SEE MORE

A toolkit to establish low vision services

This publication is one of the outcomes of the Tempus IV project entitled Curriculum and Skill development in Vision Rehabilitation which includes 10 Universities and non-governmental organizations from Europe and the Middle East committed to improve services to persons with visual impairment.

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Welcome to the SEE MORE Toolkit

This toolkit was written by a multi-disciplinary team of professionals working to facilitate the development of teaching and training resources available to practitioners working with people with visual impairment (PVI) in Jordan and Palestine. The work was funded as part of a European Commission Tempus project and we are very grateful for their support.

In the text, we use the expression 'people with visual impairment or PVI' to refer to the users of vision rehabilitation services. We spent considerable time debating several other phrases to encompass people with sight loss. The term is used with full appreciation that all the people we support should be treated as individuals and with the intention of being inclusive without being discriminatory.

The folder was produced to support the establishment of low vision services in parts of the world where PVI are poorly served. We hope that the information included in these pages enables practitioners to offer PVI better help and advice and to consider what they can do to make a positive impact on the lives of PVI. The toolkit is not designed to be a comprehensive guide to all the services required by PVI, but a starting point for the establishment of a basic low vision service. We would encourage you to keep learning and developing your knowledge to offer wider support to more people.

Good Luck!

Andrew Miller and Nathalie Bussières

CONTENTS

1 GETTING STARTED

Nathalie Bussières PhD

1.1 Vision Rehabilitation

Establishing vision rehabilitation (VR) services is usually perceived as a complicated and expensive process. In this toolkit, we will show you how to start services for people with visual impairment (PVI) in your community with a minimum of efforts and resources, with a particular emphasis on persons with low vision (LV).

What is Vision Rehabilitation?

VR aims to improve the daily lives of PVI, whether they are totally blind or with reduced vision. A diagram of the people and services which may be involved in a developed LV service is found in Figure 1.1.

Before receiving VR services, every PVI should be assessed by an ophthalmologist to ensure that the vision problem cannot be improved by medical care or regular spectacles.

What is Low Vision?

The World Health Organization (WHO) defines people with LV as having **visual acuity less than 6/18** after best correction or the **visual field is less than 10°** from the point of fixation and who are using their remaining sight during the activities of daily life. Therefore it would be reasonable to consider these people as the potential users of LV services. In this book, we accept this definition, but suggest that ideally services should be able to respond to **anyone whose reduced vision is affecting their daily life and conventional spectacles or medical intervention will not help them.**

FAQ

Q: Who can benefit from LV services?

A: Anyone with LV who are willing to use their remaining sight.

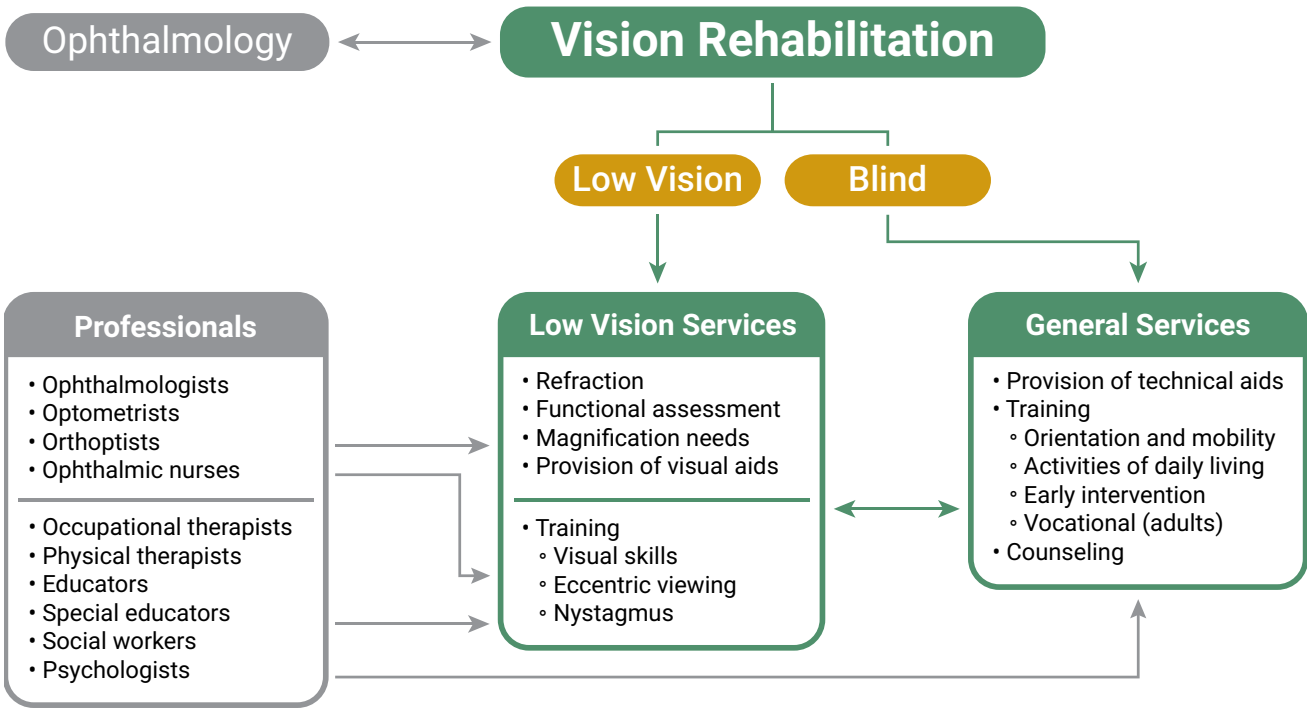

Figure 1.1 Diagram to show the people and professions which may be involved in a developed low vision service.

Table 1.1 Three schemes of low vision services based on available resources.

Means	Basic	Better	Ideal
Trained Staff	1	2 – 4	4+
Equipment	Toolkit + $	$$	$$$
Space	4 - 10 m^2	50 m^2 in 2 – 3 rooms	More than 100 m^2
Services	• Minimum assessment • Magnification • Recommendations	• Full assessment • Magnification • Vision training • Recommendations	• Full assessment • Magnification • Vision training • Early intervention • Counseling • Vocational training • Orientation & mobility

What are the impacts of Low Vision (LV)?

LV can affect various aspects of a person's life including education, social contacts and independence. Most often, however, people with LV seek rehabilitation services to help them read small printed text. VR services can decrease the impacts of visual impairment (VI) by providing appropriate visual aids, training visual skills and strategies, or simply adapting the environment.

GOLDEN RULE

LV professionals aim at maximizing the participation of people with LV in their daily activities and the lives of their family & community.

Rehabilitation is most successful if:

1. The person is motivated to overcome the obstacles caused by the impairment.
2. The professionals are presenting him/her with acceptable solutions.

1.2 Let's get started!

Depending on the resources available, LV services can take a variety of forms. It is in fact possible to start with far less equipment than you might think!

It doesn't matter if you work in the busy eye clinic of a big government hospital, a private clinic or non-profit organization, LV services can be started to allow help to be offered to those who need it. We propose three schemes: basic, better and ideal services (Table 1.1).

Where the space or time is limited, you can and should still provide **basic** LV services to those who have mild to moderate LV in the form of simple magnifiers and basic advice.

Where you have staff and space but limited financial resources, you can offer **better** LV services that include an extended assessment and training on the visual aids and skills.

Ideal LV services can be implemented where there are sufficient human and financial resources to provide services specialized to fulfill the needs of the different age groups.

Who should work in a LV center?

LV services can be delivered by specialists from various professions. However, the staff should receive training that includes the principles of magnification presented in this manual.

In addition, the staff of a LV center should be good listeners, provide encouragement and feel empathy towards the PVIs rather than pity.

Wearing blurred (simulation) glasses for reading, writing, or moving around can help staff understand the difficulties faced by people with LV and help them understand the challenges facing PVI (Fig 1.2).

FAQ

Q: How much money do you need to start LV services?

A: Very little. You just need a small space, a trained person and this toolkit.

Figure 1.2 Simple simulation spectacles to provide fully sighted people an appreciation of visual impairment. These can even be home made! Putting small holes in card allows people some understanding of peripheral restrictions; frosted paper can simulate corneal opacity or dense cataract.

1.3 Preparing the LV center

Small modifications in the rooms and corridors where the LV services are provided can make a big difference for people with LV. Here are the main points:

GOLDEN RULE

Six principles for preparing the LV center:

1. Suitable lighting
2. Good contrast
3. Limiting glare
4. Good acoustics
5. Hazard control
6. No crowding

i Suitable lighting

Good light increases the contrast between objects and thereby improves vision. Rooms, halls or corridors need to be well lit (Fig. 1.3). Hanging lights with a grill allows the light to be distributed more evenly.

Figure 1.3 Wide lamps and shades allow even distribution of light into the room. Dimmable lamps are ideal allowing control of light levels for people with different eye conditions. Photo: Ameen Harb.

Many people with LV function better with increased levels of directed light. However some eye conditions will cause people to have photophobia (light sensitivity) in which case they will be more comfortable in dim light during the assessment. Therefore it is best if the level of light in the assessment room is adjustable to help make all PVIs as comfortable as possible.

ii Good contrast

If a room is painted in one color, it will be difficult for people with low vision to distinguish the corners and the edges of the walls. Painting a wall or part of it with contrasting colors allows people with LV to gain more visual clues about the space and move around more easily.

GOLDEN RULE

Limited finance and other resources should not put you off starting a basic low vision service.

Figure 1.4 Contrasting door frames and edges allow a person with LV to better understand and navigate the space. Photos: Ameen Harb.

Figure 1.5 Contrasting edge strips on stairs enable PVIs to better judge position and height of steps. Photos: Ameen Harb.

Figure 1.6 Contrasting light switches and sockets can be easier to find. Photos: Ameen Harb.

Stairs can be modified by adding a contrasting strip to the edge of each step (Fig 1.5).

Doors, handles, electric switches and sockets will be easier to find if painted in a different color than the wall (Fig. 1.6).

iii Limit glare

A very bright light or a large, shiny surface will cause discomfort to a number of people with LV and further decreases their visual abilities. Curtains, blinds or light filtering fabric can significantly decrease glare from windows (Fig 1.7).

Figure 1.7 Blinds allow control of daylight to limit glare and adapt ambient light levels in the room. Photo: Ameen Harb.

iv Good acoustics

When vision is poor, hearing becomes very important. The LV center should be a place where the noise level is low and acoustics are good. To decrease the echo sometimes arising in empty space, it may help to put curtains or posters on the walls.

v Hazard control

People with VI can easily bump into objects and trip over things that we would normally see. Ensure that items such as bags and boxes are not left on the floor and that corridors are kept clear. The edges of the tables can be protected so that the users are less likely to get hurt and will feel more secure to move around.

vi No crowding

Too much furniture or visual information makes visual landmarks or objects more difficult to find. It will be easier for everyone to move if desks, tables and chairs are placed along the walls rather than in the middle of the rooms leaving clear space for people to navigate.

TIPS

Environmental changes that make life easier for PVI at your Center will be helpful at their homes too!

Use these adaptations in your discussion with the PVI and their family!

1.4 How to reach people with LV?

When establishing the LV services in a community, you might need to find your first users. Schools for the Blind are key places to find children with LV: it is not unusual to find that more than 50% of their students have some useful residual vision.

When informed of the availability of LV services, school managers of these institutions can help you inform the parents about your clinic.

The eye clinic is another place where adults and children with LV can be found. Ophthalmologists should know that services are available for their patients with LV. Forming professional links with eye specialists should allow a steady stream of people needing VR services. In addition, ophthalmologists need to be aware that LV services do not have to wait until the end of treatment regimes. Rehabilitation advice and training can run alongside a program of medical treatment for eye disease.

Who should come along to a LV assessment?

Family, relatives and friends of the person with LV can play a significant role in the rehabilitation process. For example, by attending the assessment, they can better understand the problems faced by their loved one, as well as the advantages and limitations of the magnifiers.

What is the role of the community?

Unlike people who are blind, people with LV can be difficult to recognize and their problems misinterpreted. They might easily move around people and obstacles, and their problems may lie in recognizing faces or their surroundings. Walking by someone they know in a street or failing to respond to things around them may be perceived as rude or absent-minded.

Increasing awareness of the problems and the needs for people with LV is essential for their social inclusion.

Mainstream teachers and school administrators should understand what their students with LV can do and their limitations in order to insure not only their access to the curriculum but also their social integration.

When informed of the condition of a person with LV, the employer and colleagues can often make simple adjustments to the work place to make living with VI much easier.

NOW YOU SHOULD UNDERSTAND:

1. The skills needed to get a service started.

2. The keys points to prepare the space.

3. How to reach people with LV.

1 RESOURCES

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1.1 Test your knowledge

The following is a list of myths and facts that have actually been suggested as reasons for low vision. See if you can work out the truth.

#	Statements	True	False
1	Children who still have a little vision should not use it too much; so that the vision does not get worse, (Vision will wear out if it is used too much).		
2	Most children with low vision have also other problems.		
3	Reading on a computer screen or by holding a book very close to the eyes or sitting close to the television will harm the eyes.		
4	Any child wearing glasses has low vision.		
5	Reading or sewing in a dim light will not damage vision.		
6	Electric lighting is bad for the eyes.		
7	Low vision or blind people can hear better than sighted people.		
8	A child with one good eye and one bad eye has low vision.		
9	The distance is not very important to understand visual functioning.		
10	Visual skills develop automatically in children with impaired vision.		
11	Functional vision can be improved with training.		
12	Changing the physical environment can benefit people with visual impairment.		
13	Children with low vision should learn Braille.		
14	The person who wears spectacles sees less than the others do.		
15	Every person with low vision sees the same way.		
16	Blindness and low vision are synonyms.		
17	No need to verbally inform the person with VI before touching him.		
18	Persons with VI may have cognitive or hearing problems; this is why people tend to talk over their head instead of addressing them directly.		
19	Leaving things thrown around and changing the furniture arrangement without telling the person with VI will affect his mobility.		
20	People with VI can be trained to estimate the size of a room using only their hearing.		
21	It is not acceptable to take things off the hands of person with VI in order to save time.		
22	Describing the details and explaining what is going around is a priority when communicating with persons with VI.		

Answers are on p. 102

1.2 Making simulation glasses

The simulation glasses are used as educational tool to demonstrate different types of functional vision loss. It can be done in different ways; here is one.

You need:

- The template (p. 7)
- Pencil
- Ruler
- Scissors
- Thick cardboard
- Transparent plastic
- Needle
- Tape
- Rubber

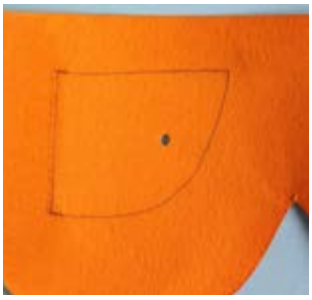
The center of the simulation glasses will be different according to the type of vision loss:

- **Overall blur:** replace the center piece with layers of tape or plastic wrap until you cannot read this text when putting them on.
- **Central field loss (central scotoma):** cut out the center piece, remove a few mm on the edges and tape it back.
- **Peripheral loss (tunnel vision):** use a needle to make a small hole in the center piece at the level of the pupils. For better results, make the two holes with the inter pupillary distance (IPD) of the user.

