning, etc.). The possibilities for learning and instruction are nearly endless.

The idea of media convergence is also becoming a major factor in education, particularly higher education. Defined as separate technologies such as voice (and telephony features), data (and productivity applications) and video that now share resources and interact with each other, media convergence is rapidly changing the curriculum in universities all over the world. Likewise, it is changing the availability, or lack thereof, of jobs requiring this savvy technological skill.

The English education in middle school in China is well invested and assisted with various equipments. In contrast, the original objective has not been achieved at the desired effect. The government, schools, families, and students spend a lot of time working on improving scores, but hardly gain practical skills. English education today has gone into the vicious circle. Educators need to consider how to perfect the education system to improve students' practical ability of English. Therefore, an efficient way should be used to make the class vivid. Multimedia teaching will bring students into a class where they can interact with the teacher and the subject. Multimedia teaching is more intuitive than old ways; teachers can simulate situations in real life. In many circumstances teachers do not have to be there, students will learn by themselves in the class. More importantly, teachers will have more approaches to stimulating students' passion of learning.

]
Newspaper companies all over are also trying to embrace the new phenomenon by implementing its practices in their work. While some have been slow to come around, other major newspapers like The New York Times, USA Today and The Washington Post are setting the precedent for the positioning of the newspaper industry in a globalized world.

News reporting is not limited to traditional media outlets. Freelance journalists can make use of different new media to produce multimedia pieces for their news stories. It engages global audiences and tells stories with technology, which develops new communication techniques for both media producers and consumers. The Common Language Project, later renamed to The Seattle Globalist, is an example of this type of multimedia journalism production.

Multimedia reporters who are mobile (usually driving around a community with cameras, audio and video recorders, and laptop computers) are often referred to as mojos, from mobile journalist.

Engineering

Software engineers may use multimedia in computer simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as a collaboration between creative professionals and software engineers.

Industry

In the industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers. Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technology.

Mathematical and scientific research
In mathematical and scientific research, multimedia is mainly used for modeling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the Journal of Multimedia.

**Medicine**

In medicine, doctors can get trained by looking at a virtual surgery or they can simulate how the human body is affected by diseases spread by viruses and bacteria and then develop techniques to prevent it. Multimedia applications such as virtual surgeries also help doctors to get practical training.

**Document imaging**

Document imaging is a technique that takes hard copy of an image/document and converts it into a digital format (for example, scanners).

**Disabilities**

Ability Media allows those with disabilities to gain qualifications in the multimedia field so they can pursue careers that give them access to a wide array of powerful communication forms.

**Miscellaneous**

In Europe, the reference organisation for Multimedia industry is the European Multimedia Associations Convention (EMMAC).

**Structuring information in a multimedia form**

Multimedia represents the convergence of text, pictures, video and sound into a single form. The power of multimedia and the Internet lies in the way in which information is linked.
Multimedia and the Internet require a completely new approach to writing. The style of writing that is appropriate for the 'on-line world' is highly optimized and designed to be able to be quickly scanned by readers.

A good site must be made with a specific purpose in mind and a site with good interactivity and new technology can also be useful for attracting visitors. The site must be attractive and innovative in its design, function in terms of its purpose, easy to navigate, frequently updated and fast to download.

When users view a page, they can only view one page at a time. As a result, multimedia users must create a "mental model" of information structure.

Conferences

There is a large number of multimedia conferences, the two main scholarly scientific conferences being:

- ACM Multimedia;

High-concept is a type of artistic work that can be easily pitched with a succinctly stated premise. It can be contrasted with low-concept, which is more concerned with character development and other subtleties that aren't as easily summarized. The origin of the term is disputed.

High-concept narratives are typically characterised by an overarching "what if?" scenario that acts as a catalyst for the following events. Often, the most popular summer blockbuster movies are built on a high-concept idea, such as "what if we could clone dinosaurs?", as in Jurassic Park.

However, it is important to differentiate a high-concept narrative from an analogous narrative. In the case of the latter, a high-concept story may be employed to allow commentary on an implicit subtext. A prime example of this might be George Orwell's Nineteen Eighty-Four, which asks, "What if we lived in a future of totalitarian government?" while simultaneously
generating social comment and critique aimed at Orwell's own (real world) contemporary society. Similarly, the Gene Roddenberry sci-fi series Star Trek went beyond the high-concept storytelling of a futurist starship crew, by addressing 20th century social issues in a hypothetical and defamiliarising context.

1.8 COMMERCIAL BENEFITS

High-concept television series and movies often rely on pre-sold properties such as movie stars to build audience anticipation, and they might use cross-promotional advertising campaigns with links to a soundtrack, music videos, and licensed merchandise such as DVD box sets. They commonly apply market and test screening feedback to alter the narrative (or even, as in the case of Snakes on a Plane, the dialogue) to ensure maximum popularity. Some commercial blockbuster movies are built as star vehicles for successful music and sports personalities to enter the movie business. In such commercial vehicles, where the onscreen activity is less important than the saleability of the product brand, a high-concept narrative is often used as a "safe" option to avoid the risk of alienating audiences with a convoluted or overly taxing plot exposition.

1.9 SUMMARY

A concept is a abstraction or generalisation from experience or the result of a transformation of existing ideas.[1] The concept is instantiated (reified) by all of its actual or potential instances, whether these are things in the real world or other ideas. Concepts are treated in many if not most disciplines both explicitly, such as in linguistics, psychology, philosophy, etc., and implicitly, such as in mathematics, physics, etc. In informal use the word concept often just means any idea, but formally it involves the abstraction component.

When the mind makes a generalization such as the concept of tree, it extracts similarities from numerous examples; the simplification enables higher-level thinking.
In metaphysics, and especially ontology, a concept is a fundamental category of existence. In contemporary philosophy, there are at least three prevailing ways to understand what a concept is.\[^2\][See talk page]

The idea of media convergence is also becoming a major factor in education, particularly higher education. Defined as separate technologies such as voice (and telephony features), data (and productivity applications) and video that now share resources and interact with each other, media convergence is rapidly changing the curriculum in universities all over the world. Likewise, it is changing the availability, or lack thereof, of jobs requiring this savvy technological skill.

The English education in middle school in China is well invested and assisted with various equipments. In contrast, the original objective has not been achieved at the desired effect. The government, schools, families, and students spend a lot of time working on improving scores, but hardly gain practical skills. English education today has gone into the vicious circle. Educators need to consider how to perfect the education system to improve students’ practical ability of English. Therefore, an efficient way should be used to make the class vivid. Multimedia teaching will bring students into a class where they can interact with the teacher and the subject. Multimedia teaching is more intuitive than old ways; teachers can simulate situations in real life. In many circumstances teachers do not have to be there, students will learn by themselves in the class. More importantly, teachers will have more approaches to stimulating students' passion of learning.

1.10 check your progress

1. Write major characteristics of vimd.
2. What are the arguments against the vimd theory?
3. What is the usage/application of vimd theory?
4. What are the issues in vimd theory?
5. What are the factors of vimd?
Check Your Progress
15. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.15.1. Points for discussion
Points for clarification
1.11 REFERENCES


UNIT 2: ETIOLOGY OF VIMD

2.1 INTRODUCTION

2.2 CHARACTERSTICS OF VIMD

2.3 CAUSE AN EFFECT

2.4 FACTORS OF VIMD

2.5 FEATURES OF VIMD

2.6 DEVELOPMENT OF VIMD
2.7 SIGNIFICANCE OF VIMD

2.8 SUMMARY

2.9 CHECK YOUR PROGRESS

2.10 REFERENCE
2.1 INTRODUCTION

After his arrival, Rico meets up with Sheldon and fellow agent Maria Kane, and they ally themselves with a guerrilla group staging a rebellion against the regime and the Rioja drug cartel, another enemy of the government. Rico assists them in their civil war against Mendoza's corrupt officials; Black Hand mercenaries and the Montano cartel. Rico can also assist in the liberation of various territories to further destabilize the government's rule over the island.

Eventually, Sheldon discovers that Mendoza does, indeed, have control of WMDs, and with San Esperito so politically unstable and with the guerrillas having the upper hand, the president is forced to retreat to his private presidential island just off the mainland. Sheldon and Kane fly Rico to the island to kill Mendoza, but he attempts to escape via jet. However, Rico boards the jet and kills Mendoza and his remaining bodyguards, stopping his reign on the islands.

Game play

The core gameplay consists of elements of a third-person shooter and a driving game, with a large, open world environment to move around in. On foot, the player's character is capable of walking, swimming, and jumping, as well as utilizing weapons and basic hand-to-hand combat. Players can take control of a variety of vehicles, including cars, boats, fixed wing aircraft, helicopters, and motorcycles. Players can also perform stunts with their cars in which they can stand on the roof and jump to another car, or choose to open their parachute while still in motion on the roof. Other key features of the game include skydiving, base jumping, and parasailing (by latching onto a moving car or boat while one's parachute is deployed).

The open, non-linear environment allows players to explore and choose how they wish to play the game. Although storyline missions are necessary to progress through the game, players
can complete them at their own leisure. When not taking on a storyline mission, players can free-roam. However, doing so can attract unwanted and potentially fatal attention from the authorities.

The player can also partake in a variety of optional side missions, for example, liberating a village or taking over a drug cartel hideout. These are necessary to gain points with certain factions.

Reception

However, IGN UK awarded the game a score of 8.8, and the Official Xbox Magazine UK gave Just Cause a score of 9 out of 10, praising it for "varied, consistent, imaginative game play". The Official PlayStation Magazine UK gave it 8 out of 10, criticising its repetitive side missions and short story (saying it could be completed in less than five hours), but praising some of the game play mechanics.

The game suffers from its share of bug-related issues though, as noted by many reviewers, who feel the game may have been "rushed" to market without sufficient time to fix certain problems. The PlayStation 2 version, in particular, suffers from a number of 'game-killing' bugs that render certain missions impossible to complete, or the entire game unplayable until it is reset. Eidos has not released a patch for the PC or Xbox 360 versions of the game.

2.2 CHARACTERSTICS OF VIMD

Ancient Greek thought pressing down onto possible causes of epilepsy, naturally found understanding of seizures within a divine origin and cause.

Diet

Malnutrition and over nutrition may increase the risk of seizures. Examples include the following:

- Vitamin B1 deficiency (thiamine deficiency) was reported to cause seizures, especially in alcoholics
• Vitamin B6 depletion (pyridoxine deficiency) was reported to be associated with pyridoxine-dependent seizures.
• Vitamin B12 deficiency was reported to be the cause of seizures for adults and for infants.

Folic acid in large amounts was considered to potentially counteract the anti seizure effects of antiepileptic drugs and increase the seizure frequency in some children, although that concern is no longer held by epileptologists.

Those with various medical conditions may suffer seizures as one of their symptoms. These include:

• Angelman syndrome
• Arteriovenous malformation
• Brain abscess
• Brain tumor
• Cavernoma
• Cerebral palsy
• Down syndrome
• Eclampsia
• Epilepsy
• Encephalitis
• Fragile X syndrome
• Meningitis
• Multiple sclerosis
• Systemic lupus erythematosus
• Tuberous sclerosis

Various other conditions have been associated not necessarily with the induction of seizures, but with lower seizure thresholds and/or increased likelihood of seizure comorbidity. Examples include depression, psychosis, obsessive-compulsive disorder (OCD), attention deficit hyperactivity disorder (ADHD), and autism, among many others.
Drugs

Seizures may be a side effect of certain drugs, though with most, the effect is quite rare, and for most patients, they are safe. These include:

- Aminophylline
- Bupivicaine
- Bupropion
- Butyrophenones
- Caffeine (in high amounts of 500 mgs and above could increase the occurrence of seizures, particularly if normal sleep patterns are interrupted)
- Chlorambucil
- Ciclosporin
- Clozapine
- Corticosteroids
- Dextropropoxyphene
- Diphenhydramine
- Enflurane
- Estrogens
- Fentanyl
- Insulin
- Lidocaine
- Maprotiline
- Meperidine
- Olanzapine
- Pentazocine
- Phenothiazines (such as chlorpromazine)
- Prednisone
- Procaine
- Propofol
- Propoxyphene
- Quetiapine
- Risperidone
- Sevoflurane
- Theophylline
- Tramadol
- Tricyclic antidepressants (especially clomipramine)
- Venlafaxine
- The following antibiotics: isoniazid, lindane, metronidazole, nalidixic acid, and penicillin, though vitamin B6 taken along with them may prevent seizures; also, fluoroquinolones and carbapenems

Use of certain recreational drugs may also lead to seizures in some, especially when used in high doses or for extended periods of time. These include amphetamines (such as amphetamine, methamphetamine, MDMA ("ecstasy"), and mephedrone), cocaine, psilocybin, psilocin, methylphenidate, phenylpropanolamine, tramadol, and GHB.

If treated with the wrong kind antiepileptic drugs (AED), seizures may increase, as most AEDs are developed to treat a particular type of seizure.

Convulsant drugs (the functional opposites of anticonvulsants) will always induce seizures at sufficient doses. Examples of such agents, some of which are used or have been used clinically for various purposes, and others of which are naturally-occurring toxins, include strychnine, bemegride, flumazenil, cyclothiazide, flurothyl, pentylenetetrazol, bicuculline, cicutoxin, and picrotoxin.

**Alcohol**

There are varying opinions on the likelihood of alcoholic beverages triggering a seizure. Consuming alcohol may temporarily reduce the likelihood of a seizure immediately following consumption. But after the blood alcohol content has dropped, chances may increase. This may occur, even in non-epileptics.

Heavy drinking in particular has been shown to possibly have some effect on seizures in epileptics. But studies have not found light drinking to increase the likelihood of having a seizure
at all. EEGs taken of patients immediately following light alcohol consumption have not revealed any increase in seizure activity.\textsuperscript{[16]}

Consuming alcohol with food is less likely to trigger a seizure than consuming it without.

Consuming alcohol while using many anticonvulsants may reduce the likelihood of the medication working properly. In some cases, it may actually trigger a seizure. Depending on the medication, the effects vary.

**Drug withdrawal**

Various medicinal and recreational drugs can dose-dependently precipitate seizures in withdrawal, especially when withdrawing from high doses and/or chronic use. Examples include drugs that affect GABAergic and/or glutamatergic systems, such as alcohol (see alcohol withdrawal), benzodiazepines, barbiturates, and anesthetics, among others.

Sudden withdrawal from anticonvulsants may lead to seizures. It is for this reason that if a patient's medication is changed, the patient will be weaned from the medication being discontinued following the start of a new medication.

**Missed anticonvulsants**

A missed dose or incorrectly timed dose of an anticonvulsant may be responsible for a breakthrough seizure, even if the person often missed doses in the past, and has not had a seizure as a result. Missed doses are one of the most common reasons for a breakthrough seizure. Even a single missed dose is capable of triggering a seizure in some patients. This is true, even when the patient has not suffered a seizure after previously missing much more of his/her medication. Doubling the next dose does not necessarily help.

Missed doses can occur as a result of the patient's forgetfulness, unplanned lack of access to the medication, difficulty in affording the medication, or self-rationing of the medication when one's supply is low, among other causes.
Incorrect dosage amount: A patient may be receiving a sub-therapeutic level of the anticonvulsant. Switching medicines: This may include sudden withdrawal of an anticonvulsant without replacing it at all, or to switch abruptly to another anticonvulsant. In some cases, switching from brand to the generic version of the same medicine may induce a breakthrough seizure.

**Fever**

In children between the ages of 6 months and 5 years, a fever of 38 °C (100.4 °F) or higher may lead to a seizure known as a febrile seizure. About 2-5% of all children will experience such a seizure during their childhood. In most cases, a febrile seizure will not lead to epilepsy. Approximately 40% of children who experience a febrile seizure will have another one.

In those with epilepsy, fever can trigger a seizure. Additionally, in some, gastroenteritis, which causes vomiting and diarrhea, can lead to diminished absorption of anticonvulsants, thereby reducing protection against seizures.

**Lights**

In some epileptics, flickering or flashing lights, such as strobe lights, can be responsible for the onset of a tonic clonic, absence, or myoclonic seizure. This condition is known as photosensitive epilepsy, and in some cases, the seizures can be triggered by activities that are harmless to others, such as watching television or playing video games, or by driving or riding during daylight along a road with spaced trees, thereby simulating the "flashing light" effect. Some people can suffer a seizure as a result of blinking one's own eyes. Contrary to popular belief, this form of epilepsy is relatively uncommon, accounting for just 3% of all cases.

A routine part of the EEG test involves exposing the patient to flickering lights in order to attempt to induce a seizure, to determine if such lights may be triggering a seizure in the patient, and to be able to read the wavelengths when such a seizure occurs.
Head injury

A severe head injury, such as one suffered in a motor vehicle accident, fall, assault, or sports injury, can result in one or more seizures that can occur immediately after the fact or up to a significant amount of time later. This could be hours, days, or even years following the injury.

A brain injury can cause seizure(s) because of the unusual amount of energy that is discharged across the brain when the injury occurs and thereafter. When there is damage to the temporal lobe of the brain, there is a disruption of the supply of oxygen.

The risk of seizure(s) from a closed head injury is about 15%. In some cases, a patient who has suffered a head injury is given anticonvulsants, even if no seizures have occurred, as a precaution to prevent them in the future.

Sleep deprivation

Sleep deprivation is the second most common trigger of seizures. In some cases, it has been responsible for the only seizure a person ever suffers. However, the reason for which sleep deprivation can trigger a seizure is unknown. One possible thought is that the amount of sleep one gets affects the amount of electrical activity in one's brain.

Patients who are scheduled for an EEG test are asked to deprive themselves of some sleep the night before in order to be able to determine if sleep deprivation may be responsible for seizures.

In some cases, patients with epilepsy are advised to sleep 6-7 consecutive hours as opposed to broken-up sleep (e.g. 6 hours at night and a 2-hour nap) and to avoid caffeine and sleeping pills in order to prevent seizures.
Parasites and stings

In some cases, certain parasites can cause seizures. The Schistosoma sp. flukes that causes Schistosomiasis. Pork tapeworm and Beef tapeworm causes seizures when the parasite create cyst at the brain. Echinococcosis, Malaria, Toxoplasmosis, African Trypanosomiasis, and many other parasitic diseases can cause seizures. Seizures have also been associated with insect stings.

Reports suggest that patients stung by red imported fire ants (Solenopsis invicta) and Polistes wasps suffered seizures because of the venom.

Stress

In one study, emotional stress was reported by 30-60% prior to their seizures. This may include stress over hard work one is trying to accomplish, one's obligations in life, worries, emotional problems, frustration, anger, anxiety, or many other problems.

Stress may trigger a seizure because it affects the hormone cortisol. Stress can also affect the part of the brain that regulates emotion.[43][44] Although stress can alter levels of these hormones, it remains unclear whether or not stress can directly result in an increase in seizure frequency.