When the simulators are ready, make two small holes on both sides, insert the elastic band in the holes and attach it.

Overall blur

Central scotoma



Tunnel vision

Attach

1.3 Try them on

Use your simulation glasses to carry on at least 3 activities (see examples below). Describe the difficulties you encountered.

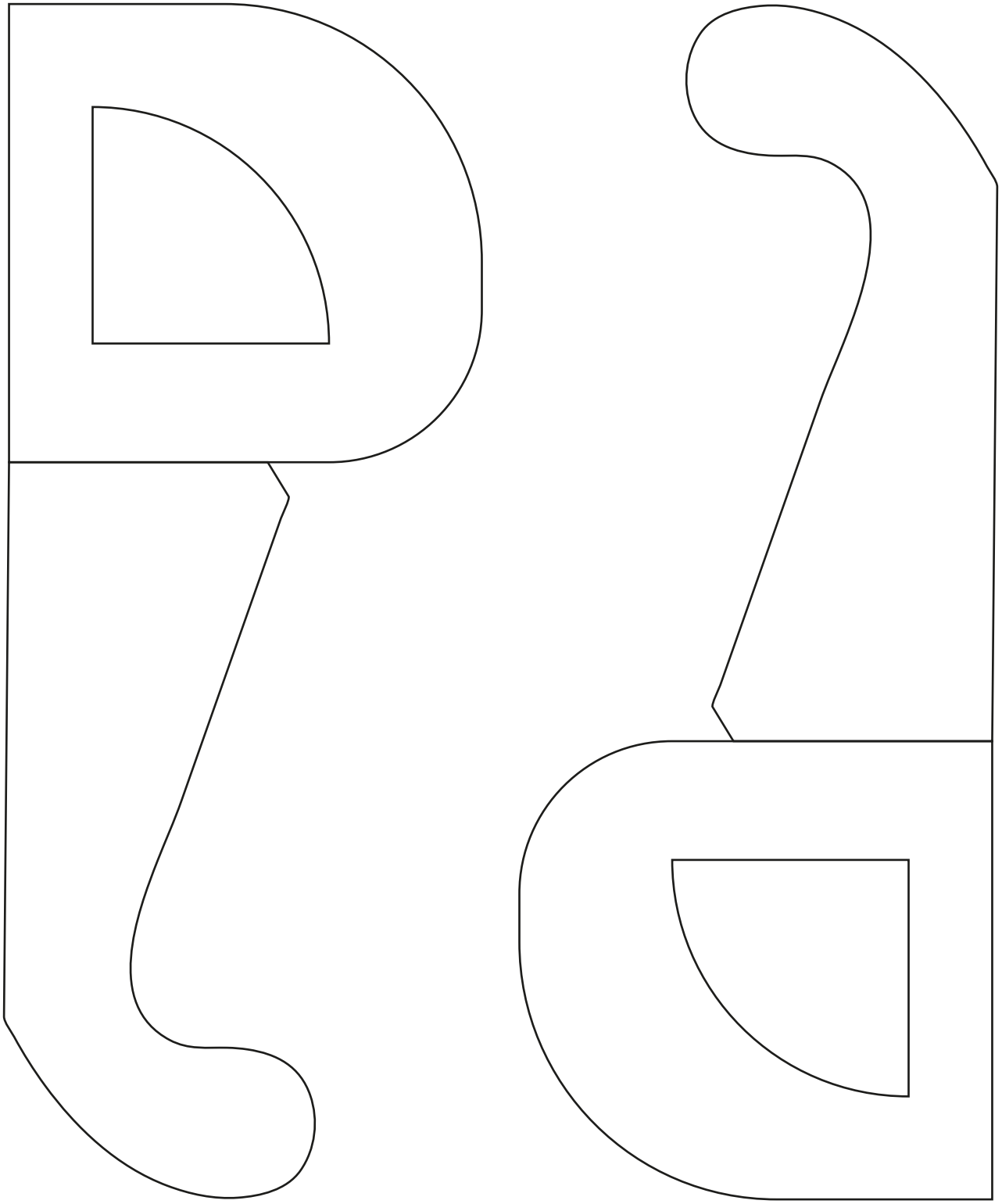
While sitting or standing

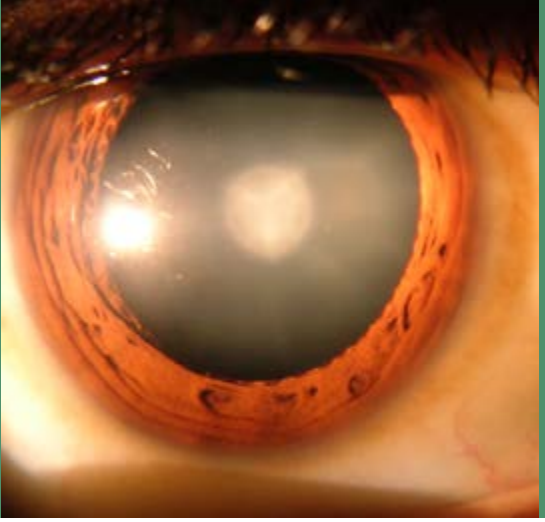
- Talk with people
- Write shopping list
- Call a friend on mobile
- Drink from glass or cup
- Pour liquid
- Look at pictures
- Watch TV
- Use a vending machine

Moving

- Find the restroom in a public place
- Find a certain shop in a shopping area or mall
- Buy items from a shop

1.4 Template for simulation glasses





2 VISUAL IMPAIRMENT

Muawyah Al Bdour MBBS. FRCSI (Ophth)

FAQ

Q: Do PVI have to wait for eye treatment to finish before they seek help from low vision services?

A: No. Many eye diseases are chronic and treatment may continue for many years.

Low vision work will not interfere with the solutions offered by eye doctors. However, it can be useful to write and inform them of your actions and recommendations.

2.1 Diseases leading to VI

There are many different diseases causing VI. It is beyond the scope of this book to go into detail about all of these conditions. But when working with PVI it is important to understand the basic structures of the eye as well as having an understanding of the main diseases which cause VI. An understanding of eye diseases will allow you to better appreciate the challenges and difficulties facing the people who use your services.

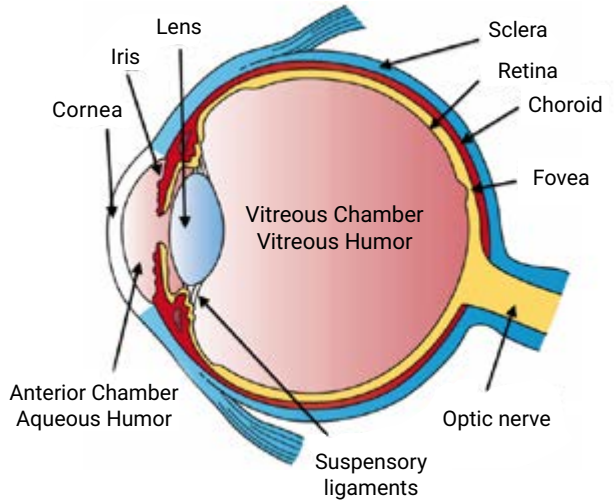


Figure 2.1 Cross section diagram to show the main parts of the eye. Illustration: "Three Main Layers of the Eye" Artwork by Holly Fischer via Wikimedia Commons.

GOLDEN RULE

Before any low vision work starts, all people should have an up to date assessment from an eye doctor.

Low vision work is NOT a substitute for medical treatment of an eye disease. All medical options to preserve vision should be explored before low vision work starts.

The main causes of VI also vary across the world. This is summarized in Table 2.1 and Figure 2.2.

Table 2.1 The major causes of VI in different regions of the world.

Global Region	Main Cause of VI
Africa + Asia	Cataract, uncorrected refractive error, trachoma, corneal disease, glaucoma, vitamin A deficiency
Latin America	Cataract, glaucoma, diabetic retinopathy
North America + Europe	AMD, diabetic retinopathy, glaucoma

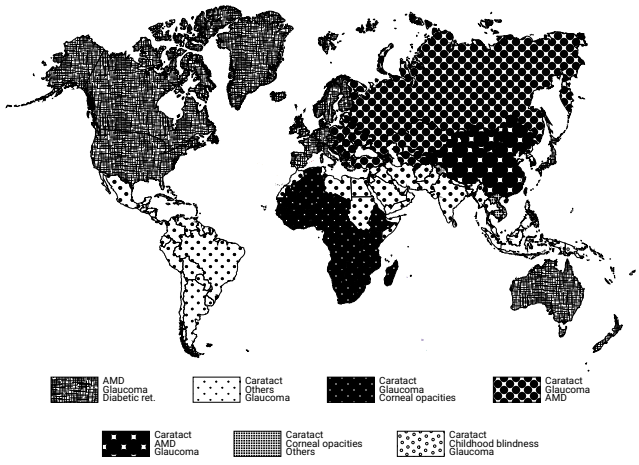


Figure 2.2 Main causes of VI worldwide. The map is based on the data published by Resnikoff and his colleagues in 2004, using the WHO division of regions. The eye diseases are listed in the order of their prevalence. The term "Others" refers to not one of the 8 main causes (cataract, glaucoma, AMD, corneal opacities, diabetic retinopathy, childhood blindness, trachoma and onchocerciasis).

The main diseases leading to VI can be classified in various ways; we will consider two of them:

1. Etiological classification based on the causes.
2. Anatomical classification based on the part of the eye affected.

TIPS

Etiology or aetiology: noun, plural: aetiologies.

Medicine: the cause, set of causes, or manner of causation of a disease or condition.

Example "The importance of sunlight in the etiology of cataract".

Below is a list of some of the most common eye diseases and their etiology.

Etiology	Example
Inherited	Retinitis pigmentosa (RP)
Infectious	Trachoma, onchocerciasis
Traumatic	Blow, car crash injuries etc
Inflammatory and dystrophic	Keratitis, keratoconus
Metabolic and nutritional causes	Diabetes, Vitamin A deficiency
Degenerative and age related	Age Related Macular Degeneration (AMD)
Uncorrected refractive error	Not able or willing to wear spectacles

Another way to classify eye diseases is to consider the part of the eye that is affected by the disease. This is not a perfect system as the same disease may affect different anatomical structures, so there may be some overlap. But knowing the structures affected allows a greater understanding of the type of problems facing the PVI.

Diseases can be roughly divided into 3 groups based on the areas of the visual system mostly affected:

i. **Anterior segment** or front of the eye for example cataract and corneal diseases.

ii. **Posterior segment** or back of the eye including glaucoma, retinal diseases and albinism.

iii. **Visual pathways** including the optic nerve and the brain such as in cortical visual impairment.

i Anterior segment

Cataract

Cataract is a clouding (opacity) of the lens inside the eye. It is the most common cause of blindness in the world.

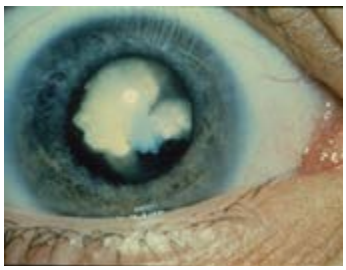


Figure 2.3 Cataract causes the lens to become cloudy. Photo: "White_congenital_cataract" by National Eye Institute in the public domain.

Cataract may develop as a result of:

- aging,
- trauma,
- congenital (present at birth),
- drug induced (e.g. high dose of steroids),
- metabolic problems such as diabetes.

GOLDEN RULE

Understanding the type and cause of the VI can allow you to better understand the PVI and the problems they may be struggling with.

It may also help you identify possible ways you can help.

Age group affected: All, but the senile form (aging cataract) is by far the most common.

Clinical presentation: Visual loss occurs because clouding of the lens obstructs light from passing through and being focused on the retina (Fig. 2.3). The denser the clouding becomes, the greater the level of VI.

Management: Although there are no scientifically proven means of preventing cataracts, wearing ultraviolet (UV) protecting sunglasses, avoiding smoking, and good diabetic control may slow the rate of development. There is no effective medical treatment (drops etc.) for established cases of cataract; the treatment is surgical.

Indications for cataract surgery: Whether or not to operate depends primarily on the effect of the cataracts on the PVI's vision.

If the cataract is the only eye disease the outcome of the surgery is generally very good, with PVI's noting an improved visual acuity and color vision.

For PVIs who have a cataract with other eye disease present (for example RP or glaucoma) then it can be much harder to anticipate the exact benefit of cataract surgery. Therefore the surgeon's advice is tailored to each individual PVI.

Corneal diseases

The cornea is the clear, curved surface that covers the front of the eye. The effects of corneal disease vary; some corneal conditions cause few, if any, visual problems. However, if the cornea becomes cloudy, light cannot penetrate the eye to reach the retina, and severe VI or even blindness may result.

Keratoconus

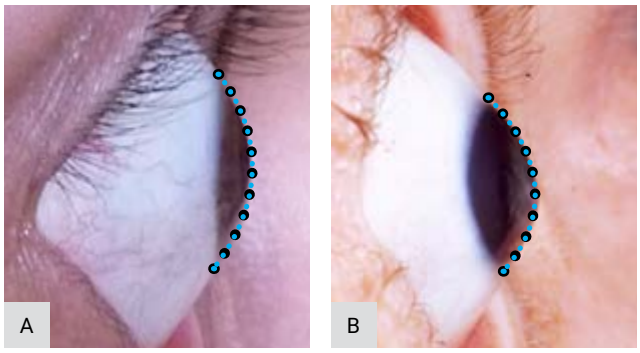


Figure 2.4 Keratoconus A) A normal cornea. B) The cornea shows a characteristic conical shaped seen in keratoconus. This causes distortion and blurring of the images in the eye. Illustration: B) "Keratoconus eye" by Indiana University School of Medicine, Department of Ophthalmology licensed under CC BY-SA 2.5.

Keratoconus is a dystrophy in which structural changes within the cornea cause it to become thin and change from the normal curve to a more conical shape (corneal ecstasia; Fig. 2.4). At advanced stages, the cornea may become painful, scarred and cloudy.

Age group affected: Usually starts at puberty and might progress. In most cases, the progression stops by the age of 35 years.

Clinical presentation: Initially present with refractive errors (usually myopic astigmatism) that change rapidly. At later stages, interference with corneal integrity and/or transparency can result in blurred or distorted images on the retina and thus PVIs may experience glare, cloudy vision, and reduced acuity.

Management: In most cases contact lenses, fitted by a specialist, are effective enough to allow the PVI to continue to drive legally and function normally.

Further progression of the disease may require surgery, for which several options are available. These include intra-stromal corneal ring segments and collagen cross linking to strengthen the cornea and prevent further progression.

If further changes occur and the cornea becomes permanently clouded or scarred, eye doctors may be able to restore vision with a corneal transplant. This involves surgical replacement of the old cornea with new tissue (from a matched donor).

Trachoma

Trachoma is caused by an infection of the ocular surface by a bacterium (Chlamydia trachomatis serotypes A-C), which is endemic in many countries of Africa, the Middle East, South America, and Asia. Trachoma can cause a severe inflammation of the ocular surface resulting in scarring of the eyelids. This causes eyelashes to grow in the wrong direction and rub the cornea.

Age group affected: usually during childhood or early adulthood.

Clinical presentation: Initially causes irritation and photophobia. Multiple re-infections can cause scarring, severe dryness and opacity of the cornea.

Management: Prevention is established by having a clean environment and suitable sanitation. Early cases can be treated with antibiotics, however longstanding cases with scarring don't respond to antibiotics and need surgery.

To address trachoma, the World Health Organization (WHO) recommends carrying out an initiative called 'SAFE' which stands for:

- **S**urgery to repair damage to the eye.
- **A**ntibiotics to treat the infection.
- **F**ace washing to reduce the spread of infection.
- **E**nvironmental changes, such as providing access to clean water and suitable sanitation.

Onchocerciasis

Also known as river blindness, onchocerciasis is caused by the filarial nematode Onchocerca volvulus, a worm transmitted by the Simulium black fly which breeds in rivers and streams of Africa, the Middle East, parts of Central America and Brazil. Onchocerciasis is endemic in at least 27 sub-Saharan African countries and in Yemen.

Age group affected: Usually childhood or early adulthood.

Clinical presentation: The infection can cause conjunctivitis, corneal scarring, uveitis, and glaucoma with involvement of the retina and optic nerve. It carries a high risk of blindness.

Management: A drug called Ivermectin should be used for a long period (months or even years) and complications of the disease should be treated as they arise.

Vitamin A deficiency

Vitamin A deficiency can result in xerophthalmia (severe dryness), which leads to complications at the anterior and posterior segments of the eye. It is the single most important cause of childhood blindness in developing countries.

Age group affected: An estimated 2.8 million pre-school-age children are at risk of blindness from Vitamin A deficiency.

Clinical presentation: Initially causes irritation due to dryness, then scarring of the cornea, ulceration and perforation (keratomalacia). In addition, night blindness can occur.

Management: Vitamin A supplements. This simple treatment can reduce child mortality by up to 34% in areas where Vitamin A deficiency is a public health problem.

TIPS

Anterior segment eye disease often causes clouding of the cornea (front of the eye) or the lens.

This clouding causes light scatter and hazy vision, leading to problems with glare and seeing items of low contrast.

EXAMPLE

You have found out that the PVI has lost vision due to keratitis.

You should now understand that this is an inflammation that causes corneal clouding and as a result, he may be struggling with glare and seeing objects with low contrast.

These should be things that your LV service can help with.

ii Posterior segment

Glaucoma

Glaucoma refers to a range of disorders with a characteristic type of optic nerve damage and progressive visual field loss. There are many mechanical, vascular, and biochemical theories as to the cause but high intraocular pressure also seems to be associated with glaucoma.

There are two main categories of glaucoma and they have very different mechanisms.

1. **Open-angle** glaucoma is the most common type. It occurs from decreased aqueous drainage caused by a dysfunction or microscopic clogging of the trabecular meshwork. This leads to chronically elevated eye pressure, and over many years, cause gradual vision loss.
2. **Closed-angle** glaucoma, also called "acute glaucoma", occurs when the angle between the cornea and iris closes abruptly. With this closure, aqueous fluid can't access the drainage pathway, causing eye pressure to increase rapidly. This is an ophthalmological emergency.

Age group affected: Except for the congenital glaucoma, the majority of cases of open and close-angle glaucoma develop after the age of forty.

Childhood or congenital glaucoma is when a newborn is affected by glaucoma. When the glaucoma manifests in late childhood and puberty, it is described as **juvenile glaucoma**. In both cases it is an inherited disease.

Clinical presentation: A PVI with primary open angle glaucoma may not notice any symptoms until severe visual damage has occurred. This is because the rise in intraocular pressure and consequent damage occur so slowly that the PVI does not recognize the changes to their vision until significant damage has been done.

In contrast, the clinical presentation of acute angle closure glaucoma is easier to identify, as the intraocular pressure rises rapidly and results in a red, painful eye with disturbance of vision.

In **congenital** glaucoma, the raised intraocular pressure can stretch and enlarge the eye, which is still elastic. The term used to describe such a case is "buphthalmus".

Medication: Intraocular pressure can be lowered with medication, usually eye drops. PVIs will sometimes need several types of drops, used at different times of the day, to control the pressure so adherence to medication protocol can be confusing and expensive.

Laser: Laser treatment can be used to burn portions of the trabecular meshwork itself. The resulting scarring opens up the meshwork and increases outflow. A laser can also be used to burn away part of the ciliary body to decrease aqueous production.

Surgery: It was traditionally used only when other treatment (medication or laser) had failed to halt the progress of glaucoma, but there is some recent evidence that suggests earlier surgical intervention is beneficial for selected PVIs.

Over a period of time, especially if left untreated, glaucoma causes irreversible optic nerve and visual field damage, and reduced visual acuity. The resulting damage causes significant problems with mobility, impaired night vision and reading skills.

Management: The treatment of congenital glaucoma is surgery with eye drops.

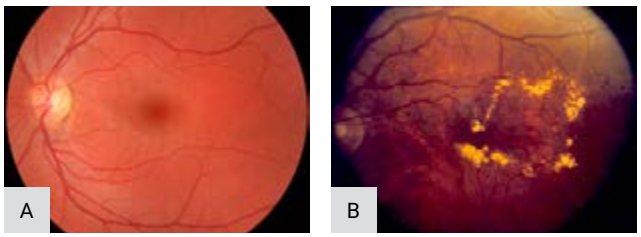


Figure 2.5 Examples of retinal fundus. A) Normal. B) Diabetic retinopathy. Note the fatty yellow exudates leaking in the retina causing damage in this case to the central vision. Photos: A) "Fundus photograph of normal left eye" by Mikael Häggström licensed under CC0. B) "Diabetic macular edema" NEI by United States licensed in Public Domain

Diabetic Retinopathy

Diabetes is a common disease which can affect the small blood vessels of the body including those in the retina. Diabetic retinopathy is the term used to describe this retinal damage. The problems caused by diabetes in the retina include:

- Ischemia: blood vessels fail to transport food, waste and oxygen,
- Leakage: blood vessels leak blood or fats causing damage to the retina,
- Abnormal shape: blood vessels can cause massive hemorrhages or retinal detachment.

Approximately 40% of people with diabetes have some degree of diabetic retinopathy. In addition to the retinal problems diabetes can also cause problems with other structures in the eye including the lens and the optic nerve. People with diabetes have a 25 times greater risk for blindness than the general population.

Age group affected: The longer a person has diabetes and the poorer their control, the higher his chances are of developing diabetic retinopathy.

Clinical presentation: Asymptomatic in early stages, then there will be fluctuating or severely reduced visual acuity, sensitivity to glare and reduced contrast sensitivity. At advanced neglected stages, it can lead to blindness.

Management: Modification in the life style and diabetic control will delay the onset and progression of complications. Once the retina is severely damaged, the treatments (below) are used to stop the progression of the disease and will rarely restore the vision lost.

Laser treatment: Can be used focally to seal off leaking vessels in the retina by burning them. Laser can also be applied in multiple spots around the peripheral retina (pan retinal). This destroys the ischemic retina, decreasing the risk of complications.

Intravitral injections of anti-vascular endothelial growth factors (anti VEGF) are used to reduce macular edema.

Surgery may also need to be performed to clean vitreous hemorrhage. This surgery involves removing the vitreous humor from the eye to eliminate any fine strands of vitreous attached to the retina and relieve traction that may lead to a retinal detachment.

Age related macular degeneration (AMD)

Macular degeneration is caused by degenerative changes to the central area of the retina (macular). Smoking is a well-known risk factor. There are two basic forms of the disease.

- **Dry AMD**, characterized by a slow progression. The vast majority (80-90%) of the persons with AMD suffer from this form.
- **Wet AMD** is caused by the leaking of blood vessels underneath the retina. This causes the vision to deteriorate rapidly.

Age group affected: usually above the age of 55.

Clinical presentation:

- Sudden image distortion (Wet AMD),
- Absolute or relative area of no vision (scotoma) primarily in central areas,
- Reading and driving becomes increasingly difficult due to the progressive reduction in visual acuity,
- Decrease in color recognition and contrast sensitivity.

Management: Dry AMD has no current medical intervention although it has been shown that a good balanced diet and stopping smoking can be useful in slowing the progression. Antioxidant vitamins have also been shown to have a useful benefit in reducing the rate of "wet transformation" in some individuals.

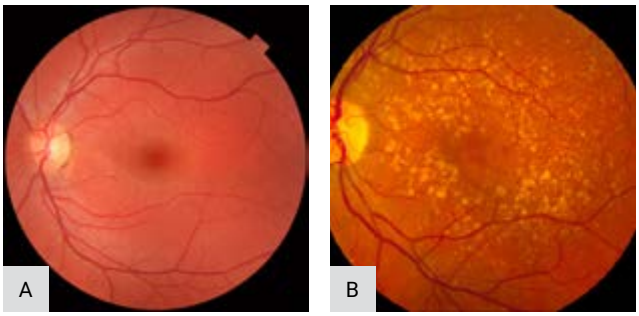


Figure 2.6 Examples of retinal fundus. A) Normal. B) Dry AMD. Note the white circular drusen causing damage to the macular. This progressive disease causes central vision loss. Photos: A) "Fundus photograph of normal left eye" by Mikael Häggström licensed under CC0. B) "Intermediate age related macular degeneration" NEI by United States licensed in Public Domain.

These PVIs should be monitored for any sudden changes in vision which may indicate a progression to wet AMD. PVIs can monitor themselves with an Amsler Grid chart (a sheet of straight lines they can look at weekly to look for distortion, (see Chapter 8).

Wet AMD in its earlier stages can be treated with intravitral injections of anti-vascular endothelial growth factor (anti VEGF) to seal off and prevent growth of abnormal leaking blood vessels. Treatment is aimed at preventing further harm to the retina rather than healing damage already in place. It is therefore essential that these PVIs are assessed and treated with reasonable speed.

Retinal dystrophies

This is a heterogeneous group of inherited eye diseases that cause severe vision impairment and often blindness. The most common conditions are discussed in this section.

Retinitis Pigmentosa (RP)

RP is the most common cause of inherited blindness, characterized by the progressive loss of photoreceptor cells of the retina. Usually the rod photoreceptors (responsible for night vision) are affected first, which is why night blindness (nyctalopia) is typically the first symptom. Daytime vision (mediated by the cone photoreceptors) is usually preserved until the late stages of the disease.

Age group affected: Varied. Some people will exhibit symptoms from early childhood (juvenile RP); others may not notice symptoms until later in life.

Clinical presentation: Night vision and peripheral vision go hand in hand - the more advanced the RP, the smaller the remaining visual field (tunnel vision) and the more difficult to move around safely. Also reading becomes more difficult as the visual field becomes smaller and the central retina becomes involved.

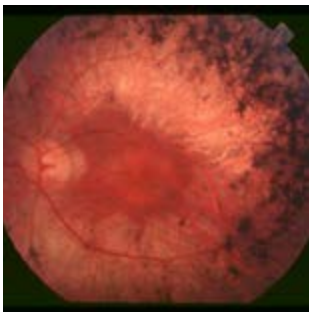


Figure 2.7 Retinitis Pigmentosa. Note the lack of healthy blood vessels and the dark pigmentation at the edge of the retina. This progressive disease causes initially peripheral vision loss (tunnel vision), night blindness and sensitivity to glare. Photo: "Fundus of patient with retinitis pigmentosa, mid stage" by Christian Hamel licensed under CC BY 2.0.

Management: At present, no medical or surgical treatments are known to stop or decrease the progression of RP. Prevention includes advice against marriage of relatives as it is an inherited disease.

Albinism

Albinism is characterized by a deficiency in the pigmentation of the skin and hair, as well as the iris and retina. It is a trait that is inherited through autosomal recessive or sex-linked transmission.

Age group affected: PVIs will exhibit symptoms from birth.

Clinical presentation: Persons with albinism have a decrease in visual acuity due to macular under development (hypoplasia), nystagmus, an associated refractive error and photophobia.

Management: Treatment consists of corrective spectacle lenses as well as absorptive lenses to reduce light sensitivity. As it is an inherited disease, discouraging marriage with relatives can decrease the prevalence of the condition.

Fig. 2.8 Albinism. Photo: 'Eyes of a person with complete OCA1 (Albinism)' By Karen Grønskov, Jakob Ek, and Karen Brondum-Nielsen licnesed under CC BY 2.0.

TIPS

Posterior segment eye disease has different effects on the vision depending on the area affected:

- Diseases affecting the peripheral vision will typically lead to problems with orientation & mobility and with night vision.
- Diseases affecting the central vision will typically cause problems with details and color perception.

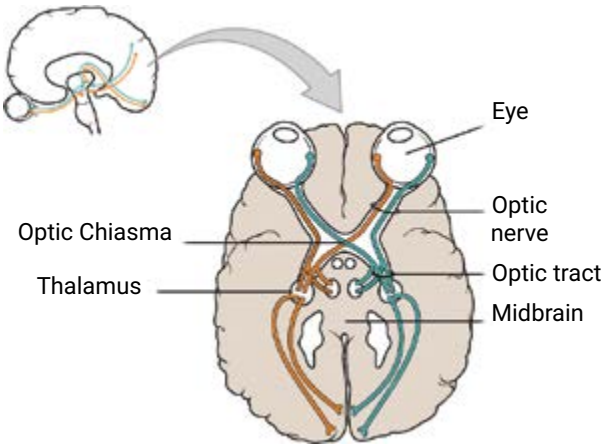


Figure 2.9 The visual pathways from the eyes to the primary visual cortex. Information from the nasal retina crosses at the optic chiasm. Illustration: "1204 Optic Nerve vs Optic Tract" by OpenStax College licensed under CC BY 3.0

iii Visual pathways

Diseases which affect the optic nerve and visual pathway can lead to visual impairment despite having a healthy eye.

Cortical visual impairment (CVI)

CVI is caused by a brain problem rather than an eye problem. CVI is also sometimes known as cortical blindness, although most people with CVI are not totally blind. Though the vision of a person with CVI may change, it rarely if ever becomes totally normal.

The major causes of CVI are as follows:

- Lack of oxygen (which may occur during the birth process) caused by either:
  - asphyxia,
  - hypoxia (a lack of sufficient oxygen in the body's blood cells),
  - ischemia (not enough blood supply to the brain),
- developmental brain defects,
- head injury,
- hydrocephalus (when the cerebrospinal fluid does not circulate properly around the brain, and collects in the head, putting pressure on the brain),
- stroke involving the occipital lobe,
- infections of the central nervous system, such as meningitis and encephalitis.

Clinical presentation: Symptoms of CVI usually include several (but not necessarily all) of the following:

- Variable vision. Visual ability can change from one day to the next, but it can also fluctuate from minute to minute, especially when the person is tired.
- Some objects may be easier to see than others. For example, the person may have difficulty recognizing faces or facial expressions but have fewer problems with written materials. This is presumably due to the different way that the brain processes different things.

Management: There is no cure for CVI. Over time, people can be helped to develop strategies to overcome some of the deficits particularly by using color and contrast. The brain's color processing is distributed in such a way that it is more difficult to damage, so people with CVI usually retain full perception of color. This can be used to advantage by color-coding objects that might be hard to identify otherwise. Other areas to consider include:

- Avoiding visual clutter (plain surfaces with very few objects),
- Repetition of visual tasks helps learning,
- Pairing visual stimuli with other sensory clues e.g. texture or sound,
- Presenting tasks with high contrast between objects.