Breakthrough seizure

A breakthrough seizure is an epileptic seizure that occurs despite the use of anticonvulsants that have otherwise successfully prevented seizures in the patient. Breakthrough seizures may be more dangerous than non-breakthrough seizures because they are unexpected by the patient, who may have considered themselves free from seizures and therefore, not take any precautions. Breakthrough seizures are more likely with a number of triggers. Often when a breakthrough seizure occurs in a person whose seizures have always been well controlled, there is a new underlying cause to the seizure. Rates of breakthrough seizures vary. Studies have shown the rates of breakthrough seizures ranging from 11–37%. The treatment for a breakthrough seizure involves measuring the level of the anticonvulsant in the patient's system,
and may include increasing the dosage of the existing medication, adding another medication in addition to the existing one, or altogether switching medications. A person with a breakthrough seizure may require hospitalization for a period of time for observation.

### 2.3 CAUSE AN EFFECT

Cause An Effect is the first album by the former 1200 Techniques frontman, N'fa. The Australian hip hop artist collaborated with various producers around the world including Roots Manuva, Mr Yoshiaki (The Black Eyed Peas), DJ Peril (of 1200 Techniques) and Deceptikonz (Dawn Raid Entertainment). Three singles were released from the album, "Seduction is Evil (She's Hot)”, "Cause An Effect" and "Universal King (Left Right Left)". The actor, Heath Ledger, directed two video clips for the album, "Seduction is Evil (She's Hot)” and "Cause An Effect". In 2010, N'fa re-released the single "Cause An Effect" as an EP with various remixes of the track and video clip on iTunes.

"Cause An Effect" video clip

In October 2009, N'fa posted a making-of video to his YouTube channel discussing working with Heath Ledger, who had directed the video clip for "Cause An Effect". N'fa reveals in the video:

"We shot it in Sydney… and he called me at this crazy hour, saying, 'I've got this idea, let's make a video!'. We found a few different ideas for clothing, a massive sheet and black curtain, and got in touch with two really good makeup artists… and shot it all in his garage. The idea was to keep it really artistic. Heath was basically running around directing the shots… it was a really cool day. Every day I count my blessings that he directed this piece of art. It was a song I was proud to have written but I never expected to have such an immense video made for it. I've known Heath since we were very young and he was always a creative kind of guy and, in many ways, ahead of the curve."
N'fa was given the opportunity to show the video clip at the 2009 Rome Film Festival on a theatre screen. Ledger invested his time entirely for the video clip directly after The Dark Knight had finished filming. On July 12, 2010, N'fa reflected again on the video clip:

"Heath loved the song, and wanted to make a video that artistically married itself to the energy of the track, to indulge listeners and viewers alike. At the end of the day though, it was two old friends hangin' out doing what we love. Good times."

Set six years after its predecessor, Just Cause 3 follows series protagonist Rico Rodriguez as he returns to his birthplace of Medici, a fictional Mediterranean island under the brutal control of dictator General Sebastiano Di Ravello. The game is played from a third-person view and allows players to explore the island of Medici in an open-ended environment.

Upon release, Just Cause 3 received generally positive reviews; critics praised the open-ended gameplay and the nation of Medici, the game's destruction mechanics and promotion of player agency, while criticism was directed at the game's narrative, which was considered cliched and uninspired, and multiple performance issues, particularly on the console versions of the game.

2.4 FACTORS OF VIMD

A variety of tools are provided to players for traversal in the game. Just Cause 2's signature features – the grappling hook and parachute – reappear with improved mechanics. The focus on chaos and exaggerated physics also remain. A new wingsuit, which is permanently equipped by the player, is featured in the game and allows players to glide across the world in a much faster way. When the player almost reaches the ground while using the wingsuit, they can draw themselves back up in the air by using grapples. Players can switch between using the parachute and wingsuit freely during missions or free-roam. In addition to the equipment provided, a wide range of weapons, like missile launchers and shotgun RPGs, and vehicles, such as fighter aircraft, planes, ships, and exotic cars, are included in the game. These vehicles can be customized by the player and can be used as weapons.
Other game mechanics have been overhauled and updated. For example, Rico now has the ability to attach and tether multiple objects together with his grappling hook, with the amount of tethers available increase by activating in-game ‘mods’, earned by completing challenges. Also parachuting is more stable and allows players to shoot enemies from the air. Every object and non-playable character can also be hooked by the player with the use of the grappling hook. In-game currency has been left out of Just Cause 3, making the series' supply drops more easily accessible and imaginative for the player. However, this affects difficulty; for example, if the player chooses to ride a tank, the enemy AI matches the power of it and adopts weapons that are able to take down a tank. Another new feature is giving the character infinite C4. The C4 can be placed free over the world by the player but only three at a time, though by using the in-game featured 'mods', up to five can be deployed. Unlike previous installments that required players to purchase C4, Just Cause 3 instates this weapon to allow for more chaos. In Just Cause 2 players were able to stand on top of moving vehicles but only in the center; players are now allowed to move around on vehicles freely in Just Cause 3. Players can liberate hostile military bases and towns featured in the game; they act as fast travel locations if the liberation is successful.

Creativity and destruction are heavily emphasized in Just Cause 3. For instance, many things in the game, including structures like bridges and statues, can be destroyed in a variety of ways. A new mechanic called Rebel Drop was introduced. It allows the player to pause the game to select equipment, weapons, and vehicles through a pause menu. The selected objects are dropped into the game's world and can be used by players. The game also features Challenge Modes. It includes mini-games like wingsuit races and the destruction frenzy mode, in which new objectives and challenges are unlocked when the player destroys an enemy base.

Despite the multiplayer mod of Just Cause 2 being well received by players, the game only featured asynchronous multiplayer at launch, in which challenges and leaderboards were included instead of any co-operative or competitive multiplayer mode, as the studio wanted to focus their manpower, time and resources in creating the world of the game.

2.5 FEATURES OF VIMD
Six years after the events of *Just Cause 2*, Rico Rodriguez returns to his homeland of Medici, a fictional Mediterranean island under the brutal control of dictator General Sebastiano Di Ravello, who has set his eyes on world domination. Wanting to stop him, Rico goes on a journey to destroy his evil plans.

When he arrives at Medici, he meets up with his childhood friend Mario Frigo and scientist Dimah al-Masri, who are now serving in the rebellion to overthrow Di Ravello. They proceed to liberate Manaea, Medici's former capital, and destroy the Vis Electra power plant, which powers a military base. Furious with the rebellion's success, Di Ravello orders his soldiers to raze the town of Costa del Porto. With Rico's help, the rebellion turn the tide on the military. They also learn that Di Ravello plans to use Bavarium, an explosive and magnetic mineral, as a means to conquer the world.

Dimah requests Rico to retrieve a Bavarium scanner, only to find out he's delivering it to Tom Sheldon, Rico's Agency coordinator. Angered because he knows of the Agency's operations in toppling dictatorships, he destroys the scanner before giving it to Sheldon. Rico and Mario later escort Zeno, a scientist defecting from Di Ravello. Di Ravello's forces launch a Bavarium missile aimed at a town. Rico prevents the damage by changing its course so that it destroys a military base instead. With the successes of recent operations, Mario steals some casks of wine from Di Ravello's stash and has Rico drive it to the rebels for celebration.

Sometime later, Sheldon informs Rico that the Di Ravello's military are sending frigates after Mario and Dimah, who are out in the sea. He rescues them and they engage in a firefight with Di Ravello's forces. Rico meets Annika and Teo, two foreign smugglers also fighting against Di Ravello. In the firefight Mario is severely injured, and Annika offers to aid him if Rico is able to help her with favours.

The smugglers ask Rico to steal the Imperator tank, an armoured vehicle with a Bavarium shield. Rico and the smugglers later hit a Bavarium refinery, as well as trying out an electromagnetic pulse device reverse-engineered from the Imperator tank. Rico becomes wary of elements within the rebellion who act as a mole to Di Ravello, causing him to be able to grasp their every movement. During this time Mario recovers due to the smugglers' treatment. Di
Ravello's soldiers attack the rebels' hideout. The rebels repel them and after that, destroy another power plant.

Rico escorts Rosa Manuela, a Medician politician, as she returns to Medici. Rosa recognises Zeno as Di Ravello's scientist and Rico finds out that Zeno is the mole. Rico stops a train carrying Bavarium out of the country, and help the smugglers free their comrades imprisoned by Di Ravello. Rico, Dimah and Sheldon stop another transport plane carrying a Bavarium bomb. The military attacks the rebels again, as a ruse to free Zeno. Rico confronts Zeno and destroys his helicopter.

The rebels engage in a final battle with the military, as well as destruction of Di Ravello's central command. Dimah cannot disable the missiles aimed at the base, so she pushes Rico away as the missiles hit the control tower she is in, killing her. The rebels learn later that Di Ravello has escaped in an advanced helicopter using the same Bavarium shield as the Imperator. Rico confronts him at a volcano island, destroying the helicopter Di Ravello is piloting. The player, as Rico, can choose to execute Di Ravello by shooting him, or wait until he commits suicide by falling into the lava. After Di Ravello's death, it is implied that Rosa becomes president of Medici.

2.6 DEVELOPMENT OF VIMD

The development of Just Cause 3 began in 2012, and was handled by Avalanche Studios' satellite studio in New York, which has around 75 staff members, while the main studio in Sweden focused on the development of Mad Max, which was announced in 2013. The game's controls received an overhaul, and several members from Criterion Games, the developer of the racing video game series Burnout, joined the studios and worked on the vehicle handling of the game. Inspiration for the game's asynchronous multiplayer was taken from racing games like Need for Speed and Forza Horizon 2, while the "Destruction Frenzy" mechanic was inspired by the Red Faction series. Inspirations for the game were drawn from the modding community of Just Cause 2. As a result, the upgrades featured in the game are called "mods".

When designing the game's world, the studio collected photo books of the Mediterranean area and sent a team to several Mediterranean islands to get a better glimpse of the area. The
environment of the game is inspired by the landscape of Monaco and the southern Mediterranean area. Avalanche Studios considered such areas "an untapped resource" which no other developer had worked on before. In order to portray a world with dictatorship, the developers of the game established a color scheme, which is composed of mainly grey, yellow, and red, to reflect and show a sense of "oppression". The size of the game's world is similar to that of Just Cause 2, but Avalanche promised that the content featured in the world would be "denser" than its predecessor. Environmental destruction is expanded in Just Cause 3, as Avalanche considered it a key element in creating a cinematic experience and a mechanic to give players more freedom. The team also considered that with the advancements in technologies, they were able to add more destruction mechanics, which are of larger scale, to the game.

In an interview, the CEO of Avalanche Studios Christofer Sundberg stated that the game would continue to retain and expand Just Cause 2's joy and humor, and that the tone of the game would not be very serious, but slightly more so than that of Just Cause 2. He described the tone of the game "70 percent wacky and 30 percent serious". The game's campaign explores the series' protagonist Rico Rodriguez's backstory, as the game is set in his motherland. His image was made more "approachable", in which he wears casual clothing like jeans throughout the game, as oppose to his uniform in the original Just Cause and Just Cause 2. His gadgets and equipment are made more realistic. The art director of the game explained that the studios "[wanted] just a touch of that James Bond agency feel [on Rico Rodriguez] without going too far into the goofy and outlandish like XXX starring Vin Diesel."

The game was first teased by the CEO of Avalanche Studios on February 27, 2013. In August 2014, Avalanche Studios announced that 2015 would be their "biggest year since the inception of the studio". Several "surprises" were also teased The game was rumored to feature a free-to-play structure and microtransactions. However, the developer denied such rumors and confirmed that it would be a full-price game without microtransactions. The game was officially announced on November 11, 2014. The first gameplay demo for the game was shown at Square Enix's E3 2015 conference.

2.7 SIGNIFICANCE OF VIMD
Each installment in the Just Cause series features a story of multiple factions fighting for control of a small nation. Although all three games take place in real world locations (the Caribbean, Southeast Asia, and the Mediterranean) the islands are fictional and the games only draw inspiration from those locations. The player can partake in a variety of optional side missions, for example liberating a village or taking over a drug cartel's villa. In Just Cause these missions are generally quite repetitive, but necessary to gain points with certain factions. In Just Cause 2 the side missions became unique and more complex. When not taking on a storyline mission, players can free-roam and create chaos. However, doing so can attract unwanted and potentially fatal attention from the authorities in the form of "heat".

The core game play consists of elements of a third-person shooter and a driving game, with a huge open-world map to explore. On foot, the player's character is capable of walking, swimming and jumping, as well as utilizing weapons. Players can take control of a variety of vehicles, including cars, boats, airplanes, helicopters, motorcycles and even an underwater scooter. Players can also perform stunts with their cars in which they can stand on the roof and jump to another car, or choose to open their parachute whilst still in motion on the roof. Other key features of the game include parasailing (grappling onto a car while utilizing a parachute) and skydiving.

The open, non-linear environment allows players to explore and choose how they wish to play the game. Like many 'sandbox' style games, while storyline missions are necessary to progress through the game, players can complete them at their own leisure.

**Facts**

The core game play consists of elements of a third-person shooter and a driving game, with a large, open environment to move around in. On foot, the player's character is capable of walking, swimming and jumping, as well as utilizing weapons and basic hand-to-hand combat. Players can take control of a variety of vehicles, including cars, boats, airplanes, helicopters and motorcycles. Players can also perform stunts with their cars in which they can stand on the roof and jump to another car, or choose to open their parachute whilst still in motion on the roof.
Other key features of the game include parasailing (grappling onto a car while utilizing a parachute) and skydiving.

The open, non-linear environment allows players to explore and choose how they wish to play the game. Although storyline missions are necessary to progress through the game, players can complete them at their own leisure. When not taking on a storyline mission, players can free-roam and create havoc. However, doing so can attract unwanted and potentially fatal attention from the authorities described as "Heat". The higher your heat levels are the more authorities there are and gets increasingly harder.

The player can also partake in a variety of optional side missions, for example liberating a village or taking over a drug cartel plantation/villa. These are generally quite repetitive but are necessary to gain points with certain factions.

Originally set to be released in 2008, it was pushed back multiple times until it was released on March 23, 2010 in North America and March 26, 2010 in Europe.

It could be bought in original or limited edition which came with Rico's Signature Gun, Bulls Eye Assault Rifle, Chevalier Classic, Agency Hovercraft, Chaos Parachute and a double sided Panauan Intel Map and Poster. All these items (other than the map) can be obtained as Downloadable content.

There is also a free demonstration version of the game available for download

### 2.8 SUMMARY

After his arrival, Rico meets up with Sheldon and fellow agent Maria Kane, and they ally themselves with a guerrilla group staging a rebellion against the regime and the Rioja drug cartel, another enemy of the government. Rico assists them in their civil war against Mendoza's corrupt officials; Black Hand mercenaries and the Montano cartel. Rico can also assist in the liberation of various territories to further destabilize the government's rule over the island.
Eventually, Sheldon discovers that Mendoza does, indeed, have control of WMDs, and with San Esperito so politically unstable and with the guerrillas having the upper hand, the president is forced to retreat to his private presidential island just off the mainland. Sheldon and Kane fly Rico to the island to kill Mendoza, but he attempts to escape via jet. However, Rico boards the jet and kills Mendoza and his remaining bodyguards, stopping his reign on the islands.

The development of Just Cause 3 began in 2012, and was handled by Avalanche Studios' satellite studio in New York, which has around 75 staff members, while the main studio in Sweden focused on the development of Mad Max, which was announced in 2013. The game's controls received an overhaul, and several members from Criterion Games, the developer of the racing video game series Burnout, joined the studios and worked on the vehicle handling of the game. Inspiration for the game's asynchronous multiplayer was taken from racing games like Need for Speed and Forza Horizon 2, while the "Destruction Frenzy" mechanic was inspired by the Red Faction series. Inspirations for the game were drawn from the modding community of Just Cause 2. As a result, the upgrades featured in the game are called "mods".

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A breakthrough seizure is an epileptic seizure that occurs despite the use of anticonvulsants that have otherwise successfully prevented seizures in the patient. Breakthrough
seizures may be more dangerous than non-breakthrough seizures because they are unexpected by
the patient, who may have considered themselves free from seizures and therefore, not take any
precautions. Breakthrough seizures are more likely with a number of triggers. Often when a
breakthrough seizure occurs in a person whose seizures have always been well controlled, there
is a new underlying cause to the seizure. Rates of breakthrough seizures vary. Studies have
shown the rates of breakthrough seizures ranging from 11–37%. The treatment for a breakthrough
seizure involves measuring the level of the anticonvulsant in the patient's system, and may
include increasing the dosage of the existing medication, adding another medication in addition
to the existing one, or altogether switching medications. A person with a breakthrough seizure
may require hospitalization for a period of time for observation.

Each installment in the Just Cause series features a story of multiple factions fighting for
control of a small nation. Although all three games take place in real world locations (the
Caribbean, Southeast Asia, and the Mediterranean) the islands are fictional and the games only
draw inspiration from those locations. The player can partake in a variety of optional side
missions, for example liberating a village or taking over a drug cartel's villa. In Just Cause these
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Cause 2 the side missions became unique and more complex. When not taking on a storyline
mission, players can free-roam and create chaos. However, doing so can attract unwanted and
potentially fatal attention from the authorities in the form of "heat".

2.9 CHECK YOUR PROGRESS

1. What are the characteristics of vimd?
2. What are the significance of vimd?
3. What are the features of vimd?
4. What are the factors of vimd?
5. Write cause an effect of vimd.

Check Your Progress
16. Assignment/Activity

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Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.16.1. Points for discussion
Points for clarification
2.10 REFERENCES


UNIT 3: IMPACT OF VIMD ON LEARNING AND DEVELOPMENT

3.1 INTRODUCTION

3.2 SCOPE OF LEARNING AND DEVELOPMENT

3.3 FACTORS OF LEARNING AND DEVELOPMENT

3.4 TOOLS FOR LEARNING AND DEVELOPMENT

3.5 LEARNING MANAGEMENT SYSTEM

3.6 LEARNING OBJECTS
3.1 INTRODUCTION

"E-learning" redirects here. It is not to be confused with Online machine learning.

Educational technology is defined by the Association for Educational Communications and Technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources."

Educational technology refers to the use of both physical hardware and educational theoretics. It encompasses several domains, including learning theory, computer-based training, online learning, and, where mobile technologies are used, m-learning. Accordingly, there are several discrete aspects to describing the intellectual and technical development of educational technology:

- educational technology as the theory and practice of educational approaches to learning
• educational technology as **technological tools and media** that assist in the communication of knowledge, and its development and exchange

• educational technology for **learning management systems** (LMS), such as tools for student and curriculum management, and education management information systems (EMIS)

• educational technology itself as an educational subject; such courses may be called "Computer Studies" or "Information and communications technology (ICT)".