EXERCISE 2.1

A person who comes to your center has had laser treatment to her eyes due to problems caused by diabetes.

What is the cause of diabetes and what sort of vision problems may the PVIs have because of the treatments?

See answer p. 102

2.2 Amblyopia and Strabismus

Vision problems are common in children and early recognition and treatment are key to preventing permanent visual impairment.

Amblyopia (also referred to as lazy eye) is poor vision in one eye. Children develop amblyopia between birth and seven years of age, when the weak eye is "turned off" by the brain to avoid double vision. The ignored eye fails to develop fully, and amblyopia develops. Effective treatment of amblyopia needs to happen during childhood. Without treatment, this eye will never see well, even with glasses.

There are 3 kinds of amblyopia according to etiology:

1. Strabismic amblyopia (eyes are misaligned),
2. Sensory deprivation amblyopia (e.g. congenital cataract),
3. Refractive/Anisometropic amblyopia (for example, caused due to an uncorrected refractive error).

Strabismus or squint is a misalignment of the eyes. The eyes may cross or drift up or out.

Not all lazy eyes are misaligned; some children have amblyopia due to an uncorrected refractive error. This causes one or both images to be blurred and prevents normal development of the eyes.

Clinical presentation: Many children with amblyopia show no obvious sign of a vision problem, since they use their good eye to see and ignore the other. For this reason, early vision testing is essential.

Amblyopia is detected during an eye exam by finding a difference in the vision between the two eyes.

Strabismus is usually recognized as a crossing or drifting out of one or both eyes. The drifting may be constant or intermittent.

Management: Fortunately, most children with amblyopia and strabismus can be treated effectively.

In order to correct **amblyopia**, the brain must be reconditioned to pay attention to images from the lazy eye. This may be accomplished by the use of spectacles, part-time patching treatment, or eye drops that blur the vision of the stronger eye. Patching or blurring the stronger eye forces the brain to use the lazy (amblyopic) eye and over time, the vision of the weaker eye improves. Strabismus can sometimes be treated with spectacles, but may require eye muscle surgery to carefully straighten the eyes.

GOLDEN RULE

A lazy eye can be treated if discovered early enough (ideally preschool age). Young children with strabismus or significant refractive error need to be seen and treated as soon as these problems are identified to prevent the amblyopia (lazy eye) becoming permanent.

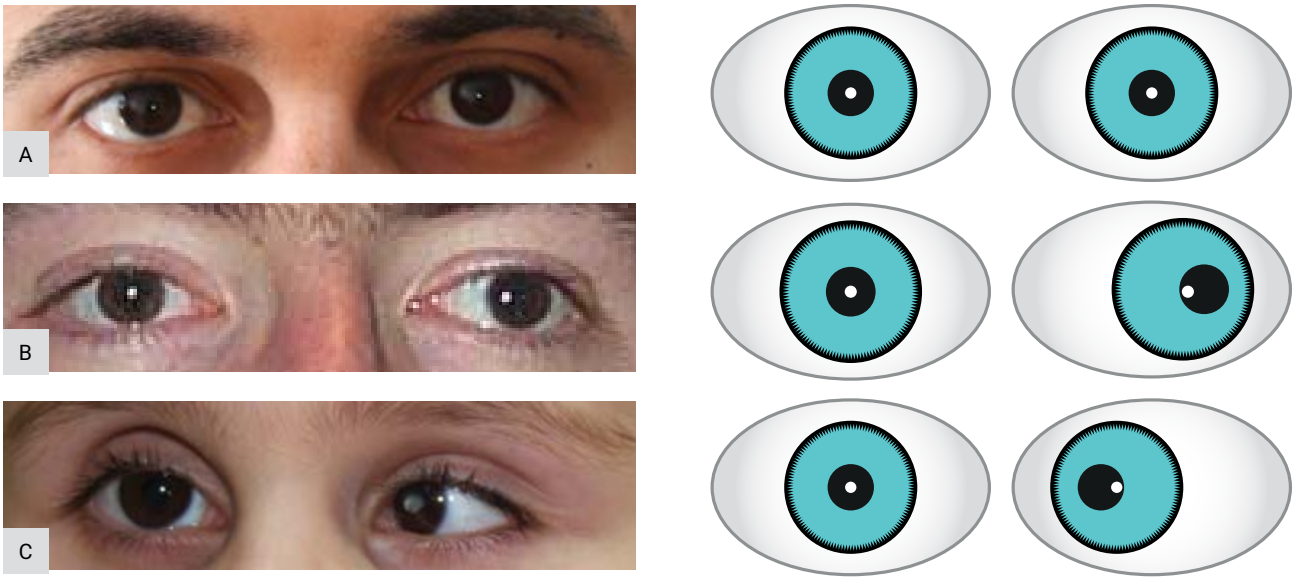


Figure 2.10 Strabismus. The eye that turns would produce double vision and confusion. The brain will "switch this eye off" quickly leading to amblyopia (lazy eye) if not treated. A) Normal gaze: both eyes are fixating in the center. B) Exotropia. When the subject looks at the light, the reflection is in the center of the pupil in the right eye but not in the left eye, where the eye turns outwards. C) Appearance of Esotropia. A child with no light perception in the left eye. The right eye looks straight at the target and the left eye is turned inwards. Photo: B) "Strabismus" by Montrealais licensed under CC BY-SA 3.0.

Table 2.2 Common eye diseases leading to visual impairment. IOP: intraocular pressure, IOL: intraocular lens. VA: visual acuity.

Disease	Part of the eye affected	Effect	Stability	Medical Treatment
Albinism	Retina: macula underdeveloped, lack of pigments	Low VA, photophobia, nystagmus	Stable	None
Age related macular degeneration DRY (AMD)	Macula: progressive degeneration	Central scotomas	Gradual loss	None. Stop smoking and change in diet may help
Age related macular degeneration WET (AMD)	Macula: progressive degeneration	Central scotomas	Rapid loss	Anti-VEGF and laser
Cataract (congenital, senile, traumatic)	Lens: clouding	Blur, faded colors, sensitivity to glare	Stable if treated	Replacement of lens by IOL
Coloboma	Iris, retina, eye lid, disk: developmental failure	Variable	Stable	None
Corneal dystrophies	Cornea: lacks of transparency	Overall blur	Stable or progressive	Corneal transplant
Corneal opacity (caused by trauma or ulcer)	Cornea: loss of transparency	Overall blur	Stable	Corneal transplant
Diabetic retinopathy	Retina: uncontrolled growth of blood vessels	Variable from person to person and day to day	Variable	Laser, drug or diet, Anti-VEGF
Glaucoma (congenital)	Eyeball: large, raised IOP that also affects the optic nerve	Initial loss of the peripheral field, corneal opacity at late stage	Variable	Drops for life/ surgery
Glaucoma (primary open angle)	Nerve: changes associated with raised IOP	Gradual and progressive field loss.	Decline if no treatment. Maybe deteriorate with treatment	Drops to lower IOP/ surgery
Glaucoma (acute angle closure)	Cornea: edema caused by high IOP	Overall blur	Stable if treated	Surgery to open angle and increase drainage
Keratoconus	Cornea: thinning and bulging out	Central distortion of images	Gradual	Rigid contact lenses, surgery
Lens subluxation	Lens: misplacement	Variable	Stable	Surgery
Microphthalmos	Whole eye: developmental failure	Variable	Stable	None
Optic nerve atrophy	Optic nerve: damaged	Low visual acuity	Stable or progressive	None
Optic neuritis	Optic nerve inflammation	Vision loss over hours to days, colour desaturation	Partial recovery possible	Corticosteroids during acute phase
Phthisis Bulbi	Eye ball: disorganization of the structures	No vision	Stable	None
Persistent Hyperplastic Primary Vitreous (PHPV)	Vitreous: developmental failure	Variable	Stable	None
Retinal detachment	Retina: separation from the epithelium	Variable	Rapid initial loss of vision. Stable if treated	Emergency surgery to close tears and reattach retina
Retinopathy of prematurity (ROP)	Retina: uncontrolled growth of blood vessels with risk of retinal detachment	Variable	Stable if treated	Laser for early stages
Retinoblastoma	Retina: tumor	Variable	Stable when tumor is treated	Treatment of tumor. May lose the eye
Retinitis pigments (RP)	Retina: rods more than cones	Tunnel vision, night blindness, central scotomas	Gradual loss	None

TIPS

Most young people with amblyopia are NOT PVI as they have only problems with one eye while the other is a fully sighted eye which allows them to see well.

However, those with only one good eye are more vulnerable to the effects of other eye diseases as they get older.

NOW YOU SHOULD UNDERSTAND:

1. The main diseases that cause VI.

2. The treatment options open for these diseases.

3. How the type of eye disease affects the vision loss.

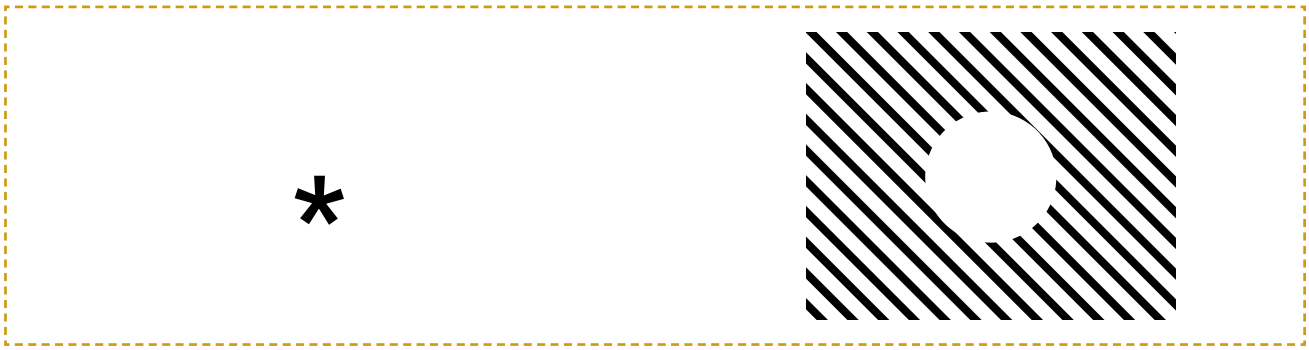
2 RESOURCES

2.1 Blinded by the blind spot

1. Close the left eye.
2. Hold the paper at arms' length.
3. Stare fixedly at the asterisk on the left side while moving the paper forward.
4. From 25 -35 cm from your eyes, the butterfly will disappear.

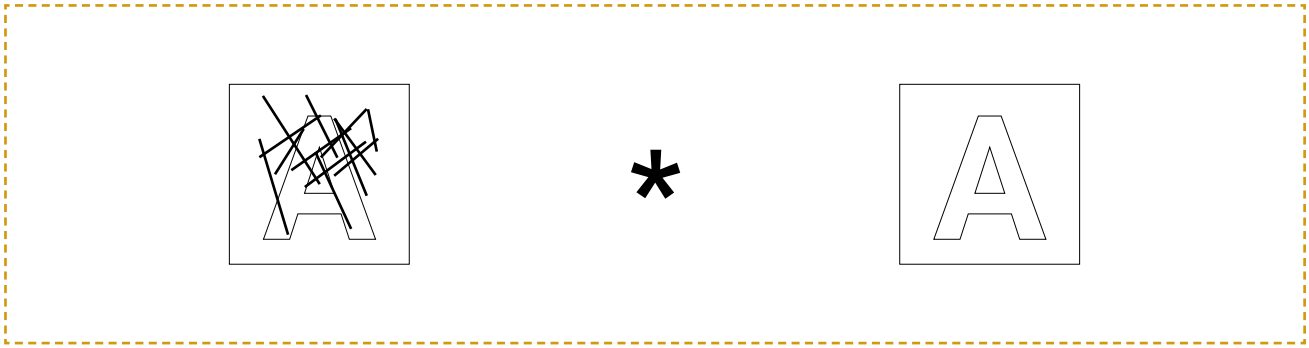
2.2 Filling the blind spot

Same as 5.3, except the dotted pattern will fill the white circle.



2.3 Crowding in the field

1. Hold the paper at 25 cm.
2. Look at the asterisk. Compare how you see the A's.



3 PRE-ASSESSMENT

Andrew Miller MSc MCOptom

3.1 History, Needs & Expectations

GOLDEN RULE

It is essential to put the persons with visual impairment (PVI) at the heart of the low vision assessment.

We need to gather information that allows us to understand their problems, their needs and the barriers to accepting support before we can look for solutions.

Before we can discuss how to develop and deliver low vision services, both you and the PVI need to understand their purpose! **Low vision services aim to improve the quality of life of a PVI by enabling them to use their residual vision to its maximum potential.**

The improvement may come by the use of:

- Devices
- Training
- Advice and guidance
- Emotional support
- But always with **HARD WORK** for both you and the PVI.

TIPS

Low Vision services allow people to cope better with their residual vision.

It should be clear that low vision services are not "Magic" or a "Cure for eye disease".

Often, PVI attend with no clear idea of your role or the possibilities and limits of low vision services. Some PVI may be expecting a medical cure that will give them back their normal sight, while others may be very depressed by the decline in their vision and be unprepared to listen or accept the valuable help you can offer.

As practitioner, you need to develop the skills that will enable you to:

1. Establish good communication with the PVI by:
   - Listening, to understand the needs of the PVI.
   - Informing, using words and language that the PVI understands.
2. Gain trust: Our work relies on people changing and adapting their lives. They will only do this if they trust you and the information you give.
3. Manage expectations: Be clear about what is possible from the services that you offer.

3.2 Barriers to Change

Very few of us like change; whether it's changing your favorite drink or your favorite football team, it is something we all find hard to do. In low vision work, we are constantly asking PVI to change ways of doing things to make the best use of their residual vision.

For example: asking a person to sit in a new chair closer to the TV than before, or to use a magnifier to read when he did not need one before.

There are several barriers to change that you will meet, these include:

- Denial: "I am still looking for a cure",
- Depression,
- Unwilling to change or compromise (can come as a result of either of the points above),
- High expectations: the PVI is looking for perfection when you can only deliver "better",
- Physical limitations: poor grip or handling (this makes some adaptations more challenging).

GOLDEN RULE

You should put in practice the knowledge you gain from this book and other sources. Be brave and be prepared to make some changes to make things better for PVIs.

It is your job to understand the barriers to change and look at ways to help and support the PVI to integrate changes as easily as possible into their lives. You must listen to them to understand their challenges, worries and fears. They must feel constantly supported.

TIPS

People who want their normal vision back will frequently find it hard to accept any changes. They may say "your solutions don't make my vision like it used to be".

To help them accept the change, you need to keep showing how your changes improve on the use of the vision they have NOW.

Making positive changes for PVI, seeing them cope and manage better following your recommendations is a wonderful feeling! It can be hard work, but be brave and be prepared to make some changes to makes things better for people.

3.3 Assessment of Need

Put simply, low vision services involve two steps:

1. Identify a visual problem.
2. Solve the problem.

It seems so simple!

In a low vision assessment, identifying the problems or "assessment of need" takes place during a conversation with the PVI (sometimes this discussion may include family/carers). The assessment of need allows us to gather information and understand the impacts of the sight loss and the problems it creates. You have to pay attention to the PVI's needs and make sure that you are addressing THEIR real problems not the ones you think they have.

A good assessment of need requires that you develop a reasonable understanding of the PVI sitting in front of you. This person needs your empathy, but not your sympathy. In your mind, you need to swap places with the PVI and remember they are people just like you and me.

TIPS

em•pa•thy (ĕm'pə-thē) *noun*.

The ability to identify with or understand another's situation or feelings.

sym•pa•thy (sĭm'pə-thē) *noun*.

A feeling of pity or sorrow for the distress of another.

This information will be essential when trying to understand what help is needed and which is the most appropriate way of delivering support to this individual.

In brief, you should try and understand the PVI's:

- Needs
- Concerns
- Barriers

EXERCISE 3.1

Imagine you are 10 years old. Write down 5 things that you would find most difficult to do if you suddenly couldn't see.

Now imagine you are 70 years old. What would be the things you think you would struggle with if you suddenly couldn't see?

How do the needs of a 70 year old PVI differ from a 10 year old? *See answer p. 103*

Questions for the Assessment of Need

When meeting our PVI for the first time, what sort of questions do you need to ask?

It is always best to start with **open questions.** Open questions are ones that cannot be answered yes and no and invite the PVI to talk and describe the difficulties they face.

For example: "*How has the sight loss affected them?*"

When you feel the PVI has had a good chance to express their problems, you can then get specific pieces of information using **closed questions.** Closed questions give you direct, quick answers.

For example: *"How big is your TV?" or "Do you have a magnifying glass?"*

TIPS

Open questions cannot be answered yes or no.

- They force the respondent to think and reflect.
- They will provide you with opinions and feelings.
- They often include "describe" "tell me about".
- They hand control of the conversation to the respondent

Closed questions provide short answer and give specific information.

- They give you facts.
- They are easy and quick to answer.
- They allow you to control the conversation.
- They keep control of the conversation with the questioner

Below is a list of topics of conversation that often need to be covered when you do a needs assessment. We would encourage you to come up with questions that are relevant to the country where you work.

Figure 3.1 Assessment of need can take some time to do. Ensure you have a quiet space away from other distractions. Getting information from family members can also be useful in understanding the problems facing the PVI.

Typically, the assessment of need will include a mixture of open and closed questions. Here is an example of a sequence:

1. What problems does your sight give you?
2. How is your social life affected by your vision loss?
3. What's wrong? (eye condition)
4. How long have your eyes been affected?
5. Do you still see your eye doctor?
6. How is your general health? (comorbidity with other relevant conditions: arthritis, tremor, diabetes etc.)
7. Do you live alone/with family/ carers?
8. How do you move outside your home? (walking, buses, trains, taxis)
9. How do you move inside your home or familiar places?
10. Do you sometimes trip, fall or get burns?
11. Can you do your shopping/cooking/cleaning?
12. What do you read? (study/survival/pleasure)

TIPS

The list of questions above is intended as a guide. The actual questions you will ask vary depending on who you are dealing with and where in the world you are. The important thing is to keep in mind that you are asking questions to understand how you can support the PVIs' needs.

Recording Answers

The assessment of need can take as long as 30 minutes. It should not be rushed and the results should be well documented with clear and accurate records of the questions and answers.

Clear records will allow you to keep track of your assessments and also allow colleagues clear understanding of the PVI and your thinking. Structured clinic record cards can help keep accurate records. You will find a template in the Resource section of Chapter 9 that you can use or adapt to best suit your needs.

Sometimes you can use the assessment of need to gauge potential barriers that may occur later. What sort of impression do you get from the answers you received? Does the PVI sound:

- Determined?
- Motivated?
- Depressed?
- Like he has low or high expectations?

Once it is done and the problems are identified, you can set some realistic goals that the PVI would like to achieve. These goals can be listed in terms of how important the priorities are to the PVI, for example:

1. Read my letters,
2. See the TV better,
3. See better in the kitchen for cooking.

As mentioned earlier, sometimes the PVI will not have a sense of what can be done and set unrealistic goals, for example a man with very poor vision who wishes to drive his car again.

This cannot be included in the goals of the assessment, as you already know it will never be achieved. Instead, there should be a discussion with the PVI to explain why this particular task is not possible and demonstrate that there are other ways you will be able to help and support him.

When both the practitioner and PVI have a clear view of what they are working towards, it makes it easier to appraise the results in the short and medium term.

EXAMPLE

Once you have a clear idea of what you are trying to achieve, it is useful to summarize it back to the PVI: *"You have told me that your main priorities are that you would like to read your letters, see the TV better, and see better in the kitchen for cooking. Do you agree?"*

This way you are both clear on what the problems are. Now we just have to try and solve them!

NOW YOU SHOULD UNDERSTAND:

1. *The importance of taking history, needs and expectations.*
2. *The barriers to change.*
3. *Types of questions to ask in the assessment of need.*
4. *The importance to set targets and goals for the assessment.*

3 RESOURCES

3.1 Examples of functional problems in children with VI
3.2 Examples of functional problems in adults with VI

Maisaa Masoud MSc, BSc (Optom)
Yosur Qutishat MSc, BSc (OT)
Sami Shublaq MSc, BSc (Optom)

The tables below show some areas that are common problems for children and adults with VI. When you are designing your assessment form you may want to include them to help you make accurate notes and to remind you of potential areas to discuss. They are included as bullet points, but remember you will need to formulate them into questions to give the PVI opportunities to talk about the problems they face.

3.1 Examples of functional problems in children with VI

Functional problems		
☐ Reading	☐ Watching TV	☐ Eating
☐ Writing	☐ Playing indoors	☐ Grooming
☐ Using cell phone, tablet, laptop, etc.	☐ Moving outdoors	☐ Managing money
☐ Seeing the board in school	☐ Playing outdoors	
☐ Recognizing faces	☐ Moving from in to out & vice versa	

Disturbed by sun/light: ☐ Yes ☐ No, **Uses sunglasses:** ☐ Yes ☐ No _____, **Helpful:** ☐ Yes ☐ No _____

Notes: _____

_____

3.2 Examples of functional problems in adults with VI

Functional problems		
☐ Reading	☐ Watching TV	☐ Doing house work
☐ Writing	☐ Moving indoors	☐ Reading medication
☐ Using cell phone, tablet, laptop, etc.	☐ Moving outdoors	☐ Shopping
☐ Office work	☐ Moving from in to out & vice versa	☐ Eating
☐ Recognizing faces	☐ Managing money	☐ Grooming

Disturbed by sun/light: ☐ Yes ☐ No, **Uses sunglasses:** ☐ Yes ☐ No _____, **Helpful:** ☐ Yes ☐ No _____

Notes: _____

_____

4 ASSESSMENT OF VISUAL FUNCTIONS

Frank Eperjesi PhD FCOptom

The way we see and understand the world around us relies on the complex processing of information about resolution, color, contrast, and brightness. When you meet a person with visual impairment (PVI) in your clinic for the first time, it is important to be able to understand the extent and impact of their visual impairment on their ability to comprehend the visual world around them.

As clinicians, we need to be able to run a series of tests that will allow us to quantify the impairment of vision and appreciate the ways it may be causing problems. Once we understand the problems, we can use the information to begin the rehabilitation process and to describe the impairment to others who may be working with the PVI.

There are many tests that can be done to assess visual function. We will use this chapter to describe some of the main ones:

- Refraction
- Visual Acuity
- Visual Fields
- Contrast Sensitivity
- Color Vision

4.1 Refraction

It must be appreciated that as best corrected acuity falls due to eye disease, the benefit of spectacles diminishes significantly. Lower powered prescriptions or small changes in existing prescriptions that would benefit the fully sighted person may have less impact for someone with visual impairment.

GOLDEN RULE

It is important that the PVI coming for assessment has an up to date refraction and spectacles to improve their acuity to the best possible levels. This is the base that we build our other support upon.

When conducting a refraction with a PVI, optometrists should rely more heavily on objective refraction and in particular retinoscopy readings, as subjective readings can be harder to elicit. It should be noted that for PVIs with nystagmus, poor media and central scotoma auto-refractor readings can also be inaccurate.

TIPS

We must remember that myopic people often prefer to read without their spectacles on. This allows them to hold things closer and use less accommodation.

PVI who are myopic can use this as a simple way of adding near magnification and it should not be discouraged.

Figure 4.1 Low vision and refractive errors. A child with high myopia looks under her spectacles to see the details of a toy. The spectacles allow a clearer distance image, but she sees better without the spectacles when viewing very close targets. This allows a larger clearer image and should not be discouraged.

Figure 4.2 Low vision and refractive errors. A visually impaired child with a hyperopic (longsighted) spectacle prescription uses his spectacles for all tasks.

4.2 Distance and Near Acuity

Visual acuity (VA) can be described as the smallest symbol or letter that can be identified, while best corrected VA (BCVA) refers to the VA measured after correcting any refractive errors with spectacles or contact lenses.

Use

Accurate VA assessment is important in terms of:

- detecting and monitoring disease,
- determining the outcome of refraction,
- determining the strength of optical devices that will help the person achieve their goals,
- establishing legal blindness, job eligibility and school program placement.

VA can be measured with a chart or any other system that uses letters or symbols (also known as optotypes). The measurement of VA with optotypes can also be described as assessing recognition or identification (minimum recognizable) ability.

Several factors can affect the VA measured including:

- the actual VA,
- test setting (illumination, contrast),
- motivation and attention of the PVI,
- presence of any pathology,
- skill of the practitioner and PVI-practitioner rapport.

Procedure

Information about which eye is best is useful when providing optical magnification. For this reason, VA should be measured with each eye in turn, testing the poorer eye first, then the stronger eye and finally binocularly. Some individuals will be able to tell you which eye is the poorest and for others this information may be in the case history. Otherwise, the right eye is usually tested first.

Some people may remember letters from one eye to the next, so different letters of approximate equal difficulty should be used for VA determination in each eye and then binocularly. An occluder should be used to cover the eye not being tested (Fig. 4.3). It is not appropriate to ask the PVI to cover one eye with the palm of their hand as some PVIs may peek between their fingers or press too firmly, distort the cornea and lead to an artificially reduced VA measurement when that eye is assessed. Similarly, it is not appropriate to ask the PVI to hold the occluder, as poor positioning in front of one eye may lead to an over estimate of VA in the other eye.

Figure 4.3 An occluder should be used to cover the eye not being tested. It is not acceptable to use a hand to cover the eye. If not available these can be made very easily.

GOLDEN RULE

It can be difficult and de-motivating for PVI if they fail to see any of the symbols on a chart. To avoid this, you should use a chart where the working distance can be decreased to allow the PVI to see some letters/symbols.

This helps to improve PVI/practitioner rapport and can allow a more consistent and accurate recording of VA.

For PVI try and use a logMar chart as it gives a much more accurate representation of visual acuity than a Snellen chart.

Pushing PVIs to their **threshold VA** (forced choice) will make the measurement more accurate. To achieve this, all PVIs should be encouraged to read as many letters as possible. Children (and some adults) are naturally cautious and don't want to make mistakes, so may stop before their threshold. PVIs should be gently encouraged and allowed to guess but ***not*** allowed to lean or move forward closer to the chart.

TIPS

You should aim to measure threshold acuity, the best that a PVI can do when really trying. This gives a more consistent end point improving accuracy. Threshold acuity readings also reduce inconsistencies in readings from one visit to another and between practitioners.

Types Of Distance Acuity Charts

There are many different types of VA charts, and ideally a chart should be selected that is appropriate for the PVI who is being assessed. Many special charts have been designed to accommodate PVIs with reduced acuity, those who do not read letters, or children and people with cognitively impairment. If you can choose, the selection of the chart may be based on:

- The levels of VA expected
- Age of PVI
- Reading ability of PVI

The Snellen chart was the first standardized VA chart and was developed in 1862. Probably the most widely used chart, it is quick and easy to use, familiar to clinicians and PVIs worldwide and correlates well in most cases with PVI's subjective VA. logMAR charts were designed by Bailey and Lovie in 1976 to overcome the shortcomings of the Snellen chart (Table 4.1 and Fig. 4.5). For example, the spaces between optotypes and between lines are linear, and they allow to measure of wider range of VA.

Recording Findings

Confusingly there are several ways of recording findings and all are in common usage.

i. Fraction (metric) e.g. 6/9
   - The first number (numerator) refers to the testing distance (in this case 6 meters)
   - The second number (denominator) refers to the size of the letter read on the chart. This number also describes how far away the letter may be placed so a person with "normal" vision can still see it. So a size 18 letter can be seen 18m away by a fully sighted person (Fig. 4.4).

ii. Fraction (US), this is similar to above but using feet rather than meters e.g. 20/20.

iii. Decimal. This is a simple conversion of the Snellen fraction e.g. 6/12 becomes 0.5 and 6/60 becomes 0.1.

iv. Logarithmic. This is the notation used in logMar charts. Normal vision is 0.0 and 6/60 vision is 1.0.

TIPS

If other people are in the room, don't let them interfere and "help" the PVI. It is important you are recording their VA not their family's!

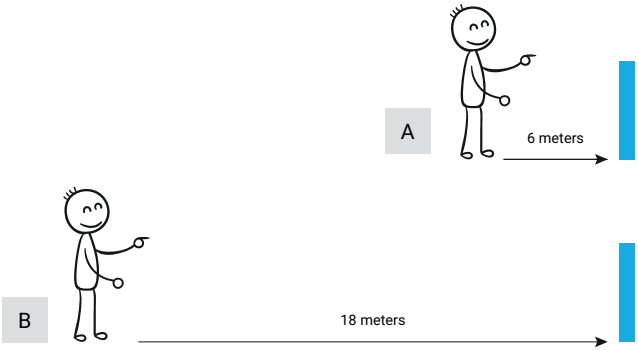


Figure 4.4 When expressed as a fraction, the VA is the relation between the distance the PVI can see the letter and the distance someone with "normal sight" can see the letter. In this case the PVI "A" sees the letter at 6m and the person with normal sight can see the same letter when 18m away. The VA is recorded as 6/18.