**Definition**

Richey defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources." The Association for Educational Communications and Technology (AECT) denoted instructional technology as "the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning." As such, educational technology refers to all valid and reliable applied education sciences, such as equipment, as well as processes and procedures that are derived from scientific research, and in a given context may refer to theoretical, algorithmic or heuristic processes: it does not necessarily imply physical technology.

Each of these numerous terms has had its advocates, who point up potential distinctive features. However, many terms and concepts in educational technology have been defined nebulously; for example, Fiedler's review of the literature found a complete lack agreement of the components of a personal learning environment. Moreover, Moore saw these terminologies as emphasizing particular features such as digitization approaches, components or delivery methods rather than being fundamentally dissimilar in concept or principle. For example, **m-learning** emphasizes mobility, which allows for altered timing, location, accessibility and context of learning; nevertheless, its purpose and conceptual principles are those of educational technology.

In practice, as technology has advanced, the particular "narrowly defined" terminological aspect that was initially emphasized by name has blended into the general field of educational
technology. Initially, "virtual learning" as narrowly defined in a semantic sense implied entering an environmental simulation within a virtual world, for example in treating posttraumatic stress disorder (PTSD). In practice, a "virtual education course" refers to any instructional course in which all, or at least a significant portion, is delivered by the Internet. "Virtual" is used in that broader way to describe a course that is not taught in a classroom face-to-face but through a substitute mode that can conceptually be associated "virtually" with classroom teaching, which means that people do not have to go to the physical classroom to learn. Accordingly, virtual education refers to a form of distance learning in which course content is delivered by various methods such as course management applications, multimedia resources, and videoconferencing.

As a further example, ubiquitous learning emphasizes an omnipresent learning milieu. Educational content, pervasively embedded in objects, is all around the learner, who may not even be conscious of the learning process: students may not have to do anything inorder to learn, they just have to be there. The combination of adaptive learning, using an individualized interface and materials, which accommodate to an individual, who thus receives personally differentiated instruction, with ubiquitous access to digital resources and learning opportunities in a range of places and at various times, has been termed smart learning. Smart learning is a component of the smart city concept.\cite{23}  

3.2 SCOPE OF LEARNING AND DEVELOPMENT

Helping people learn in ways that are easier, faster, surer, or less expensive can be traced back to the emergence of very early tools, such as paintings on cave walls. Various types of abacus have been used. Writing slates and blackboards have been used for at least a millennium. From their introduction, books and pamphlets have held a prominent role in education. From the early twentieth century, duplicating machines such as the mimeograph and Gestetner stencil devices were used to produce short copy runs (typically 10–50 copies) for classroom or home use. The use of media for instructional purposes is generally traced back to the first decade of the 20th century with the introduction of educational films (1900s) and Sidney Pressey's mechanical teaching machines (1920s). The first all multiple choice, large scale assessment was the Army Alpha, used to assess the intelligence and more specifically the aptitudes of World War I military recruits. Further large-scale use of technologies was employed in training soldiers during and
after WWII using films and other mediated materials, such as overhead projectors. The concept of hypertext is traced to description of memex by Vannevar Bush in 1945.

Slide projectors were widely used during the 1950s in educational institutional settings. Cuisenaire rods were devised in the 1920s and saw widespread use from the late 1950s.

In 1960, the University of Illinois initiated a classroom system based in linked computer terminals where students could access informational resources on a particular course while listening to the lectures that were recorded via some form of remotely linked device like a television or audio device.

In the mid 1960s Stanford University psychology professors Patrick Suppes and Richard C. Atkinson experimented with using computers to teach arithmetic and spelling via Teletypes to elementary school students in the Palo Alto Unified School District in California. Stanford's Education Program for Gifted Youth is descended from those early experiments. In 1963, Bernard Luskin installed the first computer in a community college for instruction. Working with Stanford and others he helped develop computer-assisted instruction. Working with the Rand Corporation, Luskin's landmark UCLA dissertation in 1970 analyzed obstacles to computer-assisted instruction.

In 1971, Ivan Illich published a hugely influential book called, Deschooling Society, in which he envisioned "learning webs" as a model for people to network the learning they needed. The 1970s and 1980s saw notable contributions in computer-based as well as developments at the University of Guelph in Canada. In 1976, Bernard Luskin launched Coastline Community College as a "college without walls" using television station KOCE-TV as a vehicle. In the UK the Council for Educational Technology supported the use of educational technology, in particular administering the government's National Development Programme in Computer Aided Learning (1973–77) and the Microelectronics Education Programme (1980–86).

By the mid-1980s, accessing course content became possible at many college libraries. In computer-based training (CBT) or computer-based learning (CBL), the learning interaction was between the student and computer drills or micro-world simulations.
Digitized communication and networking in education started in the mid-1980s. Educational institutions began to take advantage of the new medium by offering distance learning courses using computer networking for information. Early e-learning systems, based on computer-based learning/training often replicated autocratic teaching styles whereby the role of the e-learning system was assumed to be for transferring knowledge, as opposed to systems developed later based on computer supported collaborative learning (CSCL), which encouraged the shared development of knowledge.

Videoconferencing was an important forerunner to the educational technologies known today. This work was especially popular with Museum Education. Even in recent years, videoconferencing has risen in popularity to reach over 20,000 students across the United States and Canada in 2008-2009. Disadvantages of this form of educational technology are readily apparent: image and sound quality is often grainy or pixelated; videoconferencing requires setting up a type of mini-television studio within the museum for broadcast, space becomes an issue; and specialised equipment is required for both the provider and the participant.

The Open University in Britain and the University of British Columbia (where Web CT, now incorporated into Blackboard Inc., was first developed) began a revolution of using the Internet to deliver learning, making heavy use of web-based training, online distance learning and online discussion between students. Practitioners such as Harasim (1995) put heavy emphasis on the use of learning networks.

With the advent of World Wide Web in the 1990s, teachers embarked on the method using emerging technologies to employ multi-object oriented sites, which are text-based online virtual reality systems, to create course websites along with simple sets of instructions for its students.

Text book publishers also explored ways to utilize both the Internet and CD ROM technology as an extension to traditional learning. In 1994, Simon and Schuster was the one of first to pioneer in this area, launching the New Media Group through its then Higher-Ed subsidiary Prentice Hall. Among the New Media Group’s members was future MP3 Newswire publisher Richard Menta, whose key project was the Guest Lecture Series. This series was the
first successful delivery of online video lectures to universities. The inaugural lecture was streamed in December 1996 with Harvard physics professor Dr. Eric Mazur presenting on Peer Instruction.

By 1994, the first online high school had been founded. In 1997, Graziadei described criteria for evaluating products and developing technology-based courses that include being portable, replicable, scalable, affordable, and having a high probability of long-term cost-effectiveness.

Improved Internet functionality enabled new schemes of communication with multimedia or webcams. The National Center for Education Statistics estimate the number of K-12 students enrolled in online distance learning programs increased by 65 percent from 2002 to 2005, with greater flexibility, ease of communication between teacher and student, and quick lecture and assignment feedback.

According to a 2008 study conducted by the U.S Department of Education, during the 2006-2007 academic year about 66% of postsecondary public and private schools participating in student financial aid programs offered some distance learning courses; records show 77% of enrollment in for-credit courses with an online component. In 2008, the Council of Europe passed a statement endorsing e-learning’s potential to drive equality and education improvements across the EU.

Computer-mediated communication (CMC) is between learners and instructors, mediated by the computer. In contrast, CBT/CBL usually means individualized (self-study) learning, while CMC involves educator/tutor facilitation and requires scenarization of flexible learning activities. In addition, modern ICT provides education with tools for sustaining learning communities and associated knowledge management tasks.

Students growing up in this digital age have extensive exposure to a variety of media. Major high-tech companies such as Google, Verizon and Microsoft have funded schools to provide them the ability to teach their students through technology, in the hope that this would lead to improved student performance.
3.3 FACTORS OF LEARNING AND DEVELOPMENT

Theory

Various pedagogical perspectives or learning theories may be considered in designing and interacting with educational technology. E-learning theory examines these approaches. These theoretical perspectives are grouped into three main theoretical schools or philosophical frameworks: behaviorism, cognitivism and constructivism.

Behaviorism

This theoretical framework was developed in the early 20th century based on animal learning experiments by Ivan Pavlov, Edward Thorndike, Edward C. Tolman, Clark L. Hull, and B.F. Skinner. Many psychologists used these results to develop theories of human learning, but modern educators generally see behaviorism as one aspect of a holistic synthesis. Teaching in behaviorism has been linked to training, emphasizing the animal learning experiments. Since behaviorism consists of the view of teaching people how to something with rewards and punishments, it is related to training people.

B.F. Skinner wrote extensively on improvements of teaching based on his functional analysis of verbal behavior and wrote "The Technology of Teaching", an attempt to dispel the myths underlying contemporary education as well as promote his system he called programmed instruction. Ogden Lindsley developed a learning system, named Celebration, that was based on behavior analysis but that substantially differed from Keller's and Skinner's models.

Cognitivism

Cognitive science underwent significant change in the 1960s and 1970s. While retaining the empirical framework of behaviorism, cognitive psychology theories look beyond behavior to explain brain-based learning by considering how human memory works to promote learning. The Atkinson-Shiffrin memory model and Baddeley's working memory model were established as theoretical frameworks. Computer Science and Information Technology have had a major influence on Cognitive Science theory. The Cognitive concepts of working memory (formerly
known as short term memory) and long term memory have been facilitated by research and technology from the field of Computer Science. Another major influence on the field of Cognitive Science is Noam Chomsky. Today researchers are concentrating on topics like cognitive load, information processing and media psychology. These theoretical perspectives influence instructional design.

**Constructivism**

Educational psychologists distinguish between several types of constructivism: individual (or psychological) constructivism, such as Piaget's theory of cognitive development, and social constructivism. This form of constructivism has a primary focus on how learners construct their own meaning from new information, as they interact with reality and with other learners who bring different perspectives. Constructivist learning environments require students to use their prior knowledge and experiences to formulate new, related, and/or adaptive concepts in learning (Termos, 2012). Under this framework the role of the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge. Constructivist educators must make sure that the prior learning experiences are appropriate and related to the concepts being taught. Jonassen (1997) suggests "well-structured" learning environments are useful for novice learners and that "ill-structured" environments are only useful for more advanced learners. Educators utilizing a constructivist perspective may emphasize an active learning environment that may incorporate learner centered problem based learning, project-based learning, and inquiry-based learning, ideally involving real-world scenarios, in which students are actively engaged in critical thinking activities. An illustrative discussion and example can be found in the 1980s deployment of constructivist cognitive learning in computer literacy, which involved programming as an instrument of learning. LOGO, a programming language, embodied an attempt to integrate Piagetan ideas with computers and technology. Initially there were broad, hopeful claims, including "perhaps the most controversial claim" that it would "improve general problem-solving skills" across disciplines. However, LOGO programming skills did not consistently yield cognitive benefits. It was "not as concrete" as advocates claimed, it privileged "one form of reasoning over all others," and it was difficult to apply the thinking activity to non-LOGO based activities. By the late 1980s, LOGO and other similar programming languages had lost their novelty and dominance and were gradually de-emphasized amid criticisms.
Practice

The extent to which e-learning assists or replaces other learning and teaching approaches is variable, ranging on a continuum from none to fully online distance learning. A variety of descriptive terms have been employed (somewhat inconsistently) to categorize the extent to which technology is used. For example, 'hybrid learning' or 'blended learning' may refer to classroom aids and laptops, or may refer to approaches in which traditional classroom time is reduced but not eliminated, and is replaced with some online learning. 'Distributed learning' may describe either the e-learning component of a hybrid approach, or fully online distance learning environments.

Synchronous and asynchronous

E-learning may either be synchronous or asynchronous. Synchronous learning occurs in real-time, with all participants interacting at the same time, while asynchronous learning is self-paced and allows participants to engage in the exchange of ideas or information without the dependency of other participants’ involvement at the same time.

**Synchronous learning** refers to the exchange of ideas and information with one or more participants during the same period. Examples are face-to-face discussion, online real-time live teacher instruction and feedback, Skype conversations, and chat rooms or virtual classrooms where everyone is online and working collaboratively at the same time. Since students are working collaboratively, synchronized learning helps students create an open mind because they have to listen and learn from their peers. Synchronized learning fosters online awareness and improves many students' writing skills.

**Asynchronous learning** may use technologies such as email, blogs, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents, audio video courses, and social networking using web 2.0. At the professional educational level, training may include virtual operating rooms. Asynchronous learning is beneficial for students who have health problems or who have child care responsibilities. They have the opportunity to complete their work in a low stress environment and within a more flexible time frame. In asynchronous online courses, students proceed at their own pace. If they need to listen to a lecture a second time, or
think about a question for a while, they may do so without fearing that they will hold back the rest of the class. Through online courses, students can earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students have access to an incredible variety of enrichment courses in online learning, and can participate in college courses, internships, sports, or work and still graduate with their class.

On the other hand, the technological convergence of the mass media is the result of a long adaptation process of their communicative resources to the evolutionary changes of each historical moment. Thus, the new media became (plurally) an extension of the traditional media on the cyberspace, allowing to the public access information in a wide range of digital devices. In other words, it is a cultural virtualization of human reality as a result of the migration from physical to virtual space (mediated by the ICTs), ruled by codes, signs and particular social relationships, inside and outside classroom. Forwards, arise instant ways of synchronous and asynchronous communication, interaction and possible quick access to information, in which we are no longer mere senders, but also producers, reproducers, co-workers and providers. New technologies also help to “connect” people from different cultures outside the virtual space, what was unthinkable fifty years ago. In this giant relationships web, we mutually absorb each other’s beliefs, customs, education, values, laws and habits, cultural legacies perpetuated by a physical-virtual dynamics in constant metamorphosis (ibidem).

Linear learning

Computer-based training (CBT) refers to self-paced learning activities delivered on a computer or handheld device such as a tablet or smartphone. CBT initially delivered content via CD-ROM, and typically presented content linearly, much like reading an online book or manual. For this reason, CBT is often used to teach static processes, such as using software or completing mathematical equations. Computer-based training is conceptually similar to web-based training (WBT) which are delivered via Internet using a web browser.

Assessing learning in a CBT is often by assessments that can be easily scored by a computer such as multiple choice questions, drag-and-drop, radio button, simulation or other interactive means. Assessments are easily scored and recorded via online software, providing
immediate end-user feedback and completion status. Users are often able to print completion records in the form of certificates.

CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can be embedded to enhance the learning.

However, CBTs pose some learning challenges. Typically, the creation of effective CBTs requires enormous resources. The software for developing CBTs (such as Flash or Adobe Director) is often more complex than a subject matter expert or teacher is able to use. The lack of human interaction can limit both the type of content that can be presented and the type of assessment that can be performed, and may need supplementation with online discussion or other interactive elements.

**Collaborative learning**

Computer-supported collaborative learning (CSCL) uses instructional methods designed to encourage or require students to work together on learning tasks, allowing social learning. CSCL is similar in concept to the terminology, "e-learning 2.0" and "networked collaborative learning" (NCL). With Web 2.0 advances, sharing information between multiple people in a network has become much easier and use has increased. One of the main reasons for its usage states that it is "a breeding ground for creative and engaging educational endeavors." Learning takes place through conversations about content and grounded interaction about problems and actions. This collaborative learning differs from instruction in which the instructor is the principal source of knowledge and skills. The neologism "e-learning 1.0" refers to direct instruction used in early computer-based learning and training systems (CBL). In contrast to that linear delivery of content, often directly from the instructor's material, CSCL uses social software such as blogs, social media, wikis, podcasts, cloud-based document portals (such as Google Docs and Dropbox), and discussion groups and virtual worlds such as Second Life. This phenomenon has been referred to as Long Tail Learning. Advocates of social learning claim that one of the best ways to learn something is to teach it to others. Social networks have been used to
foster online learning communities around subjects as diverse as test preparation and language education. Mobile-assisted language learning (MALL) is the use of handheld computers or cell phones to assist in language learning.

Collaborative apps allow students and teachers to interact while studying. An example is MathChat, which allows cooperative problem solving and answer feedback. Some apps can also provide an opportunity to revise or learn new topics independently in a simulated classroom environment. A popular example is Khan Academy, which offers material in math, biology, chemistry, economics, art history and many others. It has the advantage of blending learning styles as the app offers many videos for visual and auditory learners, as well as exercises and tasks to solve for the kinesthetic learners. Other apps are designed after games, which provide a fun way to revise. When the experience is enjoyable the students become more engaged. Games also usually come with a sense of progression, which can help keep students motivated and consistent while trying to improve. Examples of educational games are Dragon Box, Mind Snacks, Code Spells and many more.

Classroom 2.0 refers to online multi-user virtual environments (MUVEs) that connect schools across geographical frontiers. Known as "eTwinning", computer-supported collaborative learning (CSCL) allows learners in one school to communicate with learners in another that they would not get to know otherwise, enhancing educational outcomes and cultural integration. Examples of classroom 2.0 applications are Blogger and Skype.

### 3.4 TOOLS FOR LEARNING AND DEVELOPMENT

Educational media and tools can be used for:

- task structuring support: help with how to do a task (procedures and processes),
- access to knowledge bases (help user find information needed)
- alternate forms of knowledge representation (multiple representations of knowledge, e.g. video, audio, text, image, data)

Numerous types of physical technology are currently used: digital cameras, video cameras, interactive whiteboard tools, document cameras, electronic media, and LCD projectors.
Combinations of these techniques include blogs, collaborative software, ePortfolios, and virtual classrooms.

**Audio and video**

Radio offers a synchronous educational vehicle, while streaming audio over the internet with webcasts and podcasts can be asynchronous. Classroom microphones, often wireless, can enable learners and educators to interact more clearly.

Video technology has included VHS tapes and DVDs, as well as on-demand and synchronous methods with digital video via server or web-based options such as streamed video from YouTube, Teacher Tube, Skype, Adobe Connect, and webcams. Telecommuting can connect with speakers and other experts. Interactive digital video games are being used at K-12 and higher education institutions.

**Computers, tablets and mobile devices**

Collaborative learning is a group-based learning approach in which learners are mutually engaged in a coordinated fashion to achieve a learning goal or complete a learning task. With recent developments in smart phone technology, the processing powers and storage capabilities of modern mobiles allow for advanced development and use of apps. Many app developers and education experts have been exploring smart phone and tablet apps as a medium for collaborative learning.

Computers and tablets enable learners and educators to access websites as well as programs such as Microsoft Word, PowerPoint, PDF files, and images. Many mobile devices support m-learning.