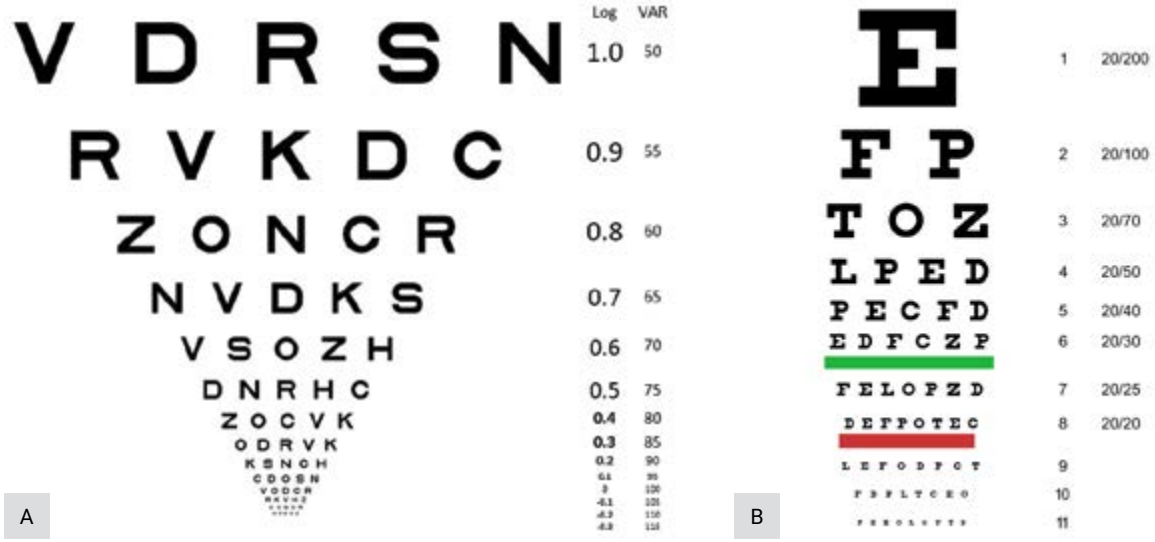


Figure 4.5 Examples of visual acuity charts. A) A logMAR chart. The size of the symbols decreases in a logarithmic manner and normal vision is 0.0logMAR B) A typical Snellen chart developed by Dutch ophthalmologist Herman Snellen in 1862, to estimate visual acuity. The E on line one should be 88.7 mm (3.5 inches) tall and when viewed at a distance of 6meters. Normal vision is 6/6 (20/20). Illustrations: A) "logMAR chart" by Khex14 licensed by CC0. B) "Snellen chart" by Jeff Dahl licensed by CC BY-SA 3.0.

Table 4.1: A table to compare the advantages and disadvantages of Snellen and logMAR test charts.

Snellen		logMAR	
Advantages	Disadvantages	Advantages	Disadvantages
• Quick test • Widely used • Reasonably well understood by other professionals • Often what people quote even if they have measured acuity in a different way	• Aimed at fully sighted people (top line typically 6/60) • Too few letters at the top of the chart for a PVI • Large gaps at lower acuity bands e.g. may jump from 6/60 to 6/36 • Uneven crowding: less at the top and more at the bottom • Less reproducible results	• Linear progression • Better subjective measurement • Even progression in the change of letter sizes between lines. • Even crowding: letter spacing dependant on letter size • Greater range of acuity levels measurable	• Takes longer than Snellen • Needs more knowledge • logMAR acuity is not widely understood and often needs converting back to Snellen • Scores can be confusing: 1.0logMAR is poorer acuity than 0.1logMAR

EXERCISE 4.1

A child cannot verbally identify an optotype correctly at any size despite correctly identifying smaller optotypes of different objects. What do you think is the most likely explanation for this? *See answer p. 103*

TIPS

With such a wide range of charts available it is often good practice to record the type of chart used. Also any additional help that was given to the PVI such as pointing at the symbols in turn should also be written down.

Resolution Acuity

The ability to distinguish black and white stripes from a uniform surface is called resolution acuity or **grating acuity.** Since bars can be perceived even if a large area of the macula is damaged, resolution acuity alone is a poor indicator of visual function. Nevertheless, it is a useful measurement when vision is too poor to be measured with the traditional VA charts or if the person (typically a very young child) cannot match shapes or letters.

Procedure

Resolution acuity can be measured using **a preferential looking** technique based on the principle that the eyes will spontaneously move towards objects that are either more colorful or complex. This requires careful observation of the eye movements by the examiner. When the child is presented with two panels, one with black and white stripes (grating) and the other one plain grey, if they can see the stripes he will spend more time looking at the striped surface. Older children can also be asked to point at the panel with the stripes (Fig. 4.6). Grating acuity is measured in cycles per degree (cpd), where one cycle is one black strip and one white strip and one degree is one degree of vision.

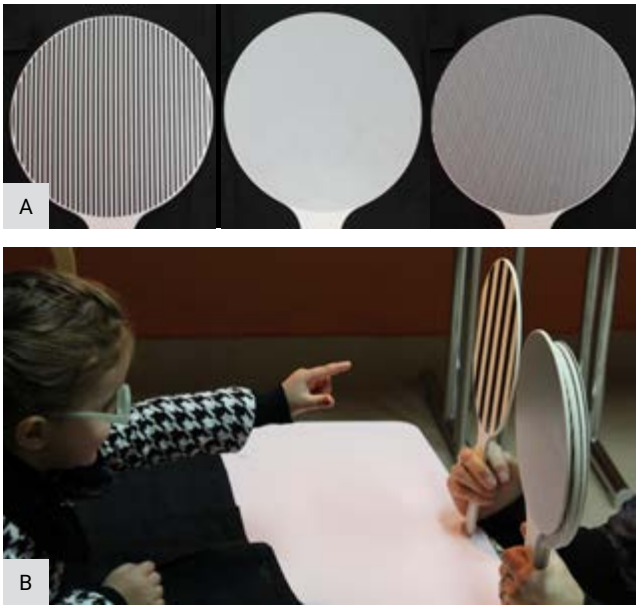


Figure 4.6 Resolution acuity. A) The person is presented two pads: a plain grey one and one with stipes, which attracts the eyes. B) The child is asked to point at the zebra lines.

When vision is too poor to use a chart

There will be occasions where the vision of an eye is so poor that even with an appropriate chart at a close working distance there are no optotypes identified.

Counting fingers is not a quantifiable or consistent measure from one examination to the next. Fingers come in different sizes, colors and spacing. If the PVI can count fingers, some letters on the chart should also be read, and the PVI should be allowed to succeed at this task.

When the PVI is truly unable to read any size letter at any distance, there are some other notations that are used as an indication of VA.

These are:

- form perception,
- motion perception,
- light perception with projection (LPP)
- and light perception only (LPO)

LPP implies that the PVI can detect a light source and indicate its location, whereas LPO indicates the ability to detect only that light is present or absent. None of these descriptors is quantifiable in the usual sense, but at least they give some indication of the PVI's level of visual function. Anyone who is unable to detect even a bright light source is said to have no light perception.

GOLDEN RULE

It must be remembered that VA is a single measurement which only tells us what the best resolution of the eye is. In isolation it is of limited value in determining how a person functions in real life settings.

The VA needs to be combined with other information relating to visual ability to build up a picture of how a person can function.

EXAMPLE

Consider two people, one with 6/30 or 0.2 acuity and one with 6/6 or 1.0 acuity. Looking at the numbers it may be thought that you can make a judgment about who has the best visual function.

But if we find out Person A has a normal visual field and Person B has only 10° of field remaining it would be clear that Person B may have far more significant problems with visual functioning, (for example moving around) than Person A.

Near Visual Acuity

Just as there are many charts for assessing distance acuity, there are also many different charts designed to be used at a shorter distance to assess near vison. One method of assessing near acuity is reading single optotypes which have been evenly spaced out on a chart. This method is employed by the Lea symbols near acuity card (Fig. 4.7). This chart uses four symbols, the house, heart (or apple), circle and square symbols. The card has a piece of string to allow accurate positioning of the chart at 40 cm and near visual acuity is measured in the same way as distance acuity.

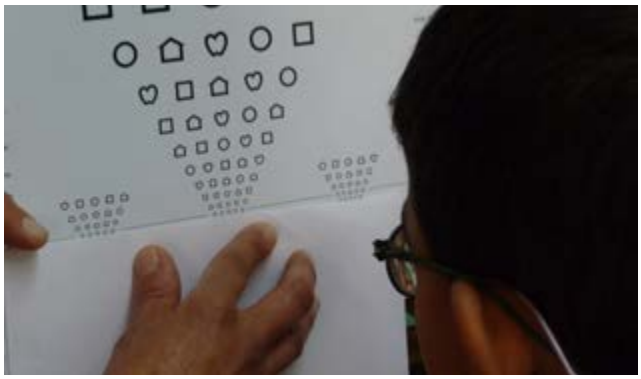


Figure 4.7 A child undertaking a near visual acuity assessment using a Lea Chart (www.lea-test.fi).

4.3 Reading Acuity

Another way to assess vision at near is to use texts in differing sizes or single words out of context to test near visual ability. This is clearly a very different assessment to that mentioned above since several other factors than the VA will affect the reading acuity:

- The words produce irregular crowding horizontally and vertically.
- The PVI needs to recognize and pronounce words, demanding learning, understanding and other higher center processing.
- To read with fluency the words are not just read in isolation but have to be strung together in a meaningful fashion.

Figure 4.8 Examples of reading charts using different scales.

Use

Since both functions use completely different types of charts, ***reading acuity*** measured using reading charts is likely to be different to ***near visual acuity*** recorded by single optotype charts.

If the purpose of the examination is to assess how a person's reading ability has been affected by visual impairment, then clearly a reading test chart provides a good vocational test. The practitioners must decide themselves how appropriate this information is when assessing the impact on non-reading near tasks such as seeing the numbers

on a cooker dial or telling the time on a watch.

Reading or near acuity should be measured monocularly and binocularly and any asymmetry noted. It is common practice to assess the near reading acuity with the use of additional localized lighting. It is also useful to assess the impact on the reading speed and size when the lamp is switched off to demonstrate the benefit of good lighting on vision.

TIPS

There is a difference between reading acuity and near visual acuity. Think about which is most appropriate to measure for your PVI.

Recording

When recording the levels of reading acuity there are many scales of measurement that are in common usage for example: "M", "N", "J".

However most reading acuity charts have linear scales so they work in a similar way increasing or decreasing in an arithmetic way, for example size N4 is half of N8 and 1.0 M is half the size of 2.0 M.

What is important is ***not*** which scale you use, but to know how your scale fits in with the real world. People will attend your practice complaining about how they cannot read the newspaper or cannot see their book in the classroom. They will ***not*** come in to complain about the fact they cannot read "N20" print!

TIPS

The N scale is in common usage and similar to that used on the Times font on your computer.

Computers often default to using size 12 for documents so this is often the size of letters or bills.

Newspapers are frequently printed smaller in size 8.

EXERCISE 4.2

Think about some things that you regularly use. What size would you expect them to be?

- Religious text
- Children's book
- A label on a tin

To find out, print a page with Times font of different sizes and use a ruler to compare the sizes.

See answer p. 103

GOLDEN RULE

When assessing a PVI, the practitioner should ideally have several charts available to assess reading or near acuity. The charts should be chosen so that they are applicable to the needs of the person being assessed.

Procedure

When working with PVI it can be misleading to simply record the size of the print that is seen. For example: N5, j1, 1.0M.

These figures need annotating to give them some more meaning.

1. Testing distance. With reading or near acuity it is essential to record the distance the test was conducted. Clearly reading and near acuity at 50 cm is very different to that found at 10 cm.
2. Threshold reading or fluent reading.

Ideally you should measure near/reading acuity to the PVI's "threshold" i.e. the smallest font size it is possible for them to read. This allows a more stable and reproducible measurement than reading to where you are comfortable.

There is a large difference between the size of print you can see and the size of print that you can read fluently. To read fluently, print would have to be made 2-3x larger than the threshold levels (**acuity reserve**).

EXAMPLE

An example of recorded acuity on clinical records could be:

- *"N5".*

A better way of recording would be:

- *"Binocular N14 Threshold @ 25 cm; N5 Threshold @15 cm; N10 fluently @ 15cm".*

This still shows that it is possible for the PVI to read N5, but allows colleagues to better understand what you have measured.

Table 4.2 Tools and techniques to measure visual acuity (VA).

Vision Test	Tool	Notation of results	Prerequisites
Light perception	Pen light	No light perception	Head movement towards light
Direction of light	Pen light	Top / down / left / right	Head movement
Movement	Hand	HM (hand motion)	Head movement
Grating	Pads	Cpd (cycles per degree)	Attention to stimulus
Detection	Various	Size, color, distance	Attention to stimulus
VA (traditional)	Chart	Fraction	Ability to match
Reading acuity	Text	Various	Ability to read

TIPS

For the purpose of assessing magnification, you might be asked to measure acuity at a fixed distance (e.g. 25cm). In addition, it is always worth measuring acuity at the PVI's habitual working position too.

This is especially important when working with children. For example, it is useful for magnification purpose to find out that a child can read N20 at 25 cm, but it is also very useful to see that when left to their own devices they chose to read at 10 cm and can now see N10.

4.4 Visual Fields

The field of vision should be thought of as the area that can be seen with the eye while the eye is fixating (not moving).

The limits of the normal field of vision are usually defined on two planes: **Horizontally** (110° temporally, 60° nasally) and **Vertically** (60° into the superior field, 75° into the inferior field).

It should be noted that these values are for one eye at a time and the full binocular field of vision (two eyes used) is wider still (Fig. 4.9).

A reduction of visual field can have a dramatic effect on a number of simple daily activities such as:

- Orientation
- Finding objects
- Night time vision
- Safety in mobility (falls)
- Confidence in mobility

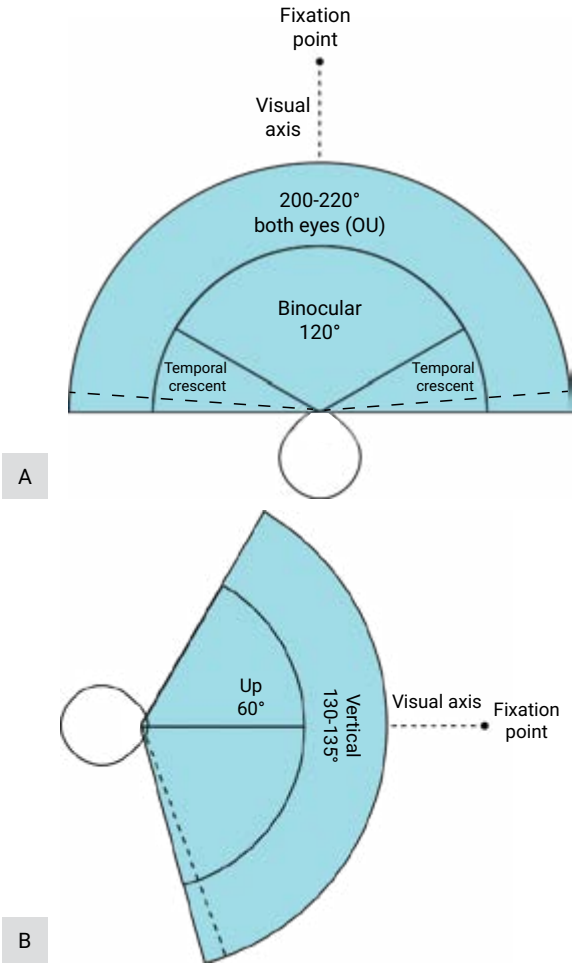
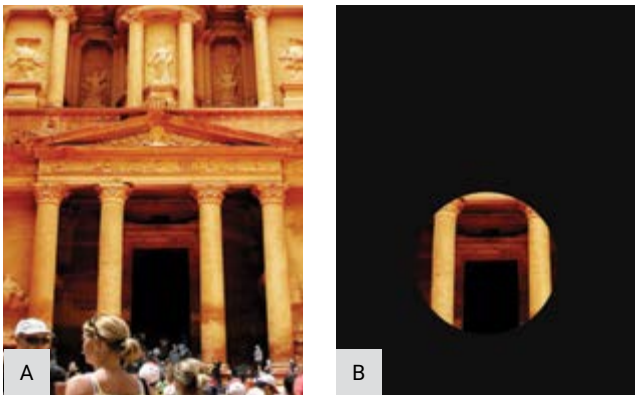


Figure 4.9 Diagrams illustrating the normal binocular peripheral visual field. A) The binocular horizontal visual field. B) The vertical visual field. Illustrations: A) "FOV both eyes" by Zyxwv99 licensed under CC BY-SA 4.0. B) "FOV vertical" by Zyxwv99 licensed under CC BY-SA 4.0.



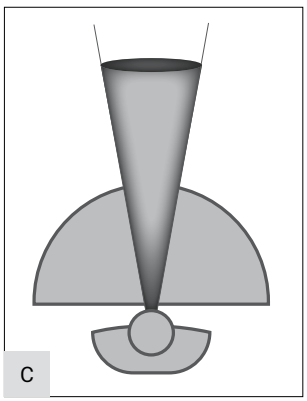


Figure 4.10 Simulation of peripheral field restriction. A) Normal view. B) Limited visual field. C) Diagram showing the field of a person with a peripheral field restriction. The size (diameter) of the field depends on the distance between the viewer and the object.

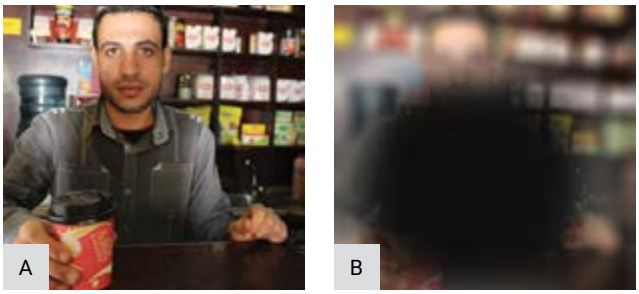


Figure 4.11 Simulation of central scotoma. A) Normal view. B) Simulation of the view of a person with a large central scotoma.

Gross Peripheral Fields Assessment

It is unlikely that people would come to your clinic with a full set of visual field data that has been collected on an automated field screener.Also you may not have access to an automated field screener to gather your own data, or if you do it may be difficult to gather exact data due to limited understanding or subjective ability of the PVI. Confrontational peripheral fields are methods of making a speedy and gross assessment of a PVI's visual field.

Procedure

The test involves moving a target in an arc centered on the PVI's eye 33 cm from the PVI. The target has to be brought slowly from a position where the PVI initially cannot see it, to one where it is seen. For this reason, it can be useful to have two people for the examination, one standing in front observing fixation and one behind the PVI to move the target.

Recording findings

The isopter for a 5/330 white target (5 is the diameter of the target and 330 is the distance from the PVI both in mm) should closely follow the limits for the normal visual field for one eye, which are:

- 110° temporally
- 60° nasally
- 75° inferiorly
- 60° superiorly

TIPS

An isopter is a line that joins points of equal sensitivity in the visual field.

Gross perimetry is a qualitative procedure and therefore only subjective comments can be made on the results.

EXAMPLE

Results of confrontational visual field test with three different PVIs

- *R&L full to 5/250 white target.*
- *R&L full to a 15/330 red target.*
- *R&L temporal defect to a 15/250 red target. L superior defect to a 5/330 white target.*

TIPS

It is occasionally useful to perform the test with a red target even when the background is not pale. For example, in chiasmal lesions due to pituitary tumors, color desaturation occurs across the vertical midline. This modification to the technique will often enable far earlier diagnosis of a neurological lesion. An ideal target is a 15 mm red hatpin, although some practitioners may use an object such as a colored eyedropper to equally good effect, comparing the color of the target in the four quadrants.

Table 4.3 Advantages and disadvantages of gross peripheral field examination.

Advantages	Disadvantages
• Quick and simple to perform • May be the only way of making any visual field assessment • Suitable for identifying gross defects	• Results are crude estimates • Background against which they are conducted can vary • Less than ideal for finer testing • Cannot easily identify small or shallow scotomas

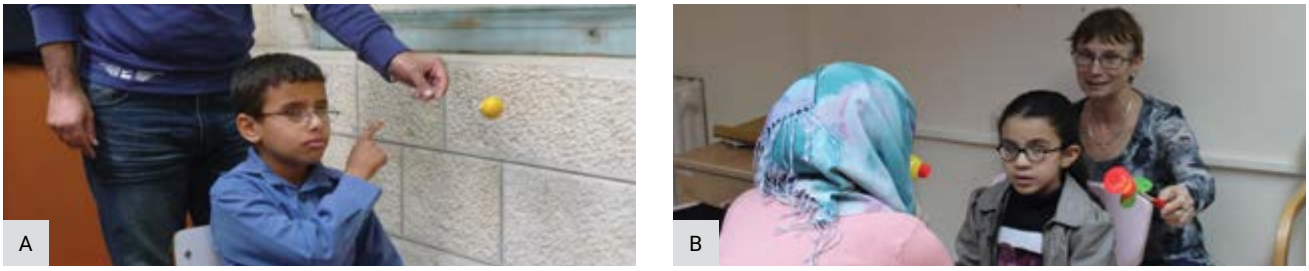


Figure 4.12 Confrontational technique to measure the visual field. The peripheral visual field can be estimated by having the subject fixate a target in front of him and having him detect (A)or following the eye movements (B) when another object entering his peripheral field. When vision is poor, the object to be detected should be bigger and brighter.

Table 4.4 Recommendations in overcoming peripheral visual field loss.

Problem	Recommendations
Spatial awareness	• Move away from the target to get a wider view. • Use of visual cues and organizational techniques • Use multi-sensory approach to gather information (e.g. mark stair, table edges, hallway corners) • Use of long cane
Illumination	• Use of general or task lighting
Glare	• Sunglasses, hats • Positioning away from the light (preferential seating)
Changes in lighting	• Eliminate/reduce extreme changes in illumination • Allow time for eyes to adjust before engaging in activities

Table 4.5 Recommendations for overcoming a central visual field loss.

Problem	Recommendations
Identifying details	• Magnify, move closer to object or move object closer • Increase illumination • Increase contrast • Simplify visual area
Incomplete or "blurred" images	• Train visual skills (eccentric viewing, scanning, tracing, tracking) • Magnify (optical/non-optical)
Color discrimination	• Compare against other contrasting colors • Increase illumination
Maintaining eye contact	• Visual skills training (eccentric viewing)
Recognizing people	• Use other sense (voice)

4.5 Contrast Sensitivity

All the VA and reading charts so far discussed are assessing high contrast acuity, the print is black and the background is white.

Although this is useful information, it can be limiting when we consider the rich variety of color and light levels in the "real world". Contrast sensitivity allows us to measure the visual performance over a range of contrast levels and this can be very informative in finding out the impact of visual impairment on everyday tasks.

Seeing the difference in performance levels when moving from a high contrast to a low contrast chart can inform both the practitioner and the PVIs of the nature of the problem. Table 4.6 shows some of the common problems experienced by PVI with reduced contrast sensitivity and the potential solutions.

Table 4.6 Impacts and recommendations for PVI with reduced contrast sensitivity.

Problem	Recommendations
Seeing small objects	• Put them on a contrasting background • Put objects in good light without glare
Reading	• Insure good quality of prints and copies • Print the images larger • Trace lines with fingers • Trace over pictures or shapes with a dark pen
Writing	• Use black pens for writing • Use paper with bold lines • Contrast paper with desk surface
Eating	• Contrast the color of the food, plates and table cloth

There are many ways of measuring contrast sensitivity using expensive low contrast charts. We have included the simple SNAB contrast in this Toolkit to give you an easy screening tool to assess whether contrast is normal or abnormal.

Figure 4.13 Examples of good (A) and poor (B) contrast. Using contrasting colors highlighting the edges of objects or surfaces makes it easier and safer for persons with low vision.

4.6 Color Vision

Color vision defects are a common and routinely found genetic vision problem in people who have otherwise normal vision. There are many tests to evaluate color defects available.

Due to their eye disease, PVI can develop acquired color vision problems; this is especially noted in people with diseases that directly affect cone function in the center of the retina. These acquired color defects are quite different to the commonly found genetic color vision defects:

- The loss may be progressive,
- PVI may be aware of the color loss,
- Are more likely to be blue yellow type defects,
- Occur in females in similar numbers to males.

When working with people with low acuity it means that some of the more common tests used to assess color vision defects may be impossible to use or produce inaccurate results.

The PV16 or Panel 16 test has been specifically designed to be used for people with poor acuity. The test consists of a set of 15 color caps and a reference or 'pilot' cap.

Procedure

Fluorescent room lights should be turned on but all light sources using tungsten filament lamps should be off as this type of illumination can make the test easier to pass for someone with a mild red color vision deficiency.

PVI are asked to start with the pilot cap and form a sequence of colors with each cap being the closest in color match to the one before.

Using the result sheet (see Fig. 4.14), join the numbers of the caps in the order selected. A normal result means the caps should be aligned 1-15 resulting in a circular line on the record sheet. An abnormal result will show lines across the circle. The number of lines crossing the circle can be used to determine type of defect or the amount of color vision loss.

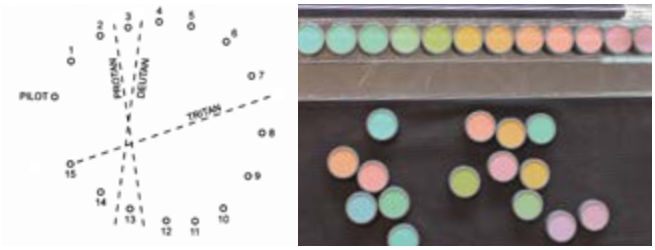


Figure 4.14 Color Vision testing can be completed using commercial equipment such as the Panel 16 test shown above. If these are not available crude assessment of color vision can be completed using simple homemade identification tests.

Simple Vocational Tests

Tests like the Panel 16 are invaluable if you are carefully analyzing color vision, but they are costly and can be difficult to source in some countries.

Simple tests can me made locally; asking children to sort and name colored pens can give an indication of a child's ability to recognize color in a classroom.

Whilst this is not a scientific way of assessing color vision, it can be a very useful clinical tool which can be played like a game with young children.

Fig 4.15 Using a pack of colored pencils children can be asked to name the colors or group together the ones that look the same color.

GOLDEN RULE

Having no formal color vision test does not mean you cannot check color vision. Simple methods may allow you to understand whether your PVI has a problem or not.

TIPS

Although no low vision aids can be used to correct color vision deficiency, knowing there is a problem can help the PVI understand and develop coping strategies. It can also be invaluable for teachers of children with visual impairment or for employers of a PVI to be aware of likely problems.

Table 4.7 Overcoming poor color vision.

Problems	Recommendations
Naming colors	• Teach the color of common objects and use clues such as color saturation (dark vs light colors)
Choosing clothes	• Use cloth tags
Reading or looking at images	• Do not use color as the only visual clue in books or class board

NOW YOU SHOULD UNDERSTAND:

1. *How to measure visual and reading acuity and understand the different types of notation.*
2. *How to use the confrontational technique to measure the peripheral visual field.*
3. *Why it is important to also measure acuity at low contrast.*
4. *The difference between inherited and acquired color deficiency.*

4 RESOURCES

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Yosur Qutishat MSc, BSc (OT)
Sami Shublaq MSc, BSc (Optom)

4.1 Measuring visual acuity

General

- Ideally, the assessment room or testing environment should:
  - Be quiet,
  - Have good light,
  - Have no shiny surface or glare that falls on the testing tools or in the eyes of the subject.
- Threshold acuity (the smallest thing the person can see):
  - Requires that the person can recognize more than 50% of the line recorded.
  - Needs also negative result (something the person cannot see). For example, if the person can read a line with difficulty, the next one, the smallest, should be tried before the line is set as threshold acuity.
  - Remember: it is not always a useful functional measure (it is not comfortable to read for long period at threshold).
- Charts:
  - The abilities of the person being assessed needs to be taken into account when selecting the chart to be used. Charts with E, C, numbers or symbols can be used for people that do not know the alphabet or cannot speak.
  - Before starting the assessment, the examiner should ask the subject to identify the symbols on the first row (by name, use of gesture, or pointing at the symbols on a key card).

Instructions

Far VA

This is the most commonly used measurement of the quality of vision.

Material:
- Distance acuity chart
- Measuring tape

Procedures:

1. **Set the distance.** The chart is placed at eye level at a distance of 3 or 4 meters from the subject (depending on the chart). If the top line appears blurred, the chart is moved closer (remember to record the new distance).
2. **Determine the threshold**. Ask the person to name the symbols on the chart, starting from the top line (largest ones). If he can read them all, ask him to read the line below and so on until the symbols are too small for the subject to read (keeping the same distance).

3. **Measure the visual acuity.** The line recorded as threshold acuity is the one where more than 50% of the symbols are read. It can be calculated (in decimals) as the distance (in meter) / Best line read (letter size M).

Near VA

It is usually measured after the far VA and should give similar results if the refractive error of the subject is corrected and the charts use the same symbols.

Material:

- Distance acuity chart
- Measuring tape

Procedures:

Same as for far VA (above).