Mobile devices such as clickers and smart phones can be used for interactive audience response feedback. Mobile learning can provide performance support for checking the time, setting reminders, retrieving worksheets, and instruction manuals.
Open Course Ware (OCW) gives free public access to information used in undergraduate and graduate programs. Participating institutions are MIT and Harvard, Princeton, Stanford, University of Pennsylvania, and University of Michigan.

Google Classroom allows instructors to create, administer, and grade assignments. While Google Classroom ultimately strives to create a paperless learning environment, there are many different types of learner; a learning environment like the one that Google Classroom projects does not work for everyone.

Social networks

Group web pages, blogs, wikis, and Twitter allow learners and educators to post thoughts, ideas, and comments on a website in an interactive learning environment. Social networking sites are virtual communities for people interested in a particular subject to communicate by voice, chat, instant message, video conference, or blogs. The National School Boards Association found that 96% of students with online access have used social networking technologies, and more than 50% talk online about schoolwork. Social networking encourages collaboration and engagement and can be a motivational tool for self-efficacy amongst students. Every student has his or her own learning requirements, and a Web 2.0 educational framework provides enough resources, learning styles, communication tools and flexibility to accommodate this diversity.

Webcams

Webcams and webcasting have enabled creation of virtual classrooms and virtual learning environment. Webcams are also being used to counter plagiarism and other forms of academic dishonesty that might occur in an e-learning environment.

Whiteboards

There are three types of whiteboards. The initial whiteboards, analogous to blackboards, date from the late 1950s. The term whiteboard is also used metaphorically to refer to virtual whiteboards in which computer software applications simulate whiteboards by allowing writing
or drawing. This is a common feature of groupware for virtual meeting, collaboration, and instant messaging. Interactive whiteboards allow learners and instructors to write on the touch screen. The screen markup can be on either a blank whiteboard or any computer screen content. Depending on permission settings, this visual learning can be interactive and participatory, including writing and manipulating images on the interactive whiteboard.

**Screen casting**

Screen casting allows users to share their screens directly from their browser and make the video available online so that other viewers can stream the video directly. The presenter thus has the ability to show their ideas and flow of thoughts rather than simply explain them as simple text content. In combination with audio and video, the educator can mimic the one-on-one experience of the classroom. Learners have an ability to pause and rewind, to review at their own pace, something a classroom cannot always offer.

**Virtual classroom**

A virtual learning environment (VLE), also known as a learning platform, simulates a virtual classroom or meetings by simultaneously mixing several communication technologies. For example, web conferencing software such as GoToTraining, WebEx Training or Adobe Connect enables students and instructors to communicate with each other via webcam, microphone, and real-time chatting in a group setting. Participants can raise hands, answer polls or take tests. Students are able to whiteboard and screen cast when given rights by the instructor, who sets permission levels for text notes, microphone rights and mouse control.

A virtual classroom provides the opportunity for students to receive direct instruction from a qualified teacher in an interactive environment. Learners can have direct and immediate access to their instructor for instant feedback and direction. The virtual classroom provides a structured schedule of classes, which can be helpful for students who may find the freedom of asynchronous learning to be overwhelming. In addition, the virtual classroom provides a social learning environment that replicates the traditional "brick and mortar" classroom. Most virtual
classroom applications provide a recording feature. Each class is recorded and stored on a server, which allows for instant playback of any class over the course of the school year. This can be extremely useful for students to retrieve missed material or review concepts for an upcoming exam. Parents and auditors have the conceptual ability to monitor any classroom to ensure that they are satisfied with the education the learner is receiving.

In higher education especially, a virtual learning environment (VLE) is sometimes combined with a management information system (MIS) to create a managed learning environment, in which all aspects of a course are handled through a consistent user interface throughout the institution. Physical universities and newer online-only colleges offer select academic degrees and certificate programs via the Internet. Some programs require students to attend some campus classes or orientations, but many are delivered completely online. Several universities offer online student support services, such as online advising and registration, e-counseling, online textbook purchases, student governments and student newspapers.

Augmented reality (AR) provides students and teachers the opportunity to create layers of digital information, that includes both virtual world and real world elements, to interact with in real time. There are already a variety of apps which offer a lot of variations and possibilities.

E-learning authoring tools

E-learning authoring tools are software or online services that enable users to create courses, simulations, or other educational experiences. These tools typically support conventional, presentation-like courses, and may enable screen recording, multimedia, interactivity, quizzes, and non-linear or adaptive approaches. An example of an e-learning authoring tools is Adobe Captivate.

Typing software

Typing software allows users to practice their typing skills. Some of these programs include Typing Instructor, Typing Master, and Mavis Beacon Keyboarding Kids.

3.5 LEARNING MANAGEMENT SYSTEM
A learning management system (LMS) is software used for delivering, tracking and managing training and education. For example, an LMS tracks attendance, time on task, and student progress. Educators can post announcements, grade assignments, check on course activity, and participate in class discussions. Students can submit their work, read and respond to discussion questions, and take quizzes. An LMS may allow teachers, administrators, students, and permitted additional parties (such as parents if appropriate) to track various metrics. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration. The creation and maintenance of comprehensive learning content requires substantial initial and ongoing investments of human labor. Effective translation into other languages and cultural contexts requires even more investment by knowledgeable personnel.

Internet-based learning management systems include Canvas, Blackboard Inc., and Moodle. These types of LMS allow educators to run a learning system partially or fully online, asynchronously or synchronously. Blackboard can be used for K-12 education, Higher Education, Business, and Government collaboration. Moodle is a free-to-download Open Source Course Management System that provides blended learning opportunities as well as platforms for distance learning courses. Eliademy is a free cloud based Course Management System that provides blended learning opportunities as well as platforms for distance learning courses.

Learning content management system

A learning content management system (LCMS) is software for author content (courses, reusable content objects). An LCMS may be solely dedicated to producing and publishing content that is hosted on an LMS, or it can host the content itself. The Aviation Industry Computer-Based Training Committee (AICC) specification provides support for content that is hosted separately from the LMS.

A recent trend in LCMSs is to address this issue through crowdsourcing.

Computer-aided assessment
Computer-aided assessment (e-assessment) ranges from automated multiple-choice tests to more sophisticated systems. With some systems, feedback can be geared towards a student's specific mistakes or the computer can navigate the student through a series of questions adapting to what the student appears to have learned or not learned. Formative assessment sifts out the incorrect answers, and these questions are then explained by the teacher. The learner then practices with slight variations of the sifted out questions. The process is completed by summative assessment using a new set of questions that only cover the topics previously taught.

Electronic performance support system

An electronic performance support system (EPSS) is, according to Barry Raybould, "a computer-based system that improves worker productivity by providing on-the-job access to integrated information, advice, and learning experiences". Gloria Gery defines it as "an integrated electronic environment that is available to and easily accessible by each employee and is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others."

3.6 LEARNING OBJECTS

- Fact – unique data (e.g. symbols for Excel formula, or the parts that make up a learning objective)
- Concept – a category that includes multiple examples (e.g. Excel formulas, or the various types/theories of instructional design)
- Process – a flow of events or activities (e.g. how a spreadsheet works, or the five phases in ADDIE)
- Procedure – step-by-step task (e.g. entering a formula into a spreadsheet, or the steps that should be followed within a phase in ADDIE)
- Strategic principle – task performed by adapting guidelines (e.g. doing a financial projection in a spreadsheet, or using a framework for designing learning environments)
Pedagogical elements

Pedagogical elements are defined as structures or units of educational material. They are the educational content that is to be delivered. These units are independent of format, meaning that although the unit may be delivered in various ways, the pedagogical structures themselves are not the textbook, web page, video conference, Podcast, lesson, assignment, multiple choice question, quiz, discussion group or a case study, all of which are possible methods of delivery.

Learning objects standards

Much effort has been put into the technical reuse of electronically based teaching materials and in particular creating or re-using learning objects. These are self-contained units that are properly tagged with keywords, or other metadata, and often stored in an XML file format. Creating a course requires putting together a sequence of learning objects. There are both proprietary and open, non-commercial and commercial, peer-reviewed repositories of learning objects such as the Merlot repository. Sharable Content Object Reference Model (SCORM) is a collection of standards and specifications that applies to certain web-based e-learning. Other specifications such as Schools Framework allow for the transporting of learning objects, or for categorizing metadata (LOM).

Higher education

Online college course enrollment has seen a 29% increase in enrollment with nearly one third of all college students, or an estimated 6.7 million students are currently enrolled in online classes. In 2009, 44 percent of post-secondary students in the USA were taking some or all of their courses online, which was projected to rise to 81 percent by 2014.

Although a large proportion of for-profit higher education institutions now offer online classes, only about half of private, non-profit schools do so. Private institutions may become more involved with on-line presentations as the costs decrease. Properly trained staff must also be hired to work with students online. These staff members need to understand the content area, and also be highly trained in the use of the computer and Internet. Online education is rapidly increasing, and online doctoral programs have even developed at leading research universities.
Although massive open online courses (MOOCs) may have limitations that preclude them from fully replacing college education, such programs have significantly expanded. MIT, Stanford and Princeton University offer classes to a global audience, but not for college credit. University-level programs, like edX founded by Massachusetts Institute of Technology and Harvard University, offer wide range of disciplines at no charge, while others permit students to audit a course at no charge but require a small fee for accreditation. MOOCs have not had a significant impact on higher education and declined after the initial expansion, but are expected to remain in some form.

Private organizations also offer classes, such as Udacity, with free computer science classes, and Khan Academy, with over 3,900 free micro-lectures available via YouTube. Distributed open collaborative course (DOCC) sees itself as a counter-movement to MOOC, emphasizing decentralized teaching. University of the People is a non-profit accredited online university. Coursera offers online courses. According to Fortune magazine, over a million people worldwide have enrolled in free online courses.

Corporate and professional

Companies with spread out distribution chains use e-learning for staff training and development and to bring customers information about the latest product developments. Continuing professional development (CPD) can deliver regulatory compliance updates and staff development of valuable workplace skills. For effectiveness and competitive learning performance, scoring systems are designed to give live feedback on decision-making in complex (mobile) learning scenarios.

Public health

There is an important need for recent, reliable, and high-quality health information to be made available to the public as well as in summarized form for public health providers. Providers have indicated the need for automatic notification of the latest research, a single searchable portal of information, and access to grey literature. The Maternal and Child Health (MCH)
Library is funded by the U.S. Maternal and Child Health Bureau to screen the latest research and develop automatic notifications to providers through the MCH Alert. Another application in public health is the development of m Health (use of mobile telecommunication and multimedia into global public health). M Health has been used to promote prenatal and newborn services, with positive outcomes. In addition, "Health systems have implemented m Health programs to facilitate emergency medical responses, point-of-care support, health promotion and data collection." In low and middle income countries, m Health is most frequently used as one-way text messages or phone reminders to promote treatment adherence and gather data.

Disabilities

The design of e-learning platforms in ways that enable universal access has received attention from several directions, including the World Wide Web Consortium's Web Accessibility Initiative (WAI). WAI provides universal formatting standards for websites so they can remain accessible to people with disabilities. For example, developing or adopting e-learning material can enable accessibility for people with visual impairment. The Perkins School for the Blind offers learning resources tailored for the visually impaired, including webcasts, webinars, downloadable science activities, and an online library that has access to over 40,000 resource materials on blindness and deaf blindness.

Online education may appear to be a promising alternative for students with physical and sensory disabilities because they get to work at their own pace and in their own home. However, not all online programs are equal when it comes to their resources for students with disabilities. Students with disabilities who wish to enroll in online education must either be able to advocate for themselves and their own rights or have a person whom is willing to advocate for them. The American with Disabilities Act states that online programs must provide appropriate accommodations for students with disabilities, but has not specifically defined what that means. "Once students with disabilities are accepted into an online program, they should prepare to be direct and open about what they need to succeed, experts say" (Haynie).

Identity options
Educational technology, particularly in online learning environments, can allow students to use real identity, pseudonym, or anonymous identity during classroom communication. Advantages in anonymizing race, age, and gender are increased student participation and increased cross-cultural communication. Risks include increased cyber bullying, and aggressive or hostile language.

3.7 LEARNING AND DEVELOPMENT

Human resource management regards training and development as a function concerned with organizational activity aimed at bettering the job performance of individuals and groups in organizational settings. Training and development can be described as "an educational process which involves the sharpening of skills, concepts, changing of attitude and gaining more knowledge to enhance the performance of employees". The field has gone by several names, including "Human Resource Development", "Human Resource Development and Training and Development in 2000 arguing that "human resource development" is too evocative of the master-slave relationship between employer and employee for those who refer to their employees as "partners" or "associates" to feel comfortable with. Eventually, the CIPD settled upon "learning and development", although that was itself not free from problems, "learning" being an over-general and ambiguous name, and most organizations referring to it as "training and development".

Practice

Training and development encompasses three main activities: training, education, and development.

- Training: This activity is both focused upon, and evaluated against, the job that an individual currently holds.
- Education: This activity focuses upon the jobs that an individual may potentially hold in the future, and is evaluated against those jobs.
• Development: This activity focuses upon the activities that the organization employing the individual, or that the individual is part of, may partake in the future, and is almost impossible to evaluate.

The "stakeholders" in training and development are categorized into several classes. The sponsors of training and development are senior managers. The clients of training and development are business planners. Line managers are responsible for coaching, resources, and performance. The participants are those who actually undergo the processes. The facilitators are Human Resource Management staff. And the providers are specialists in the field. Each of these groups has its own agenda and motivations, which sometimes conflict with the agendas and motivations of the others.

The conflicts that are the best part of career consequences are those that take place between employees and their bosses. The number one reason people leave their jobs is conflict with their bosses. And yet, as author, workplace relationship authority, and executive coach, Dr. John Hoover points out, "Tempting as it is, nobody ever enhanced his or her career by making the boss look stupid." Training an employee to get along well with authority and with people who entertain diverse points of view is one of the best guarantees of long-term success. Talent, knowledge, and skill alone won't compensate for a sour relationship with a superior, peer, or customer.

Typical roles in the field include executive and supervisory/management development, new-employee orientation, professional-skills training, technical/job training, customer-service training, sales-and-marketing training, and health-and-safety training. Job titles may include vice-president of organizational effectiveness, training manager or director, management development specialist, blended-learning designer, training-needs analyst, chief learning officer, and individual career-development advisor.

Talent development is the process of changing an organization, its employees, its stakeholders, and groups of people within it, using planned and unplanned learning, in order to achieve and maintain a competitive advantage for the organization. Rothwell notes that the name may well be a term in search of a meaning, like so much in management, and suggests that it be
thought of as selective attention paid to the top 10% of employees, either by potential or performance.

While talent development is reserved for the top management it is becoming increasingly clear that career development is necessary for the retention of any employee, no matter what their level in the company. Research has shown that some type of career path is necessary for job satisfaction and hence job retention. Perhaps organizations need to include this area in their overview of employee satisfaction.

The term talent development is becoming increasingly popular in several organizations, as companies are now moving from the traditional term training and development. Talent development encompasses a variety of components such as training, career development, career management, and organizational development, and training and development. It is expected that during the 21st century more companies will begin to use more integrated terms such as talent development.

3.8 BENEFITS OF LEARNING AND DEVELOPMENT

Effective technology use deploys multiple evidence-based strategies concurrently (e.g. adaptive content, frequent testing, immediate feedback, etc.), as do effective teachers. Using computers or other forms of technology can give students practice on core content and skills while the teacher can work with others, conduct assessments, or perform other tasks. Through the use of educational technology, education is able to be individualized for each student allowing for better differentiation and allowing students to work for mastery at their own pace.

Modern educational technology can improve access to education, including full degree programs. It enables better integration for non-full-time students, particularly in continuing education, and improved interactions between students and instructors. Learning material can be used for long distance learning and are accessible to a wider audience. Course materials are easy to access. In 2010, 70.3% of American family households had access to the internet. In 2013, according to Canadian Radio Television and Telecommunications Commission Canada, 79% of homes have access to the internet. Students can access and engage with numerous online resources at home. Using online resources such as Khan Academy or TED Talks can help
Students spend more time on specific aspects of what they may be learning in school, but at home. Schools like MIT have made certain course materials free online. Although some aspects of a classroom setting are missed by using these resources, they are helpful tools to add additional support to the educational system. The necessity to pay for transport to the educational facility is removed.

Students appreciate the convenience of e-learning, but report greater engagement in face-to-face learning environments.

According to James Kulik, who studies the effectiveness of computers used for instruction, students usually learn more in less time when receiving computer-based instruction and they like classes more and develop more positive attitudes toward computers in computer-based classes. Students can independently solve problems. There are no intrinsic age-based restrictions on difficulty level, i.e. students can go at their own pace. Students editing their written work on word processors improve the quality of their writing. According to some studies, the students are better at critiquing and editing written work that is exchanged over a computer network with students they know. Studies completed in "computer intensive" settings found increases in student-centric, cooperative and higher order learning, writing skills, problem solving, and using technology. In addition, attitudes toward technology as a learning tool by parents, students and teachers are also improved.

Employers' acceptance of online education has risen over time. More than 50% of human resource managers SHRM surveyed for an August 2010 report said that if two candidates with the same level of experience were applying for a job, it would not have any kind of effect whether the candidate’s obtained degree was acquired through an online or a traditional school. Seventy-nine percent said they had employed a candidate with an online degree in the past 12 months. However 66% said candidates who get degrees online were not seen as positively as a job applicant with traditional degrees.

The use of educational apps generally has positive effect on learning. Pre- and post-tests reveal that the use of apps on mobile devices reduces the achievement gap between struggling and average students. Some educational apps improve group work by allowing students to
receive feedback on answers and promoting collaboration in solving problems, examples of these apps can be found in the third paragraph. The benefits of app-assisted learning have been exhibited in all age groups. Kindergarten students that use I Pads show much higher rates of literacy than non-users. Medical students at University of California Irvine that utilized I Pad academically have been reported to score 23% higher on national exams than previous classes that did not. Mobile devices and apps have also been shown to assist in the education of disabled students, with one study reporting increased engagement and accelerated comprehension and learning.

**Disadvantages**

Many US states spend large sums of money on technology. However, as of 2013, none were looking at technology return on investment (ROI) to connect expenditures on technology with improved student outcomes.

New technologies are frequently accompanied by unrealistic hype and promise regarding their transformative power to change education for the better or in allowing better educational opportunities to reach the masses. Examples include silent film, broadcast radio, and television, none of which have maintained much of a foothold in the daily practices of mainstream, formal education. Technology, in and of itself, does not necessarily result in fundamental improvements to educational practice. The focus needs to be on the learner's interaction with technology—not the technology itself. It needs to be recognized as "ecological" rather than "additive" or "subtractive". In this ecological change, one significant change will create total change.

According to Branford et al., "technology does not guarantee effective learning" and inappropriate use of technology can even hinder it. A University of Washington study of infant vocabulary shows that it is slipping due to educational baby DVDs. Published in the Journal of Pediatrics, a 2007 University of Washington study on the vocabulary of babies surveyed over 1,000 parents in Washington and Minnesota. The study found that for every one hour that babies
8–16 months of age watched DVDs and Videos they knew 6-8 fewer of 90 common baby words than the babies that did not watch them. Andrew Meltzoff, a surveyor in this study states that the result makes sense, that if the baby's 'alert time' is spent in front of DVDs and TV, instead of with people speaking, the babies are not going to get the same linguistic experience. Dr. Dimitri Chistakis, another surveyor reported that the evidence is mounting that baby DVDs are of no value and may be harmful.

Adaptive instructional materials tailor questions to each student's ability and calculate their scores, but this encourages students to work individually rather than socially or collaboratively (Kruse, 2013). Social relationships are important but high-tech environments may compromise the balance of trust, care and respect between teacher and student.

Massively open online courses (MOOCs), although quite popular in discussions of technology and education in developed countries (more so in US), are not a major concern in most developing or low-income countries. One of the stated goals of MOOCs is to provide less fortunate populations (i.e., in developing countries) an opportunity to experience courses with US-style content and structure. However, research shows only 3% of the registrants are from low-income countries and although many courses have thousands of registered students only 5-10% of them complete the course. MOOCs also implies that certain curriculum and teaching methods are superior and this could eventually wash over (or possibly washing out) local educational institutions, cultural norms and educational traditions.

With the Internet and social media, using educational apps makes the students highly susceptible to distraction and sidetracking. Even though proper use has shown to increase student performances, being distracted would be detrimental. Another disadvantage is increased potential for cheating. Smart phones can be very easy to hide and use inconspicuously, especially if their use is normalized in the classroom. These disadvantages can be managed with strict rules and regulations on mobile phone use.

**Over-stimulation**

Electronic devices such as cell phones and computers facilitate rapid access to a stream of sources, each of which may receive cursory attention. Michel Rich, an associate professor at
Harvard Medical School and executive director of the center on Media and Child Health in Boston, said of the digital generation, "Their brains are rewarded not for staying on task, but for jumping to the next thing. The worry is we're raising a generation of kids in front of screens whose brains are going to be wired differently." Students have always faced distractions; computers and cell phones are a particular challenge because the stream of data can interfere with focusing and learning. Although these technologies affect adults too, young people may be more influenced by it as their developing brains can easily become habituated to switching tasks and become unaccustomed to sustaining attention. Too much information, coming too rapidly, can overwhelm thinking.

Technology is "rapidly and profoundly altering our brains." High exposure levels stimulate brain cell alteration and release neurotransmitters, which causes the strengthening of some neural pathways and weakening of others. This leads to heightened stress levels on the brain that, at first, boost energy levels, but, over time, actually augment memory, impair cognition, lead to depression, alter the neural circuitry of the hippocampus, amygdala and prefrontal cortex. These are the brain regions that control mood and thought. If unchecked, the underlying structure of the brain could be altered. Over-stimulation due to technology may begin too young. When children are exposed before the age of seven, important developmental tasks may be delayed, and bad learning habits might develop, which "deprives children of the exploration and play that they need to develop."

**Socio cultural criticism**

According to Lai, "the learning environment is a complex system where the interplay and interactions of many things impact the outcome of learning." When technology is brought into an educational setting, the pedagogical setting changes in that technology-driven teaching can change the entire meaning of an activity without adequate research validation. If technology monopolizes an activity, students can begin to develop the sense that "life would scarcely be thinkable without technology."

Leo Marx considered the word "technology" itself as problematic, susceptible to reification and "phantom objectivity", which conceals its fundamental nature as something that is
only valuable insofar as it benefits the human condition. Technology ultimately comes down to affecting the relations between people, but this notion is obfuscated when technology is treated as an abstract notion devoid of good and evil. Langdon Winner makes a similar point by arguing that the underdevelopment of the philosophy of technology leaves us with an overly simplistic reduction in our discourse to the supposedly dichotomous notions of the "making" versus the "uses" of new technologies, and that a narrow focus on "use" leads us to believe that all technologies are neutral in moral standing. These critiques would have us ask not, "How do we maximize the role or advancement of technology in education?", but, rather, "What are the social and human consequences of adopting any particular technology?"

Winner viewed technology as a "form of life" that not only aids human activity, but that also represents a powerful force in reshaping that activity and its meaning. For example, the use of robots in the industrial workplace may increase productivity, but they also radically change the process of production itself, thereby redefining what is meant by "work" in such a setting. In education, standardized testing has arguably redefined the notions of learning and assessment. We rarely explicitly reflect on how strange a notion it is that a number between, say, 0 and 100 could accurately reflect a person’s knowledge about the world. According to Winner, the recurring patterns in everyday life tend to become an unconscious process that we learn to take for granted. Winner writes,

By far the greatest latitude of choice exists the very first time a particular instrument, system, or technique is introduced. Because choices tend to become strongly fixed in material equipment, economic investment, and social habit, the original flexibility vanishes for all practical purposes once the initial commitments are made. In that sense technological innovations are similar to legislative acts or political foundings that establish a framework for public order that will endure over many generations.

**Digital divide**

The concept of the digital divide is a gap between those who have access to digital technologies and those who do not. Access may be associated with age, gender, socio-economic status, education, income, ethnicity, and geography.
Teacher training

Since technology is not the end goal of education, but rather a means by which it can be accomplished, educators must have a good grasp of the technology and its advantages and disadvantages. Teacher training aims for effective integration of classroom technology.

The evolving nature of technology may unsettle teachers, who may experience themselves as perpetual novices. Finding quality materials to support classroom objectives is often difficult. Random professional development days are inadequate.

3.9 DEVELOPMENT GOALS

Since 1909, the ratio of children in the developing world attending school has increased. Before then, a small minority of boys attended school. By the start of the 21st century, the majority of all children in most regions of the world attended school.

Universal Primary Education is one of the eight international Millennium Development Goals, towards which progress has been made in the past decade, though barriers still remain. Securing charitable funding from prospective donors is one particularly persistent problem. Researchers at the Overseas Development Institute have indicated that the main obstacles to funding for education include conflicting donor priorities, an immature aid architecture, and a lack of evidence and advocacy for the issue. Additionally, Transparency International has identified corruption in the education sector as a major stumbling block to achieving Universal Primary Education in Africa. Furthermore, demand in the developing world for improved educational access is not as high as foreigners have expected. Indigenous governments are reluctant to take on the ongoing costs involved. There is also economic pressure from some parents, who prefer their children to earn money in the short term rather than work towards the long-term benefits of education.

A study conducted by the UNESCO International Institute for Educational Planning indicates that stronger capacities in educational planning and management may have an important spill-over effect on the system as a whole. Sustainable capacity development requires complex
interventions at the institutional, organizational and individual levels that could be based on some foundational principles:

- national leadership and ownership should be the touchstone of any intervention;
- strategies must be context relevant and context specific;
- plans should employ an integrated set of complementary interventions, though implementation may need to proceed in steps;
- partners should commit to a long-term investment in capacity development, while working towards some short-term achievements;
- outside intervention should be conditional on an impact assessment of national capacities at various levels;
- a certain percentage of students should be removed for improvisation of academics (usually practiced in schools, after 10th grade).

**Internationalization**

Nearly every country now has Universal Primary Education.

Similarities — in systems or even in ideas — that schools share internationally have led to an increase in international student exchanges. The European Socrates-Erasmus Program facilitates exchanges across European universities. The Soros Foundation provides many opportunities for students from central Asia and eastern Europe. Programs such as the International Baccalaureate have contributed to the internationalization of education. The global campus online, led by American universities, allows free access to class materials and lecture files recorded during the actual classes.

**Education and technology in developing countries**

Technology plays an increasingly significant role in improving access to education for people living in impoverished areas and developing countries. Charities like One Laptop per Child are dedicated to providing infrastructures through which the disadvantaged may access educational materials.
The OLPC foundation, a group out of MIT Media Lab and supported by several major corporations, has a stated mission to develop a $100 laptop for delivering educational software. The laptops were widely available as of 2008. They are sold at cost or given away based on donations.

In Africa, the New Partnership for Africa's Development (NEPAD) has launched an "e-school program" to provide all 600,000 primary and high schools with computer equipment, learning materials and internet access within 10 years. An International Development Agency project called nabuur.com, started with the support of former American President Bill Clinton, uses the Internet to allow co-operation by individuals on issues of social development.

India is developing technologies that will bypass land-based telephone and Internet infrastructure to deliver distance learning directly to its students. In 2004, the Indian Space Research Organisation launched EDUSAT, a communications satellite providing access to educational materials that can reach more of the country's population at a greatly reduced cost.

Private vs public funding in developing countries

Research into LCPS (low cost private schools) found that over 5 years to July 2013, debate around LCPSs to achieving Education for All (EFA) objectives was polarized and finding growing coverage in international policy. The polarization was due to disputes around whether the schools are affordable for the poor, reach disadvantaged groups, provide quality education, support or undermine equality, and are financially sustainable. The report examined the main challenges encountered by development organizations which support LCPSs. Surveys suggest these types of schools are expanding across Africa and Asia. This success is attributed to excess demand. These surveys found concern for:

- Equity: This concern is widely found in the literature, suggesting the growth in low-cost private schooling may be exacerbating or perpetuating already existing inequalities in developing countries, between urban and rural populations, lower- and higher-income families, and between girls and boys. The report findings suggest that girls may be underrepresented and that LCPS are reaching low-income families in smaller numbers than higher-income families.
• Quality and educational outcomes: It is difficult to generalize about the quality of private schools. While most achieve better results than government counterparts, even after their social background is taken into account, some studies find the opposite. Quality in terms of levels of teacher absence, teaching activity, and pupil to teacher ratios in some countries are better in LCPSs than in government schools.

• Choice and affordability for the poor: Parents can choose private schools because of perceptions of better-quality teaching and facilities, and an English language instruction preference. Nevertheless, the concept of 'choice' does not apply in all contexts, or to all groups in society, partly because of limited affordability (which excludes most of the poorest) and other forms of exclusion, related to caste or social status.

• Cost-effectiveness and financial sustainability: There is evidence that private schools operate at low cost by keeping teacher salaries low, and their financial situation may be precarious where they are reliant on fees from low-income households.

The report showed some cases of successful voucher and subsidy programmes; evaluations of international support to the sector are not widespread. Addressing regulatory ineffectiveness is a key challenge. Emerging approaches stress the importance of understanding the political economy of the market for LCPS, specifically how relationships of power and accountability between users, government, and private providers can produce better education outcomes for the poor.

Educational theory

Purpose of schools

Individual purposes for pursuing education can vary. Understanding the goals and means of educational socialization processes may also differ according to the sociological paradigm used.

The early years of schooling generally focus around developing basic interpersonal communication and literacy skills. This lays a foundation for more complex skills and subjects. Later, education usually turns toward gaining the knowledge and skills needed to create value and establish a livelihood.
People also pursue education for its own sake to satisfy innate curiosity, out of interest in a specific subject or skill, or for overall personal development.

Education is often understood as a means of overcoming handicaps, achieving greater equality, and acquiring wealth and status for all (Sargent 1994). Education is also often perceived as a place where children can develop according to their unique needs and potentials, with the purpose of developing every individual to their full potential.

Some claim that there is education inequality because children did not exceed the education of their parents. This education inequality is then associated with income inequality. Although critical thinking is a goal of education, criticism and blame are often the unintended by-products of our current educational process. Students often blame their teachers and their textbooks, despite the availability of libraries and the internet. When someone tries to improve education, the educational establishment itself occasionally showers the person with criticism rather than gratitude. Better by-products of an educational system would be gratitude and determination.

Developed countries have people with more resources (housing, food, transportation, water and sewage treatment, hospitals, health care, libraries, books, media, schools, the internet, education, etc.) than most of the world’s population. One merely needs to see through travel or the media how many people in the undeveloped countries live to sense this. However, one can also use economic data to gain some insight into this. Yet criticism and blame are common among people in the developed countries.

Gratitude for all these resources and the determination to develop oneself would be more productive than criticism and blame because the resources are readily available and because, if you blame others, there is no need for you to do something different tomorrow or for you to change and improve. Where there is a will, there is a way. People in developed countries have the will and the way to do many things that they want to do. They sometimes need more determination and will to improve and to educate themselves with the resources that are abundantly available. They occasionally need more gratitude for the resources they have,
including their teachers and their textbooks. The entire internet is also available to supplement these teachers and textbooks.

3.10 LEARNING MODALITIES

There has been much interest in learning modalities and styles over the last two decades. The most commonly employed learning modalities are:

- **Visual**: learning based on observation and seeing what is being learned.
- **Auditory**: learning based on listening to instructions/information.
- **Kinesthetic**: learning based on movement, e.g. hands-on work and engaging in activities.

Other commonly employed modalities include **musical**, **interpersonal**, **verbal**, **logical**, and **intrapersonal**.

Dunn and Dunn focused on identifying relevant stimuli that may influence learning and manipulating the school environment, at about the same time as Joseph Renzulli recommended varying teaching strategies. Howard Gardner identified a wide range of modalities in his **Multiple Intelligences** theories. The **Myers-Briggs Type Indicator** and Keirsey Temperament Sorter, based on the works of Jung, focus on understanding how people's personality affects the way they interact personally, and how this affects the way individuals respond to each other within the learning environment. The work of David Kolb and Anthony Gregorc’s Type Delineator follows a similar but more simplified approach.

Some theories propose that all individuals benefit from a variety of learning modalities, while others suggest that individuals may have preferred learning styles, learning more easily through visual or kinesthetic experiences. A consequence of the latter theory is that effective teaching should present a variety of teaching methods which cover all three learning modalities so that different students have equal opportunities to learn in a way that is effective for them. Guy Claxton has questioned the extent that learning styles such as Visual, Auditory and Kinesthetic(VAK) are helpful, particularly as they can have a tendency to label children and therefore restrict learning. Recent research has argued "there is no adequate evidence base to justify incorporating learning styles assessments into general educational practice."
Philosophy

As an academic field, philosophy of education is "the philosophical study of education and its problems (...) its central subject matter is education, and its methods are those of philosophy"."The philosophy of education may be either the philosophy of the process of education or the philosophy of the discipline of education. That is, it may be part of the discipline in the sense of being concerned with the aims, forms, methods, or results of the process of educating or being educated; or it may be meta disciplinary in the sense of being concerned with the concepts, aims, and methods of the discipline." As such, it is both part of the field of education and a field of applied philosophy, drawing from fields of metaphysics, epistemology, axiology and the philosophical approaches (speculative, prescriptive, and/or analytic) to address questions in and about pedagogy, education policy, and curriculum, as well as the process of learning, to name a few. For example, it might study what constitutes upbringing and education, the values and norms revealed through upbringing and educational practices, the limits and legitimization of education as an academic discipline, and the relation between education theory and practice.

Curriculum

In formal education, a curriculum is the set of courses and their content offered at a school or university. As an idea, curriculum stems from the Latin word for race course, referring to the course of deeds and experiences through which children grow to become mature adults. A curriculum is prescriptive, and is based on a more general syllabus which merely specifies what topics must be understood and to what level to achieve a particular grade or standard.

An academic discipline is a branch of knowledge which is formally taught, either at the university—or via some other such method. Each discipline usually has several sub-disciplines or branches, and distinguishing lines are often both arbitrary and ambiguous. Examples of broad areas of academic disciplines include the natural sciences, mathematics, computer science, social sciences, humanities and applied sciences.
Educational institutions may incorporate fine arts as part of K-12 grade curricula or within majors at colleges and universities as electives. The various types of fine arts are music, dance, and theatre.

**Instruction**

Instruction is the facilitation of another's learning. Instructors in primary and secondary institutions are often called teachers, and they direct the education of students and might draw on many subjects like reading, writing, mathematics, science and history. Instructors in post-secondary institutions might be called teachers, instructors, or professors, depending on the type of institution; and they primarily teach only their specific discipline. Studies from the United States suggest that the quality of teachers is the single most important factor affecting student performance, and that countries which score highly on international tests have multiple policies in place to ensure that the teachers they employ are as effective as possible. With the passing of NCLB in the United States (No Child Left Behind), teachers must be highly qualified. A popular way to gauge teaching performance is to use student evaluations of teachers (SETS), but these evaluations have been criticized for being counterproductive to learning and inaccurate due to student bias.

**Economics of education**

It has been argued that high rates of education are essential for countries to be able to achieve high levels of economic growth. Empirical analyses tend to support the theoretical prediction that poor countries should grow faster than rich countries because they can adopt cutting edge technologies already tried and tested by rich countries. However, technology transfer requires knowledgeable managers and engineers who are able to operate new machines or production practices borrowed from the leader in order to close the gap through imitation. Therefore, a country's ability to learn from the leader is a function of its stock of "human capital". Recent study of the determinants of aggregate economic growth have stressed the importance of fundamental economic institutions and the role of cognitive skills.

At the level of the individual, there is a large literature, generally related to the work of Jacob Mincer, on how earnings are related to the schooling and other human capital. This work
has motivated a large number of studies, but is also controversial. The chief controversies revolve around how to interpret the impact of schooling. Some students who have indicated a high potential for learning, by testing with a high intelligence quotient, may not achieve their full academic potential, due to financial difficulties.

Economists Samuel Bowles and Herbert Gintis argued in 1976 that there was a fundamental conflict in American schooling between the egalitarian goal of democratic participation and the inequalities implied by the continued profitability of capitalist production.

Public domain resources

Some of the most valued educational resources available are all the books, music and videos works that belongs to Public Domain and were written or recorded (on audio or video formats, most of them are preserved on internet archive website. These files can be used, copied, edited and played without restrictions by any teacher or institution and used for freely to teach about any writer, music or topic in the way that teachers choose to teach, this resources can also be modified and adapted by every teacher.

3.11 SUMMARY

"E-learning" redirects here. It is not to be confused with Online machine learning.

Educational technology is defined by the Association for Educational Communications and Technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources."

Educational technology refers to the use of both physical hardware and educational theoretics. It encompasses several domains, including learning theory, computer-based training, online learning, and, where mobile technologies are used, m-learning. Accordingly, there are several discrete aspects to describing the intellectual and technical development of educational technology:
• educational technology as the **theory and practice of educational approaches** to learning
• educational technology as **technological tools and media** that assist in the communication of knowledge, and its development and exchange
• educational technology for **learning management systems** (LMS), such as tools for student and curriculum management, and education management information systems (EMIS)
• educational technology itself as an educational subject; such courses may be called "Computer Studies" or "Information and communications technology (ICT)".

Some theories propose that all individuals benefit from a variety of learning modalities, while others suggest that individuals may have preferred learning styles, learning more easily through visual or kinesthetic experiences. A consequence of the latter theory is that effective teaching should present a variety of teaching methods which cover all three learning modalities so that different students have equal opportunities to learn in a way that is effective for them. Guy Claxton has questioned the extent that **learning styles** such as Visual, Auditory and Kinesthetic (VAK) are helpful, particularly as they can have a tendency to label children and therefore restrict learning. Recent research has argued "there is no adequate evidence base to justify incorporating learning styles assessments into general educational practice.

### 3.12 CHECK YOUR PROGRESS

1. What are the benefits of training & development?
2. What are development goals?
3. What is learning management system?
4. What is learning modalities?
5. What are the tools for learning and development?
6. What are the learning objects?

**Check Your Progress**
17. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.17.1. Points for discussion

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Points for clarification
3.13 REFERENCES

UNIT 4: SCREENING, IDENTIFICATION AND ASSESSMENT OF VISUALLY IMPAIRED CHILDREN WITH ASSOCIATED DISABILITIES

4.1 INTRODUCTION

4.2 TYPES OF LEARNING DISABILITIES

4.3 DIAGNOSIS OF LEARNING DISABILITIES

4.4 ASSESSMENT OF LEARNING DISABILITIES

4.5 MANAGEMENT OF LEARNING DISABILITIES

4.6 LEARNING DISABILITIES

4.7 CATEGORIES AND PREVALENCE OF LEARNING DISABILITIES

4.8 EFFECTIVE INSTRUCTION FOR STUDENTS WITH DISABILITIES
4.1 INTRODUCTION

Learning disability is a classification that includes several areas of functioning in which a person has difficulty learning in a typical manner, usually caused by an unknown factor or factors. Given the "difficulty learning in a typical manner", this does not exclude the ability to learn in a different manner. Therefore, some people can be more accurately described as having a "Learning Difference", thus avoiding any misconception of being disabled with a lack of ability to learn and possible negative stereotyping.

While learning disability, learning disorder and learning difficulty are often used interchangeably, they differ in many ways. Disorder refers to significant learning problems in an academic area. These problems, however, are not enough to warrant an official diagnosis. Learning disability on the other hand, is an official clinical diagnosis, whereby the individual meets certain criteria, as determined by a professional (psychologist, pediatrician, etc.). The difference is in degree, frequency, and intensity of reported symptoms and problems, and thus the two should not be confused. When the term "learning disorder" is used, it describes a group of disorders characterized by inadequate development of specific academic, language, and
speech skills. Types of learning disorders include reading (dyslexia), mathematics (dyscalculia) and writing (dysgraphia).

The unknown factor is the disorder that affects the brain's ability to receive and process information. This disorder can make it problematic for a person to learn as quickly or in the same way as someone who is not affected by a learning disability. People with a learning disability have trouble performing specific types of skills or completing tasks if left to figure things out by themselves or if taught in conventional ways.

Individuals with learning disabilities can face unique challenges that are often pervasive throughout the lifespan. Depending on the type and severity of the disability, interventions and current technologies may be used to help the individual learn strategies that will foster future success. Some interventions can be quite simplistic, while others are intricate and complex. Current technologies may require student training to be effective classroom supports. Teachers, parents and schools can create plans together that tailor intervention and accommodations to aid the individuals in successfully becoming independent learners. School psychologists and other qualified professionals quite often help design the intervention and coordinate the execution of the intervention with teachers and parents. Social support may improve the learning for students with learning disabilities.

4.2 TYPES OF LEARNING DISABILITIES

Learning disabilities can be categorized by either the type of information processing affected by the disability or by the specific difficulties caused by a processing deficit.

By stage of information processing

Learning disabilities fall into broad categories based on the four stages of information processing used in learning: input, integration, storage, and output. Many learning disabilities are a compilation of a few types of abnormalities occurring at the same time, as well as with social difficulties and emotional or behavioral disorders.
• **Input:** This is the information perceived through the senses, such as visual and auditory perception. Difficulties with visual perception can cause problems with recognizing the shape, position, or size of items seen. There can be problems with sequencing, which can relate to deficits with processing time intervals or temporal perception. Difficulties with auditory perception can make it difficult to screen out competing sounds in order to focus on one of them, such as the sound of the teacher's voice in a classroom setting. Some children appear to be unable to process tactile input. For example, they may seem insensitive to pain or dislike being touched.

• **Integration:** This is the stage during which perceived input is interpreted, categorized, placed in a sequence, or related to previous learning. Students with problems in these areas may be unable to tell a story in the correct sequence, unable to memorize sequences of information such as the days of the week, able to understand a new concept but be unable to generalize it to other areas of learning, or able to learn facts but be unable to put the facts together to see the "big picture." A poor vocabulary may contribute to problems with comprehension.

• **Storage:** Problems with memory can occur with short-term or working memory, or with long-term memory. Most memory difficulties occur with one's short-term memory, which can make it difficult to learn new material without more repetitions than usual. Difficulties with visual memory can impede learning to spell.

• **Output:** Information comes out of the brain either through words, that is, language output, or through muscle activity, such as gesturing, writing or drawing. Difficulties with language output can create problems with spoken language. Such difficulties include answering a question on demand, in which one must retrieve information from storage, organize our thoughts, and put the thoughts into words before we speak. It can also cause trouble with written language for the same reasons. Difficulties with motor abilities can cause problems with gross and fine motor skills. People with gross motor difficulties may be clumsy, that is, they may be prone to stumbling, falling, or bumping into things. They may also have trouble running, climbing, or learning to ride a bicycle. People with fine motor difficulties may have trouble with handwriting, buttoning shirts, or tying shoelaces.
Deficits in any area of information processing can manifest in a variety of specific learning disabilities. It is possible for an individual to have more than one of these difficulties. This is referred to as comorbidity or co-occurrence of learning disabilities. In the UK, the term dual diagnosis is often used to refer to co-occurrence of learning difficulties.

**Reading disorder**

Reading disorder is the most common learning disability. Of all students with specific learning disabilities, 70–80% have deficits in reading. The term "Developmental Dyslexia" is often used as a synonym for reading disability; however, many researchers assert that there are different types of reading disabilities, of which dyslexia is one. A reading disability can affect any part of the reading process, including difficulty with accurate or fluent word recognition, or both, word decoding, reading rate, prosody (oral reading with expression), and reading comprehension. Before the term "dyslexia" came to prominence, this learning disability used to be known as "word blindness."

Common indicators of reading disability include difficulty with phonemic awareness—the ability to break up words into their component sounds, and difficulty with matching letter combinations to specific sounds (sound-symbol correspondence).

Reading disorders can be helped and there are a lot of ways to help a student suffering with dyslexia. Teachers need to focus on giving students extra time to read silently in class, and to never force them to do it out loud in front of the whole class. This can discourage the student from wanting to read. Silent reading time is good for all students, however, will give the student dealing with dyslexia more time to practice on their own, and if they need help they can always ask their teacher. Another aspect to pay attention to is to create a quiet area of the classroom. Doing so will give the student a space to concentrate and not be bothered by the noise of the other students.

**4.3 DIAGNOSIS OF LEARNING DISABILITIES**

Learning disabilities can be identified by psychiatrists, school psychologists, clinical psychologists, counseling psychologists, neuropsychologists, and other learning disability
specialists through a combination of intelligence testing, academic achievement testing, classroom performance, and social interaction and aptitude. Other areas of assessment may include perception, cognition, memory, attention, and language abilities. The resulting information is used to determine whether a child's academic performance is commensurate with his or her cognitive ability. If a child's cognitive ability is much higher than his or her academic performance, the student is often diagnosed with a learning disability. The DSM-IV and many school systems and government programs diagnose learning disabilities in this way (DSM-IV uses the term "disorder" rather than "disability").

Although the discrepancy model has dominated the school system for many years, there has been substantial criticism of this approach among researchers. Recent research has provided little evidence that a discrepancy between formally measured IQ and achievement is a clear indicator of LD. Furthermore, diagnosing on the basis of a discrepancy does not predict the effectiveness of treatment. Low academic achievers who do not have a discrepancy with IQ (i.e. their IQ scores are also low) appear to benefit from treatment just as much as low academic achievers who do have a discrepancy with IQ (i.e. their IQ scores are higher than their academic performance would suggest).

**Response to Intervention (RTI)**

Much current research has focused on a treatment-oriented diagnostic process known as response to intervention (RTI). Researcher recommendations for implementing such a model include early screening for all students, placing those students who are having difficulty into research-based early intervention programs, rather than waiting until they meet diagnostic criteria. Their performance can be closely monitored to determine whether increasingly intense intervention results in adequate progress. Those who respond will not require further intervention. Those who do not respond adequately to regular classroom instruction (often called "Tier 1 instruction") and a more intensive intervention (often called "Tier 2" intervention) are considered "non responders." These students can then be referred for further assistance through special education, in which case they are often identified with a learning disability. Some models of RTI include a third tier of intervention before a child is identified as having a learning disability.
A primary benefit of such a model is that it would not be necessary to wait for a child to be sufficiently far behind to qualify for assistance. This may enable more children to receive assistance before experiencing significant failure, which may in turn result in fewer children who need intensive and expensive special education services. In the United States, the 2004 reauthorization of the Individuals with Disabilities Education Act permitted states and school districts to use RTI as a method of identifying students with learning disabilities. RTI is now the primary means of identification of learning disabilities in Florida.

The process does not take into account children's individual neuropsychological factors such as phonological awareness and memory, that can inform design instruction. By not taking into account specific cognitive processes, RTI fails to inform educators about a students' relative strengths and weaknesses. Second, RTI by design takes considerably longer than established techniques, often many months to find an appropriate tier of intervention. Third, it requires a strong intervention program before students can be identified with a learning disability. Lastly, RTI is considered a regular education initiative and is not driven by psychologists, reading specialists, or special educators.

4.4 ASSESSMENT OF LEARNING DISABILITIES

Many normed assessments can be used in evaluating skills in the primary academic domains: reading, including word recognition, fluency, and comprehension; mathematics, including computation and problem solving; and written expression, including handwriting, spelling and composition.

The most commonly used comprehensive achievement tests include the Woodcock-Johnson IV (WJ IV), Wechsler Individual Achievement Test II (WIAT II), the Wide Range Achievement Test III (WRAT III), and the Stanford Achievement Test–10th edition. These tests include measures of many academic domains that are reliable in identifying areas of difficulty.

In the reading domain, there are also specialized tests that can be used to obtain details about specific reading deficits. Assessments that measure multiple domains of reading include Gray's Diagnostic Reading Tests–2nd edition (GDRT II) and the Stanford Diagnostic Reading Assessment. Assessments that measure reading sub skills include the Gray Oral Reading Test
IV – Fourth Edition (GORT IV), Gray Silent Reading Test, Comprehensive Test of Phonological Processing (CTOPP), Tests of Oral Reading and Comprehension Skills (TORCS), Test of Reading Comprehension 3 (TORC-3), Test of Word Reading Efficiency (TOWRE), and the Test of Reading Fluency. A more comprehensive list of reading assessments may be obtained from the Southwest Educational Development Laboratory.

The purpose of assessment is to determine what is needed for intervention, which also requires consideration of contextual variables and whether there are comorbid disorders that must also be identified and treated, such as behavioural issues or language delays. These contextual variables are often assessed using parent and teacher questionnaire forms that rate the students’ behaviours and compares them to standardized norms.

However, caution should be made when suspecting the person with a learning disability may also have dementia, especially as people with Down's syndrome may have the neuroanatomical profile but not the associated clinical signs and symptoms. Examination can be carried out of executive functioning as well as social and cognitive abilities but may need adaptation of standardised tests to take account of special needs.

Assessing process for Latino English Language Learners

Demographers in the United State report that there has been a significant increase in immigrant children in the United States over the past two decades (Child Trends, 2014). This information is vital because it has been and will continue to effect both students and how educators approach teaching methods. Various teaching strategies are more successful for students that are linguistic or culturally diverse versus traditional methods of teaching used for students who’s first language is English language. It is then also true that the proper way to diagnose a learning disability in English language learners (ELL) differs. In the United States there has been a growing need to develop the knowledge and skills necessary to provide effective school psychological services, specifically for those professionals who work with immigrant populations (Ruiz, Kabler, & Sugarman, 2011).

Currently there are no standardized guidelines for the process of diagnosing English language learners (ELL) with specific learning disabilities (SLD). This is a problem since many
students will fall through the cracks as educators are be unable to clearly asses if a student’s delay is due to a language barrier or true learning disability. With an unclear diagnosis many students will suffer because they will not be provided with the tools they need to succeed in the public education school system. For example, in many occasions teachers have suggested retention or have taken no action at all when they lack experience working with English language learners. Students were commonly pushed toward testing, based on an assumption that their poor academic performance or behavioral difficulties indicated a need for special education (Klingner, & Harry, 2006). Linguistically responsive psychologist understand that second language acquisition is a process and they understand how to support ELLs’ growth in language and academically (Rodriguez et al., 2014). When ELLs are referred for a psychoeducational assessment, it is difficult to isolate and disentangle what are the effects of the language acquisition process, from poor quality educational services, from what may be academic difficulties that result from processing disorders, attention problems, and learning disabilities (Klingner & Harry, 2006). Additionally not having trained staff and faculty becomes more of an issue when staff is unaware of numerous types of psychological factors that immigrant children in the U.S dealing could be potentially dealing with. These factors that include acculturation, fear and/or worry of deportation, separation from social supports such as parents, language barriers, disruptions in learning experiences, stigmatization, economic challenge, and risk factors associated with poverty (Jones, 2009; Martines, 2008; Rhodes, Ochoa, & Ortiz, 2005). Unfortunately in the United States there are no set policies have been enforced to mandate that all districts employ bilingual school psychologist, nor are schools equipped with specific tools and resources to assist immigrant children and families. Many school districts do not have the proper personnel that are able to communicate with this population.

Assessment process of Spanish Speaking ELL

A well trained bilingual school psychologist will be able to administer, and interpret assessment all psychological testing tool. Also an emphasis is placed on informal assessment measures such as language samples, observations, interviews, and rating scales as well as curriculum-based measurement to complement information gathered from formal assessments (Geva & Wiener, 2015; Ochoa & Ortiz, 2005). A compilation of these test are used to assess whether an ELL student has a learning disability or merely is academically delayed because of
language barriers or environmental factors. It is very unfortunate that many schools do not have school psychologist with the proper training nor access to appropriate tools. Also many school districts frown upon taking the appropriate steps to diagnosing ELL students.

4.5 MANAGEMENT OF LEARNING DISABILITIES

Interventions include:

- **Mastery model:**
  - Learners work at their own level of mastery.
  - Practice
  - Gain fundamental skills before moving onto the next level
    - Note: this approach is most likely to be used with adult learners or outside the mainstream school system.

- **Direct Instruction:**
  - Emphasizes carefully planned lessons for small learning increments
  - Scripted lesson plans
  - Rapid-paced interaction between teacher and students
  - Correcting mistakes immediately
  - Achievement-based grouping
  - Frequent progress assessments

- **Classroom adjustments:**
  - Special seating assignments
  - Alternative or modified assignments
  - Modified testing procedures
  - Quiet environment

- **Special equipment:**
  - Word processors with spell checkers and dictionaries
  - Text-to-speech and speech-to-text programs
  - Talking calculators
Books on tape
  o Computer-based activities

- Classroom assistants:
  o Note-takers
  o Readers
  o Proofreaders
  o Scribes

- Special Education:
  o Prescribed hours in a resource room
  o Placement in a resource room
  o Enrollment in a special school for learning disabled students
  o Individual Education Plan (IEP)
  o Educational therapy

Sternberg has argued that early remediation can greatly reduce the number of children meeting diagnostic criteria for learning disabilities. He has also suggested that the focus on learning disabilities and the provision of accommodations in school fails to acknowledge that people have a range of strengths and weaknesses, and places undue emphasis on academic success by insisting that people should receive additional support in this arena but not in music or sports. Other research has pinpointed the use of resource rooms as an important—yet often politicized component of educating students with learning disabilities.

Causes

The causes for learning disabilities are not well understood, and sometimes there is no apparent cause for a learning disability. However, some causes of neurological impairments include:

- **Heredity** – Learning disabilities often run in the family. Children with learning disabilities are likely to have parents or other relatives with similar difficulties.\(^{[32]}\)
• **Problems during pregnancy and birth** – Learning disabilities can result from anomalies in the developing brain, illness or injury, fetal exposure to alcohol or drugs, low birth weight, oxygen deprivation, or by premature or prolonged labor.

• **Accidents after birth** – Learning disabilities can also be caused by head injuries, malnutrition, or by toxic exposure (such as heavy metals or pesticides).

**Impact on affected individuals**

The effects of having a learning disability or learning difference are not limited to educational outcomes: individuals with learning disabilities may experience social problems as well. Neuropsychological differences can affect the accurate perception of social cues with peers. Researchers argue that persons with learning disabilities not only experience negative effects as a result of their learning distinctions, but also as a result of carrying a stigmatizing label. It has generally been difficult to determine the efficacy of special education services because of data and methodological limitations. Emerging research suggests adolescents with learning disabilities experience poorer academic outcomes even compared to peers who began high school with similar levels of achievement and comparable behaviors. It seems their poorer outcomes may be at least partially due to the lower expectations of their teachers; national data show teachers hold expectations for students labeled with learning disabilities that are inconsistent with their academic potential (as evidenced by test scores and learning behaviors).

Many studies have been done to assess the correlation between learning disability and self-esteem. These studies have shown that an individual’s self-esteem is indeed affected by his or her awareness of their learning disability. Students with a positive perception of their academic abilities generally tend to have higher self-esteem than those who do not, regardless of their actual academic achievement. However, studies have also shown that several other factors can influence self-esteem. Skills in non-academic areas, such as athletics and arts, improve self-esteem. Also, a positive perception of one’s physical appearance has also been shown to have positive effects of self-esteem. Another important finding is that students with learning disabilities are able to distinguish between academic skill and intellectual capacity. This demonstrates that students who acknowledge their academic limitations but are also aware of
their potential to succeed in other intellectual tasks see themselves as intellectually competent individuals, which increases their self-esteem.

4.6 LEARNING DISABILITIES

Learning disabilities are most often defined by describing a discrepancy between ability and performance. Children with learning disabilities are of average to above-average intelligence (or IQ), but performance assessments and standardized tests indicate that their classroom achievement fails to match their evident ability. Because learning disabilities relate specifically to classroom performance, they are rarely identified before a child enters school and confronts academic instruction.

It can be difficult to determine the cause of a learning disability, and the matter is often confusing for both parents and teachers. Learning disabilities are frequently identified when no other reason for academic failure can be found, such as a hearing or visual problem, behavioral problem, or mental deficiency.

Many professions have contributed to a working definition of learning disabilities: educators, psychologists, psychiatrists, social workers, linguists, and lawyers. Defining and describing learning disabilities are matters of ongoing discussion in the field of special education. Some researchers are committed to finding a neurobiological basis for the condition, whereas others believe that learning disabilities are, for the most part, environmental in origin. Although this debate will certainly continue, as teachers we can be most effective when we agree on a broad definition that allows us the greatest amount of flexibility. The National Joint Committee on Learning Disabilities defines learning disabilities in this way:

A general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction and may occur across the life span. Problems in self-regulatory behaviors, social perception and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability.
Using this definition, a teacher has the flexibility to recommend that a student be screened for a learning disability once it is determined that other variables—such as poor eyesight, hearing problems, and environmental factors—are not responsible for the child’s struggles in the classroom.

4.7 CATEGORIES AND PREVALENCE OF LEARNING DISABILITIES

Even if educators agree on a definition like the one just offered, the term learning disabilities covers a wide variety of academic and psychological difficulties. To put it another way, a learning disability can affect a considerable range of cognitive abilities that children need to develop preacademic skills and to succeed in school in general (Chalfant & Van Dusen, 1989; Smith, 1995). Students with learning disabilities have been found to lack skills in visual perception, visual discrimination, auditory processing, and other areas of language use and communication. They can have difficulty understanding numbers, making sense of letters on a page, or understanding cause-and-effect relationships. They may face obstacles in just one area of academics or in several, seemingly unrelated, areas. Thorough evaluation is necessary to understand each child’s unique set of learning challenges.

Students with learning disabilities often experience academic failure in school. The national dropout rate for students with learning disabilities during the 1998–1999 school year was about 27 percent (U.S. Department of Education, 2000). By comparison, the dropout rate for nondisabled youth is about 11 percent (National Center for Education Statistics, 2000). According to the Office of Special Education and Rehabilitation, 30 percent of students with a learning disability graduate from high school with a traditional diploma, versus 77 percent of nondisabled youths (National Center for Education Statistics, 2000).

The learning-disabled population is the largest group of students with disabilities. Referring to Table 1.1 in chapter 1, you can see that an estimated 5 to 10 percent of all U.S. school-age students have learning disabilities. Other sources place the figure even higher or lower—3 to 15 percent of the total school-age population (National Center for Education Statistics, 2001; National Center for Learning Disabilities, 2001). Because the term learning
disabilities includes such a wide range of disabling conditions, the exact meaning of the percentages is often difficult to determine.

**Juvenile Justice and LD**

The federal government, along with many special educators, uses the term specific learning disabilities—a helpful reminder that giving a child the label “learning disability” does not help unless we can specify the condition more exactly. At least six categories of learning disabilities have been identified:

1. **Auditory-language.** An auditory-language difficulty is a perceptual problem in which a child may take a long time to comprehend or follow directions. The student with an auditory learning disability is physically able to hear, but “hears” in a different way.

2. **Visual-spatial.** Some visual-spatial disorders involve an inability to understand color or see a difference between the foreground and the background. A student may also have trouble visualizing directions in space, and this can significantly affect the ability to learn to read. For example, the letters b, d, p, and q are all formed in essentially the same way. Those who lack a sense of spatial relationships and directionality are unable to tell these letters apart.

3. **Motor-related.** A child with motor-related learning disabilities has difficulty with either fine or gross motor coordination or both. The student is unable to perform isolated, coordinated movements. This problem is evident in many settings—in the classroom, on the playground, at home, and elsewhere. In using technology, the child can have difficulty with handwriting, keyboards, and mouse control.

4. **Organizational.** A student with an organizational learning disability may have trouble locating the beginning, middle, or end of an assignment. Drafting an outline is difficult because the child cannot narrow down and organize information. Such weaknesses make it difficult or impossible for the student to assemble materials for papers or for oral presentations.

5. **Academic difficulty.** An example of academic difficulty is a student in math class who has problems with order and placement of numbers or who switches processes, such as long division and multiplication. Another example is a history student who has difficulty
with the concept of time and cannot understand the order of events in relation to their dates of occurrence. Academic-specific learning disabilities are common among students with learning disabilities. Special education teachers often see students who are, for instance, gifted in mathematical calculation and reasoning but have significant deficits in written language and spelling.

6. **Social skills disorders.** The student with a social skills disorder has trouble with skills such as taking turns and understanding how to effectively interpret facial expressions. Such children are unable to perform social activities consistent with their chronological age and intelligence. Although social skills are not typically seen as being within the realm of the classroom teacher, these difficulties can significantly impair a child’s ability to succeed in the classroom.

### Instructional Techniques

Because learning disabilities cover a wide range of functional and learning difficulties, you will need a full spectrum of instructional techniques and strategies to teach effectively. These students have such varied sets of perceptual and communicative skills that no “one size fits all.” A student may understand how to perform a fractions problem but need a “rhyme” to remember how to add two numbers with regrouping.

When you teach a student with a learning disability, your lesson designs must be especially innovative, creative, and flexible. You must understand and respond to the unique nature of each child’s learning disability—and be prepared to change a lesson plan in midstream if it is not working. Every lesson, therefore, should include the opportunity to monitor for understanding and provide ongoing feedback to students on their performance.

Proven techniques for working with learning-disabled students include the remedial approach, the task analytic approach, project-based learning, direct instruction, multisensory and interdisciplinary techniques, and experiential learning approaches. The best learning environment for any student (with or without a learning disability) is one that combines these techniques appropriately. For a more detailed description of instructional techniques for students

**The Remedial Approach**

Teaching the student with a learning disability can be described as an intervention process. The instructional activities must mediate the student’s difficulties using a variety of tools and techniques. During school-based intervention, teachers attempt to reduce the student’s learning difficulties and to include him or her in the normal planned curriculum as much as possible. Intervention involves determining both what the student must learn and how to teach it, on a day-to-day or lesson-by-lesson schedule.

Teaching students with learning disabilities has also been called remedial teaching. When Samuel Kirk (1963) first described learning disabilities, he discussed remedial teaching as involving ten steps:

1. Discover the special needs of the child.
2. Develop annual goals and short-term objectives.
3. Analyze the tasks to be taught.
4. Begin instruction at the child’s level.
5. Decide how to teach.
6. Select appropriate awards for the child.
7. Provide the opportunity for the student to experience success.
8. Give time for extended practice.
9. Provide the student with feedback.
10. Continuously measure the student’s progress.

**Identifying students or learners with special needs**

Some children are easily identified as candidates for special needs due to their medical history. They may have been diagnosed with a genetic condition that is associated with
intellectual disability, may have various forms of brain damage, may have a developmental disorder, may have visual or hearing disabilities, or other disabilities.

For students with less obvious disabilities, such as those who have learning difficulties, two primary methods have been used for identifying them: the discrepancy model and the response to intervention model. The discrepancy model depends on the teacher noticing that the students' achievements are noticeably below what is expected. The response to intervention model advocates earlier intervention.

In the discrepancy model, a student receives special education services for a specific learning difficulty (SLD) if the student has at least normal intelligence and the student's academic achievement is below what is expected of a student with his or her IQ. Although the discrepancy model has dominated the school system for many years, there has been substantial criticism of this approach (e.g., Aaron, 1995, Flanagan and Mascolo, 2005) among researchers. One reason for criticism is that diagnosing SLDs on the basis of the discrepancy between achievement and IQ does not predict the effectiveness of treatment. Low academic achievers who also have low IQ appear to benefit from treatment just as much as low academic achievers who have normal or high intelligence.

The alternative approach, response to intervention, identifies children who are having difficulties in school in their first or second year after starting school. They then receive additional assistance such as participating in a reading remediation program. The response of the children to this intervention then determines whether they are designated as having a learning disability. Those few who still have trouble may then receive designation and further assistance. Sternberg (1999) has argued that early remediation can greatly reduce the number of children meeting diagnostic criteria for learning disabilities. He has also suggested that the focus on learning disabilities and the provision of accommodations in school fails to acknowledge that people have a range of strengths and weaknesses and places undue emphasis on academics by insisting that students should be supported in this arena and not in music or sports.

4.8 EFFECTIVE INSTRUCTION FOR STUDENTS WITH DISABILITIES
• **Goal Directed:** Each child must have an Individualized Education Program (IEP) that distinguishes his/her particular needs. The child must get the services that are designed for him/her. These services will allow him/her to reach his/her annual goals which will be assessed at the end of each term along with short-term goals that will be assessed every few months.

• **Research-Based Methods:** There has been a lot of research done about students with disabilities and the best way to teach them. Testing, IQs, interviews, the discrepancy model, etc. should all be used to determine where to place the child. Once that is determined, the next step is the best way for the child to learn. There are plenty of different programs such as the Wilson Reading Program and Direct Instruction

• **Guided by student performance:** While the IEP goals may be assessed every few months to a year, constant informal assessments must take place. These assessments will guide instruction for the teacher. The teacher will be able to determine if the material is too difficult or too easy.

**Instructional strategies**

Different instructional techniques are used for some students with special educational needs. Instructional strategies are classified as being either accommodations or modifications.

An accommodation is a reasonable adjustment to teaching practices so that the student learns the same material, but in a format that is more accessible to the student. Accommodations may be classified by whether they change the presentation, response, setting, or scheduling of lessons. For example, the school may accommodate a student with visual impairments by providing a large-print textbook. This is a presentation accommodation. A modification changes or adapts the material to make it simpler. Modifications may change what is learned, how difficult the material is, what level of mastery the student is expected to achieve, whether and how the student is assessed, or any another aspect of the curriculum. For example, the school may modify a reading assignment for a student with reading difficulties by substituting a shorter, easier book. A student may receive both accommodations and modifications.

**Examples of modifications**
• **Skipping subjects:** Students may be taught less information than typical students, skipping over material that the school deems inappropriate for the student's abilities or less important than other subjects. For example, students with poor fine motor skills may be taught to print **block letters**, but not **cursive** handwriting.

• **Simplified assignments:** Students may read the same literature as their peers but have a simpler version, such as Shakespeare with both the original text and a modern paraphrase available.

• **Shorter assignments:** Students may do shorter homework assignments or take shorter, more concentrated tests.

• **Extra aids:** If students have deficiencies in working memory, a list of vocabulary words, called a word bank, can be provided during tests, to reduce lack of recall and increase chances of comprehension. Students might use a calculator when other students do not.

• **Extended time:** Students with a slower processing speed may benefit from extended time for assignments and/or tests in order to have more time to comprehend questions, recall information, and synthesize knowledge.

• **Students can be offered a flexible setting in which to take tests.** These settings can be a new location to provide for minimal distractions.

**Examples of accommodations**

- **Response accommodations:** Typing homework assignments rather than hand-writing them (considered a modification if the subject is learning to write by hand). Having someone else write down answers given verbally.

- **Presentation accommodations:** Examples include listening to **audiobooks** rather than reading printed books. These may be used as substitutes for the text, or as supplements intended to improve the students' reading fluency and phonetic skills. Similar options include designating a person to read to the student, or providing **text to speech** software. This is considered a modification if the purpose of the assignment is **reading skills acquisition**. Other presentation accommodations may include designating a person to take notes during lectures or using a talking **calculator** rather than one with only a visual display.
• **Setting accommodations:** Taking a test in a quieter room. Moving the class to a room that is physically accessible, e.g., on the first floor of a building or near an elevator. Arranging seating assignments to benefit the student, e.g., by sitting at the front of the classroom.

• **Scheduling accommodations:** Students may be given rest breaks or extended time on tests (may be considered a modification, if speed is a factor in the test). Use a timer to help with time management.

All developed countries permit or require some degree of accommodation for students with special needs, and special provisions are usually made in examinations which take place at the end of formal schooling.

### 4.9 ISSUES FOR LEARNING DISABILITIES

At-risk students (those with educational needs that are not associated with a disability) are often placed in classes with students who have disabilities. Critics assert that placing at-risk students in the same classes as students with disabilities may impede the educational progress of people with disabilities. Some special education classes have been criticized for a watered-down curriculum.

The practice of inclusion (in mainstream classrooms) has been criticized by advocates and some parents of children with special needs because some of these students require instructional methods that differ dramatically from typical classroom methods. Critics assert that it is not possible to deliver effectively two or more very different instructional methods in the same classroom. As a result, the educational progress of students who depend on different instructional methods to learn often fall even further behind their peers.

Parents of typically developing children sometimes fear that the special needs of a single "fully included" student will take critical levels of attention and energy away from the rest of the class and thereby impair the academic achievements of all students.
Linked to this, there is debate about the extent to which students with special needs, whether in mainstream or special settings, should have a specific pedagogy, based on the scientific study of particular diagnostic categories, or whether general instructional techniques are relevant to all students including those with special needs.

Some parents, advocates, and students have concerns about the eligibility criteria and their application. In some cases, parents and students protest the students' placement into special education programs. For example, a student may be placed into the special education programs due to a mental health condition such as obsessive compulsive disorder, depression, anxiety, panic attacks or ADHD, while the student and his parents believe that the condition is adequately managed through medication and outside therapy. In other cases, students whose parents believe they require the additional support of special education services are denied participation in the program based on the eligibility criteria.

Whether it is useful and appropriate to attempt to educate the most severely disabled children, such as children who are in a persistent vegetative state, is debated. While many severely disabled children can learn simple tasks, such as pushing a buzzer when they want attention, some children may be incapable of learning. Some parents and advocates say that these children would be better served by substituting improved physical care for any academic program. In other cases, they question whether teaching such non-academic subjects, such as pushing a buzzer, is properly the job of the school system, rather than the health care system.

Another large issue is the lack of resources enabling individuals with special needs to receive an education in the developing world. As a consequence, 98 percent of children with special needs in developing countries do not have access to education.

Issues in Math

1) Cognitive Development

- **Declarative Knowledge** - This means remembering math facts that children build off of for each new lesson taught by the teacher
- **Procedural Knowledge**- This is the difficulties that students have remembering the procedures or steps for various operations. An example of this would be the Order of Operations. Most students remember that the order is parentheses, exponents, multiplication, division, addition, and then subtraction. Children remember this through various chants and rhymes. However, children with disabilities have difficulty grasping procedural knowledge.
- **Conceptual Knowledge**- This is the overall picture. Some students with disabilities have difficulties understanding how various math concepts relate and what mathematics means to our society.

2) **Problems in performance**

- Writing numbers and different math symbols correctly- Some children with various disorders such as dyslexia and dysgraphia will greatly struggle with this.
- Recalling the meanings of symbols and answers to basic facts – This goes along closely with cognitive issues. Some of these children may recognize the math symbol or the basic problem; however, they cannot recall the meaning of the symbol or answer to the math fact.
- Counting – Some children may forget which numbers come first, last, etc.
- Following the steps of a strategy – Word problems can sometimes cause an issue of a step-by-step process. Children with disabilities may forget the order, how to use context clues, etc.

3.) **Performance on basic arithmetic**

- Errors in computation -The child may be able to actually understand the problem and how to solve it. However, there may be various mistakes throughout the multi-step problem.
- Difficulty with the fact retrieval – Every child must know their basic facts and be able to retrieve them. If the child cannot, he will struggle in math.

4.) **Difficulty with word problems**
• Excluding irrelevant information – Students with disabilities have a difficult time picking out information that is irrelevant.

• Complex sentence structures – These children may have difficulty reading the actual problem itself due to the complex wording.

4.10 SUMMARY

Learning disability is a classification that includes several areas of functioning in which a person has difficulty learning in a typical manner, usually caused by an unknown factor or factors. Given the "difficulty learning in a typical manner", this does not exclude the ability to learn in a different manner. Therefore, some people can be more accurately described as having a "Learning Difference", thus avoiding any misconception of being disabled with a lack of ability to learn and possible negative stereotyping.

While learning disability, learning disorder and learning difficulty are often used interchangeably, they differ in many ways. Disorder refers to significant learning problems in an academic area. These problems, however, are not enough to warrant an official diagnosis. Learning disability on the other hand, is an official clinical diagnosis, whereby the individual meets certain criteria, as determined by a professional (psychologist, pediatrician, etc.). The difference is in degree, frequency, and intensity of reported symptoms and problems, and thus the two should not be confused. When the term "learning disorder" is used, it describes a group of disorders characterized by inadequate development of specific academic, language, and speech skills. Types of learning disorders include reading (dyslexia), mathematics (dyscalculia) and writing (dysgraphia).

The practice of inclusion (in mainstream classrooms) has been criticized by advocates and some parents of children with special needs because some of these students require instructional methods that differ dramatically from typical classroom methods. Critics assert that it is not possible to deliver effectively two or more very different instructional methods in the same classroom. As a result, the educational progress of students who depend on different instructional methods to learn often fall even further behind their peers.
Parents of typically developing children sometimes fear that the special needs of a single "fully included" student will take critical levels of attention and energy away from the rest of the class and thereby impair the academic achievements of all students.

4.11 CHECK YOUR PROGRESS

1. What are the categories and prevalence of learning disabilities?
2. What is the issues for learning disabilities?
3. What is management of learning disabilities?
4. What are the diagnosis of learning disabilities?
5. What are the types of learning disabilities?
6. Write learning disabilities.

Check Your Progress
18. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.18.1. Points for discussion
Points for clarification
4.12 REFERENCES


UNIT 5: MULTIDISCIPLINARY ASSESSMENT OF VISUALLY IMPAIRED CHILDREN WITH ASSOCIATED DISABILITIES

5.1 INTRODUCTION
UNIT 5

MULTIDISCIPLINARY ASSESSMENT OF VISUALLY IMPAIRED CHILDREN WITH ASSOCIATED DISABILITIES
5.1 INTRODUCTION

Multiple disabilities is a term for a person with several disabilities, such as a sensory disability associated with a motor disability.

Depending on the definition, a severe intellectual disability may be included in the term "multiple disabilities". Individual usually has more than one significant disability, such as movement difficulties, sensory loss, and/or a behavior or emotional disorder.

At times, in common usage "Multiple disability", "spasticity" and "cerebral palsy" are used interchangeably. The term is widely used to connote mental disability and is accepted for usage in medical fraternity as well as in social life. Many organizations known as "Spastic Societies" viz. Spastic Society of Gurgaon are working in different areas in India as charitable bodies for people with cerebral palsy, autism, mental retardation and multiple disabilities in care-taking, rehabilitation and medical support of children with such neurological muscular development disabilities. Similar organizations are also working very effectively in U.K, U.S.A, Australia and some other developed countries.

5.2 CHARACTERISTICS OF MULTIDISCIPLINARY DISABILITIES

People with severe or multiple disabilities may exhibit a wide range of characteristics, depending on the combination and severity of disabilities, and the person’s age. There are, however, some traits they may share, including:

**Psychological**

- May Feel ostracized
- Tendency to Withdraw from society
- Students with multiple disabilities may become fearful, angry, and upset in the face of forced or unexpected changes.
- May execute self-injurious behavior
Behavioral

- May display an immature behavior inconsistent with chronological age
- May exhibit an impulsive behavior and low frustration level
- May have difficulty forming interpersonal relationships
- May have limited self-care skills and independent community living skills

Physical/health

- A variety of medical problems may accompany severe disabilities. Examples include seizures, sensory loss, hydrocephalus, and scoliosis.
- May be physically clumsy and awkward
- May be unsuccessful in games involving motor skills

Challenges

- A variety of medical problems may accompany severe disabilities. Examples include seizures, sensory loss, hydrocephalus, and scoliosis. Time is needed to ensure their safety at home in times of condition like seizures.
- Financially, the medical/transport fees may place burdens on the family.
- The effort needed to ensure safety of the person will require family members to take turns to look after that person.
- Individuals have only limited speech or communication
- Requires a lot of patience with individuals with multiple disabilities

Individuals

- Difficulty in basic physical mobility
- May experience fine-motor deficits that can cause penmanship problems
- May have slow clerical speed.
- May tend to forget skills through disuse
- May have trouble generalizing skills from one situation to another
- May lack high level thinking and comprehension skills
• May have poor problem-solving skills
• Ability to engage in abstract thinking is limited
• May be poor test taker due to limiting factors of the disabilities
• May have difficulty locating the direction of sound
• May have speech that is characterized by substitution, omissions
• May have difficulty learning about objects and object relationships
• May lack maturity in establishing career goals
• May face problems in socializing with peers

Accommodations/strategies

• A multi-disciplinary team consisting of the student’s parents, educational specialists, and medical specialists in the areas in which the individual demonstrates problems should work together to plan and coordinate necessary services.
• Involvement of the appropriate professionals (E.g. occupational therapists, speech/language therapist etc.)
• The arrangement of places school and homes must be easily accessible.
• Have a buddy system that ensures their needs are heard and that they get aid when needed.
• Give Simple and Specific and Systematic instructions to what you exactly want the person to do.
• Use visual aids when communicating with the child.
• Engage the child regularly in oral language activity.

• Help prevent child abuse and neglect
• Mitigate the effects of abuse and neglect
• Improve parenting skills
• Strengthen families
• Improve the child's developmental, social, and educational gains;
• Reduce the future costs of special education, rehabilitation and health care needs;
• Reduce feelings of isolation, stress and frustration that families may experience;
- Help alleviate and reduce behaviors by using positive behavior strategies and interventions; and
- Help children with disabilities grow up to become productive, independent individuals.
- Assistance with technological devices, counseling, and family training.

5.3 EARLY INTERVENTION SERVICES FOR MULTIDISCIPLINARY ASSESSMENT

The following is a list of what early intervention can provide:

- **Assisting technology devices and services** – equipment and services that are used to improve or maintain the abilities of a child to participate in such activities as playing, communication, eating or moving.
- **Audiology** – identifying and providing services for children with hearing loss and prevention of hearing loss.
- **Family training** – services provided by qualified personnel to assist the family in understanding the special needs of the child and in promoting the child’s development.
- **Medical services** – only for diagnostic or evaluation purposes.
- **Nursing services** – assessment of health status of the child for the purpose of providing nursing care, and provision of nursing care to prevent health problems, restore and improve functioning, and promote optimal health and development. This may include administering medications, treatments, and other procedures prescribed by licensed physician.
- **Nutrition services** – services that help address the nutritional needs of children that include identifying feeding skills, feeding problems, food habits, and food preferences.
- **Occupational therapy** – services that relate to self-help skills, adaptive behavior and play, and sensory, motor, and postural development.
- **Physical therapy** – services to prevent or lessen movement’s difficulties and related functional problems.
- **Psychological services** – administering and interpreting psychological tests and information about a child’s behavior and child and family conditions related to learning,
mental health and development as well as planning services including counseling, consultation, parent training, and education programs.

- **Service coordination** – someone who works in partnership with the family by providing assistance and services that help the family to coordinate and obtain their rights under the Early Intervention Program and services agreed upon in the IFSP.

- **Social work services** – preparing an assessment of the social and emotional strengths and needs of a child and family, and providing individual or group services such as counseling or family training.

- **Special instruction** – includes designing learning environments and activities that promote the child’s development, providing families with information, skills, and support to enhance the child’s development.

- **Speech-language pathology** – services for children with delay in communication skills or with motor skills such as weakness of muscles around the mouth or swallowing.

- **Vision services** – identification of children with visual disorders or delays and providing services and training to those children.

**Criticism**

Criticism of Early Childhood Intervention asserts growing up is different in detail for each individual, depending on genetic endowments and environmental circumstances. But one thing is common to everyone: the process, in order to take full advantage of the species' potential, must be natural ripening, un interfered with by clumsy intruders. Thence, criticism of Early Childhood Intervention adduces no one shall push healthy children to learn any skill or academic discipline before they choose to do so of their own accord.

In the State of Georgia the program "Babies Can't wait" was put in place to assist parents in finding their child Early Intervention Therapy. The program works the same as many government mandated Early Intervention programs in that it first evaluates the child for free and then deems what services the child needs to receive. However, this particular program has received two major criticisms: one being a timeline and the other being the collaborative model it provides.
Once referred to "Babies Can't Wait" the program has 45 days to evaluate the child, then the program has another 45 days to develop a plan and provide services for the child. Due to limited providers working with "Babies Can't Wait" it is possible this 90 timeline is not met and the services not be provided.

The collaborative model that "Babies Can't Wait" provides works in a way that all of the medical professionals communicate with each other about the services each child needs provided. However, it works in such a way that a Physical Therapist would consult with a Speech Therapist and then the Physical Therapist would provide the child with speech therapy as part of the child's physical therapy session instead of the child having an additional therapy session with the Speech Therapist.131

5.4 INDIVIDUALS WITH DISABILITIES EDUCATION ACT (IDEA)

The law regarding disability education underwent a change with the introduction of Individuals with Disabilities Education Act (IDEA). Prior to that time, the statutory focus in EHA was to provide access to education for disabled students who had been marginalized in the public school system. Satisfied that the goal of "access" had been reached, in 1997 Congress enacted IDEA with the express purpose of addressing implementation problems resulting from "low expectations, and an insufficient focus on applying replicable research on proven methods of teaching and learning for children with disabilities." 20 U.S.C. § 1400(c)(4). The statute clearly stated its commitment to "our national policy of ensuring equality of opportunity, full participation, independent living, and economic self-sufficiency for individuals with disabilities."

Arguably, passage of IDEA represented a significant shift in focus from the disability education system in place prior to 1997. IDEA added individualized transition plans (ITP) for transitioning individuals from secondary school to adult life or post secondary education. Special education coverage was extended to the categories of autism and traumatic brain injury (TBI). In 1997 IDEA was reauthorized as PL 105-17 and extended coverage to attention deficit hyperactivity disorder (ADHD), functional behavioral assessments and intervention plans were added, and the ITP's were integrated within IEP's. An additional re-authorization was made in 2004 (below).
Like EHEA before it, the act’s zero reject rule requires schools to provide educational services to every disabled child, even if there is no hope of the child benefiting from the services (e.g., if the child is in a coma).

**No Child Left Behind**

The Elementary and Secondary Education Act of 2001 (ESEA) PL 107-110, more popularly known as the No Child Left Behind Act required accountability for the academic performance of all school children, including those with disabilities. It called for 100% proficiency in reading and math by the year 2012.

The Assistive Technology Act of 2004 (ATA) PL 108-364 provided support for school-to-work transition projects and created loan programs for the purchase of assistive technology (AT) devices.

The 2004 Individuals with Disabilities Education Act reauthorization PL 108-446 changed learning disability identification procedures, required high qualification standards for special education teachers, stipulated that all students with disabilities participate in annual state or district testing or documented alternate assessments, and allowed in response to activities related to weapons, drugs or violence that a student could be placed in interim alternative educational setting.

Some student disability protections not covered by IDEA may be still covered under Section 504 or ADA due to a broader definitions of what constitutes a disability. There are some rumors in the Education field about NCLB. There is a rumor that teachers are forced to test children with severe disabilities. IDEA does cover children under the Disability Act. The problem is that they group all children as having the same severe disability. Erin Dillon a former Senior Policy Analyst, states as a writer for "Education Sector" That all special education students do not fit the criteria of severely handicapped. Students can reach grade level with tools and accommodations in place. NCLB has become more accountable by placing students in subgroups to identify the specific disability. Most of the students under IDEA have been put in the category of LEARNING DISABLED (LD). The LD label is there to ensure that students get the proper help needed to obtain grade level performances. Dillon notes that there are 4 groups
that service 80% of special education; Learning Disabled (LD), Emotional Disturbed (ED), Speech and Language Impairments & other Health Impairments, such as ADD. Since 1977 the population of students with disabilities has increased from 8% to 14% to 2006 (Dillon). African-American students account for 15% of the total student population, but carry a 21% of the identified special education students. Studies show that most Afro-American students are labeled in special education as MR or ED; white students are labeled as Autism. The major issue is how to count the scores and be fair to this population of special education students.

**Maintenance of Effort**

The purpose of federal special education funding is to maintain or improve the quality of special education services. This purpose would be undercut if additional federal dollars were "supplanted" by merely reducing the level of state or local funding for special education. For this reason, like many other such programs, the federal law and regulations contain accounting guidelines, requiring "maintenance of effort." The statute says that federal funds provided to the local education agency "(i) Shall be used only to pay the excess cost of providing special education and related services to children with disabilities; (ii) Shall be used to supplement State, local and other Federal funds and not to supplant such funds; and (iii) Shall not be used …to reduce the level of expenditures for the education of children with disabilities made by the local education agency from local funds below the level of those expenditures for the preceding fiscal year. 20 USC 1413 Regulations implementing this requirement begin with a test that seeks to assure that funds provided to a local education agency (LEA) under Part B of IDEA may not be used to reduce the level of expenditures for the education of children with disabilities made by the LEA from local funds below the level of those expenditures for the preceding fiscal year. Implementing this requirement fairly at the local level requires some exceptions.

**5.5 QUALIFYING DISABILITIES STUDENTS FOR SPECIAL EDUCATION**
By federal law, no student is too disabled to qualify for a free, appropriate education. Whether it is useful and appropriate to attempt to educate the most severely disabled children, such as children who are in a persistent vegetative state or in a coma, is debated.\textsuperscript{[16]} While many severely disabled children can learn at least simple tasks, such as pushing a buzzer when they want attention or using a brain implant if they are unable to move their hands, some children may be incapable of learning. However, schools are required to provide the services, and teachers design individual programs that expose the child to as much of the curriculum as reasonably possible. Some parents and advocates say that these children would be better served by substituting improved physical care for any academic program.

The referral

Parents who suspect or know that their child has a problem making adequate school progress should request an evaluation from their local school district. The request, called a "referral for evaluation," should be initiated in writing. The referral should be addressed to the principal of the local public school or the special education coordinator for the district, and should provide the child's name, date of birth, address, current school placement (if applicable), and the suspected area of disability or special need. Referrals can also be made by general education teachers or guidance counselors. Upon receipt of the referral, the school district will contact the parent to set up a meeting time in order to explain the process and obtain written consent to perform the necessary evaluations. To prepare for this meeting, parents should be able to describe their child's problems in depth, providing examples of their child's difficulties in the classroom. Parents can request any evaluations they feel are needed to add to the picture of the child's specific educational needs, such as speech and language testing, occupational therapy testing or neurological testing. All evaluations needed to provide a full picture of the child's disabilities must be provided by the school system at no cost to the family.

The evaluation
After the referral process, the district will begin the evaluation. The law requires a comprehensive and nondiscriminatory school evaluation involving all areas of suspected disability.

Testing must be in the native language of the child (if feasible). It must be administered by a team of professionals, which must include at least a general education teacher, one special education teacher, and a specialist who is knowledgeable in the area of the child's disability. Testing must be administered one-to-one, not in a group. Any tests or other evaluation materials used must be administered by professionals trained and qualified to administer them; i.e., psychological testing must be conducted by a psychologist trained to administer the specific tests utilized. Teachers also document any interventions they have already been using in the classroom. In addition, teachers will use formal tests such as DIBELS (Dynamic Indicators of Basic Early Literacy Skills), DRA (Developmental Reading Assessment), WJ III (Woodcock Johnson Tests of Achievement) or the WIAT (Wechsler Individual Achievement Test) to see if they are on grade level or below. Anything a teacher or committee member can bring with them to help see the student's whole academic picture (e.g. grades) is extremely helpful.

In addition to testing, an observation of the child either in school or in a comparable situation is required for an initial evaluation, and often at later stages as well. It is through the observation that the child can be assessed while interacting with his peers and teachers. To insure objectivity and cross-referencing, this observation must be conducted by a person other than the child's classroom teacher. The observation need not be done exclusively in the child's classroom, especially when the child's suspected area of disability may become manifest in larger settings, such as the lunchroom, hallways or gym.

For children over twelve years of age, vocational testing is required. This requirement is in keeping with the spirit of the IDEA 1997 Amendments that encourage preparation of children for useful employment. The vocational testing should identify areas of interest and skills needed to attain employment after graduation from school. During the testing process, the parent is free to provide any privately obtained evaluative material and reports. Experts may include professionals such as psychotherapists, psychiatrists, neurologists, pediatricians, medical
personnel, and tutors. Professionals who have been working with the child over time can often provide the district with a long-term view of the child's needs.

**Classification**

Once all the evaluative material is presented and reviewed at the meeting, the IEP team must first determine whether the child is eligible for special education services. An eligible child will require special education intervention in order to enable him/her to receive the benefits of instruction and an education.

**5.6 DIAGNOSIS FOR CHILDREN WITH DISABILITIES**

Diagnosis is a term that is more appropriately applied to medical classification systems, and individual professional's impression of a person's difficulties. Special education students are classified into the above referenced educational disorder categories by the eligibility team, through the evaluation process. Diagnosis from professionals outside the school system can play a large part in the decision making process.

For more details on this topic, see Psycho educational assessment.

**Studies and Data on Special Education**

A variety of resources provide global analysis for policy making in special education. The Special Education Elementary Longitudinal Study (SEELS) was a study of school-age students funded by the Office of Special Education Programs (OSEP) in the U.S. Department of Education and was part of the national assessment of the 1997 Individuals with Disabilities Education Act (IDEA 97). From 2000 to 2006, SEELS documented the school experiences of a national sample of students as they moved from elementary to middle school and from middle to high school. One important feature of SEELS was that it did not look at students' educational, social, vocational, and personal development at a single point in time. Rather, it was designed to assess change in these areas over time.

Since 1992, the Center for Special Education Finance (CSEF) has addressed fiscal policy issues related to the delivery and support of special education services throughout the United States.
CSEF conducted The Special Education Expenditure Project (SEEP) the fourth such project sponsored by the Office of Special Education Programs (OSEP) and its predecessor to examine the nation’s spending on special education and related services in the past 40 years. Eight SEEP studies are available on the Web.

IDEA requires that the Department of Education report annually on the progress made toward the provision of a free appropriate public education to all children with disabilities and the provision of early intervention services to infants and toddlers with disabilities. The 27th Annual Report consists of two volumes, and is electronically available.

On October 3, 2001, President George Bush established a temporary Commission on Excellence in Special Education to collect information and study issues related to Federal, State, and local special education programs with the goal of recommending policies for improving the education performance of students with disabilities. The President's Commission on Excellence in Special Education (PCESE) delivered its report to President Bush on July 1, 2002.

Data on the impact of regional special education programs is varied, and some research suggests results depend on how informed administrators are when making decisions regarding mainstreaming or inclusion programs. One study showed considerable benefit from inclusion in a secondary school, with students reporting a disability as an attribute rather than a stigma. Another showed an increase in baseline standardized test scores among students assigned to a resource room, along with special education teachers reporting dissatisfaction with the quality of special education knowledge among general education teachers and a general feeling of isolation among colleagues. Though, at least one group of special education teachers reported satisfaction in this role, noting that it helped them relate to their students. Special education programs, when implemented by qualified professionals and competent administrators, has been shown to lead to long-term positive benefits to communities such as students with special needs able to lead more independent lives, prepared to enter the work force, and develop positive relationships among their peers.

Transition Services for Students in Special Education
The Individuals with Disabilities Education Act of 2004 addresses regulations regarding transition services for children with disabilities. Transition services are designed to focus on improving academic and functional achievement of the child, is based on the individual’s needs, and provides instruction and experiences vital for employment and independent living. The goal of transitional services is to prepare students with disabilities for adult living and may provide instruction in functional living skills, social and community skills, work skills and self-advocacy skills. In most states, these services can be provided up to the age of 21 (age 26 in Michigan) or when the student meets his/her goals and objectives, which should be detailed in the student’s IEP (Individualized Education Program).

5.7 SUMMARY

Multiple disabilities is a term for a person with several disabilities, such as a sensory disability associated with a motor disability.

Depending on the definition, a severe intellectual disability may be included in the term "multiple disabilities". Individual usually has more than one significant disability, such as movement difficulties, sensory loss, and/or a behavior or emotional disorder.

At times, in common usage "Multiple disability", "spasticity" and "cerebral palsy" are used interchangeably. The term is widely used to connote mental disability and is accepted for usage in medical fraternity as well as in social life. Many organizations known as "Spastic Societies" viz. Spastic Society of Gurgaon are working in different areas in India as charitable bodies for people with cerebral palsy, autism, mental retardation and multiple disabilities in caretaking, rehabilitation and medical support of children with such neurological muscular development disabilities. Similar organizations are also working very effectively in U.K, U.S.A, Australia and some other developed countries.

Testing must be in the native language of the child (if feasible). It must be administered by a team of professionals, which must include at least a general education teacher, one special education teacher, and a specialist who is knowledgeable in the area of the child's disability.
Testing must be administered one-to-one, not in a group. Any tests or other evaluation materials used must be administered by professionals trained and qualified to administer them; i.e., psychological testing must be conducted by a psychologist trained to administer the specific tests utilized. Teachers also document any interventions they have already been using in the classroom. In addition, teachers will use formal tests such as DIBELS (Dynamic Indicators of Basic Early Literacy Skills), DRA (Developmental Reading Assessment), WJ III (Woodcock Johnson Tests of Achievement) or the WIAT (Wechsler Individual Achievement Test) to see if they are on grade level or below. Anything a teacher or committee member can bring with them to help see the student's whole academic picture (e.g. grades) is extremely helpful.

5.8 CHECK YOUR PROGRESS

1. What are the qualifying disabilities students for special education?
2. Characteristics of multidisciplinary disabilities?
3. What is early intervention services for multidisciplinary assessment?
4. What are the diagnosis for children with disabilities?
5. What is individuals with disabilities education act (idea)?

Check Your Progress
19. Assignment/Activity
Points For Discussion And Clarification

After going through this Unit you might like to have further discussion on some points and clarification on others

1.19.1. Points for discussion
Points for clarification
5.9 REFERENCES