Detection Acuity

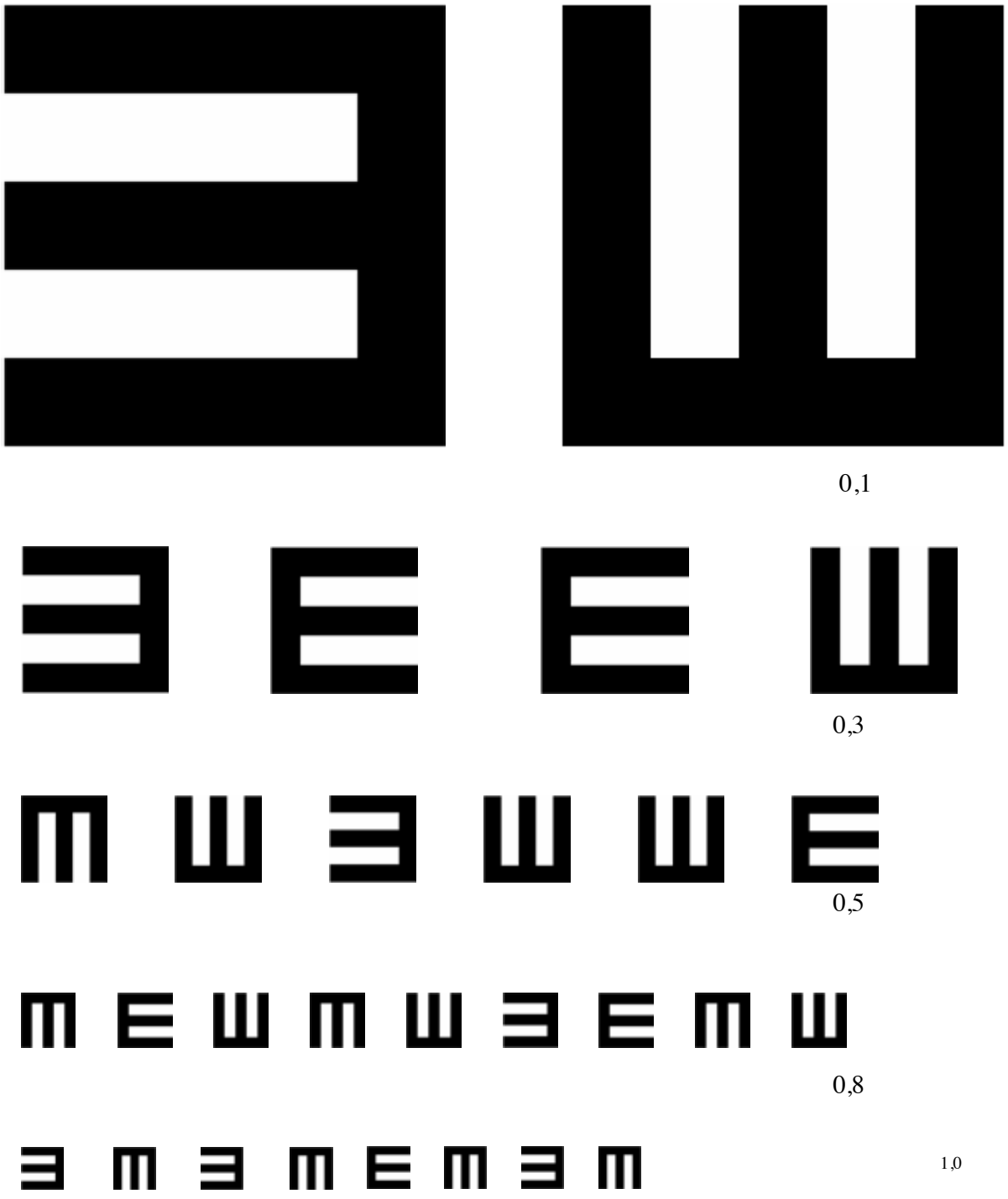
This is useful for estimating the quality of vision in toddlers. It should be done in a playful way.

Material:

- Objects or candies of various sizes and color
- White or black cloth to form a contrasting background
- Measuring tape

Procedures:

1. **Prepare the space.** The child can be sitting at a table or on the floor. The area in front of him should be plain (without patterns).
2. **Select and place the first target.** It is better to start with a large object not far from the child. The child should be distracted so he cannot follow the hands of the examiner while the object is placed in position.
3. **Ask the child to pick it up what is in front of him.** If he can do it, try a smaller object at the same distance but in a different place (same distance or further).
4. **Record.** The results include the diameter of the smallest object the child can see, its color and the background and the distance at which the child saw it.



Snellen E chart to test at 5 meters.

This page needs to be used as it is, and if copied the symbols should stay the same size (no enlargement or decrease). Source: Vision for All Screening Manual.

24p

18p

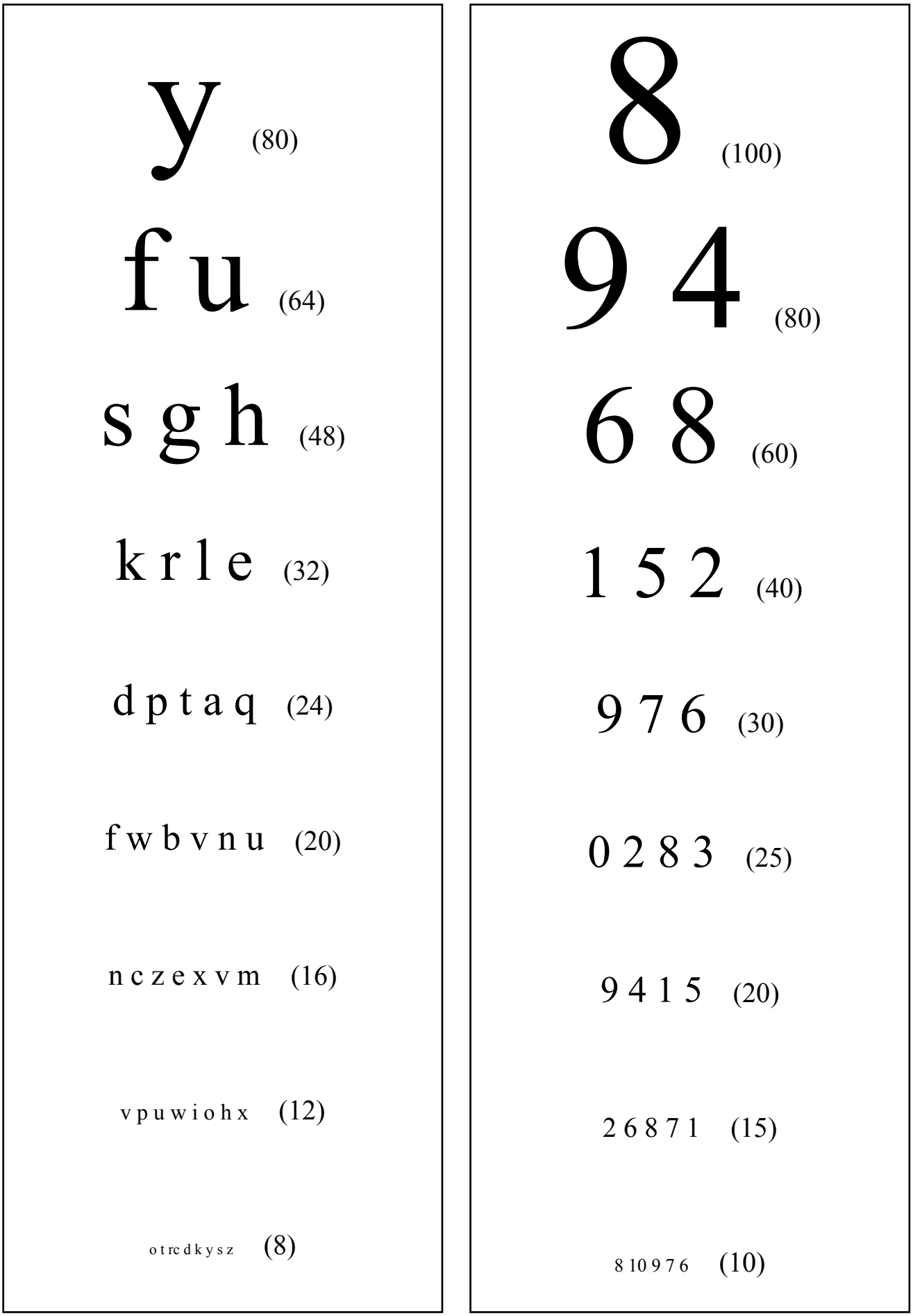
12p

8p

5p

Snellen E chart to test at 35-40 cm.

This page needs to be used as it is, and if copied the symbols should stay the same size (no enlargement or decrease). Source: Vision for All Screening Manual.



Font type: Times New Roman; numbers refer to font size. Be careful to keep the size unchanged (no enlarging or diminishing).

4.2 Measuring reading acuity

The measure is used to estimate magnification needs for reading tasks. The value recorded depends on the reading chart used. The examiner should be careful that the level of difficulty of the text fits the reading abilities of the person being tested.

Material:

- Reading chart
- Measuring tape
- Reading addition (+4 D) when testing presbyopic patients.

Procedures:

1. **Set the distance.** The person is usually asked to hold the reading chart at 25 cm.
2. **Listen.** Ask the person to start reading the large fonts, then smaller ones until the fluency changes.
3. **Record.** The (threshold) reading acuity is the size of the text at a given distance where the person can read (but is not fluent).

4.3 Measuring contrast sensitivity

General

- This information is obtained by comparing the traditional VA (black symbols on white background) with VA with charts made of gray symbols on a white background.
- As for the visual acuity, the testing environment should be quiet, well light room and without glare.
- Charts: be aware that plastic charts tend to become yellow with time and thus unusable.
- The instructions below apply for the SNAB test which is available for free by the Swiss National Association for the Blind. It contains 4 white cards with a black Landolt C ring on one side and a grey ring (contrast of 0.1) 0.2 LOG steps larger than the black one on the other side. The black rings are 4 sizes: 2.5 M, 5 M, 10 M and 20 M.

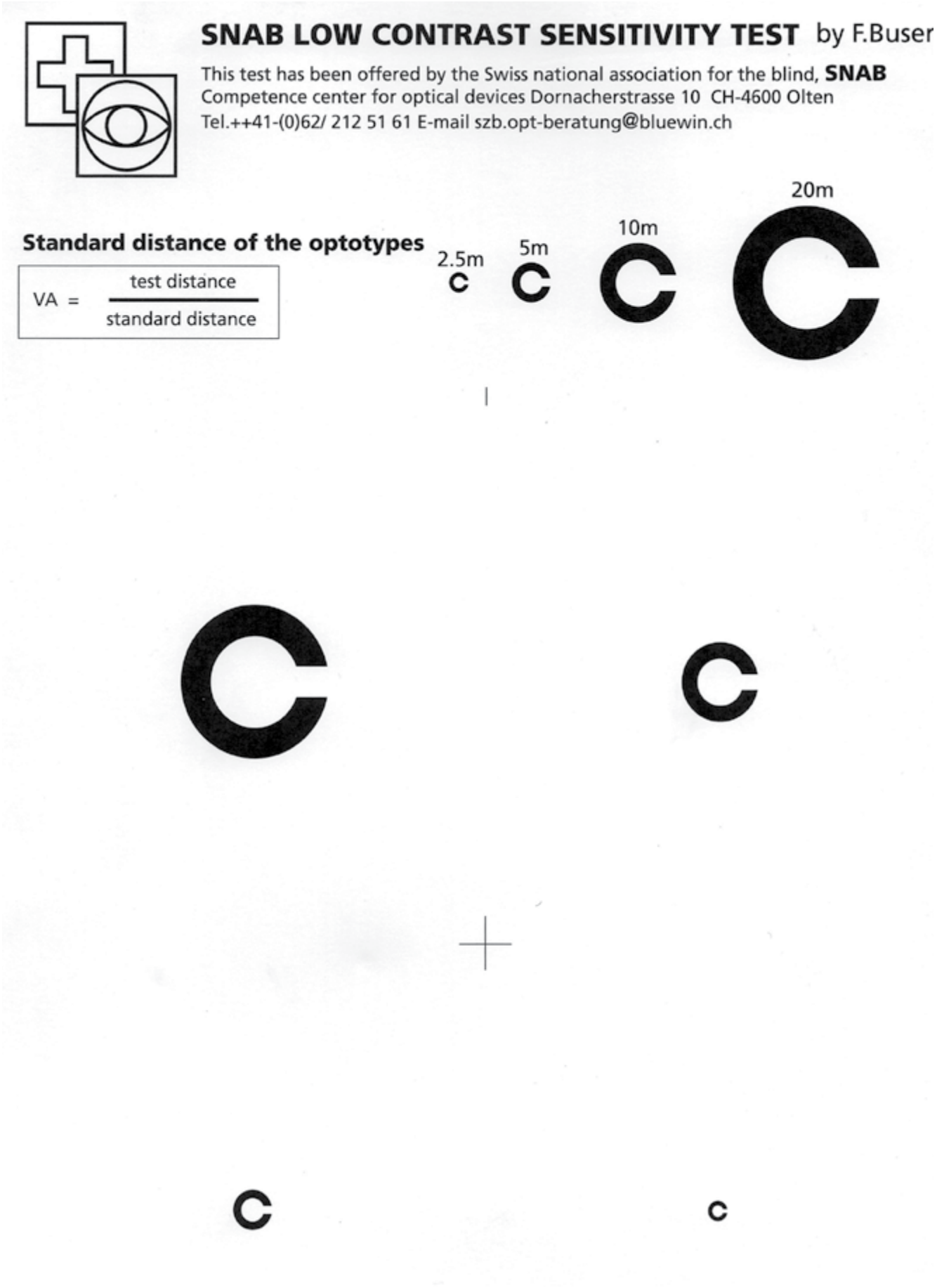
Material:

- The SNAB low contrast sensitivity test

Instructions

Procedures:

1. **Determine the testing distance.** The person doing the assessment stands away from the subject holding the 2.5 M card with the black C at the level of the eyes of the subject (too far for the subject to see it). The practitioner then walks slowly closer until the subject can see or point the direction of the opening of the black C.
2. **Test the contrast.** Turn the 2.5 M card to the grey side.
    a. If the subject can see the grey side of the 2.5 M card, his contrast sensitivity is normal and the screening test is over.
    b. If the person cannot see the grey side of the 2.5 M card, show the grey side of the next card, the 5 M and ask the direction of the C.
    c. If he cannot see it, try the grey side of the 10 M card. If he still cannot see the C, show the grey side of the 20 M card.
3. **Recording.** This is a screening test and contrast sensitivity is recorded as *normal or near normal* if the person can see the 2.5 M, *below average* and is likely to cause him problems for some tasks if he sees only the grey side of the 5 M card, and *very poor* and likely serious problems if he sees only the grey 10 M.


SNAB LOW CONTRAST SENSITIVITY TEST by F.Buser
This test has been offered by the Swiss national association for the blind, SNAB
Competence center for optical devices Dornacherstrasse 10 CH-4600 Olten
Tel.++41-(0)62/ 212 51 61 E-mail szb.opt-beratung@bluewin.ch
Standard distance of the optotypes
VA = test distance / standard distance
2.5m
5m
10m
20m

WARNING: It is not possible to reproduce the SNAB test here with the correct levels of contrast and therefore it should be used for illustration only and not clinical use.

4.4 Measuring peripheral vision

General

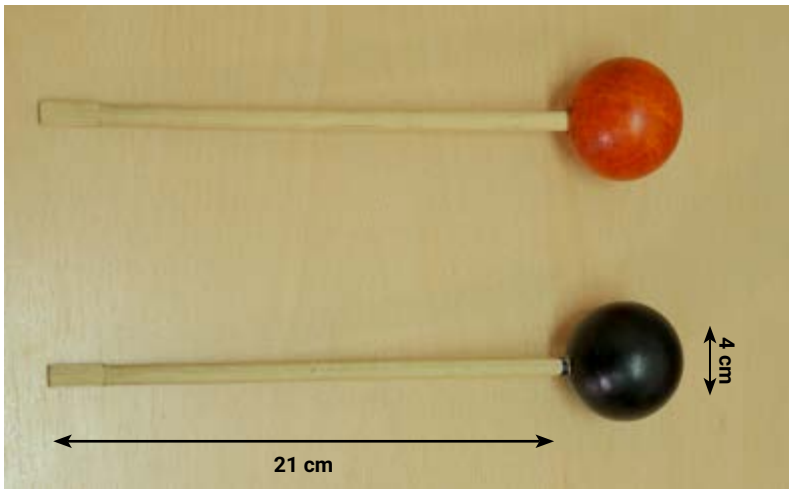
- This technique provides a rough estimate of the peripheral visual field.
- It is difficult to use this technique to test persons with central scotomas or nystagmus of high amplitude (no eye contact).
- Since the VA in the peripheral retina is low compared to the center, the size of the object to be detected should be sufficient for the subject to detect it.
- Ideally when testing children, two persons are needed: one to follow the fixation and the other to present the target from behind.

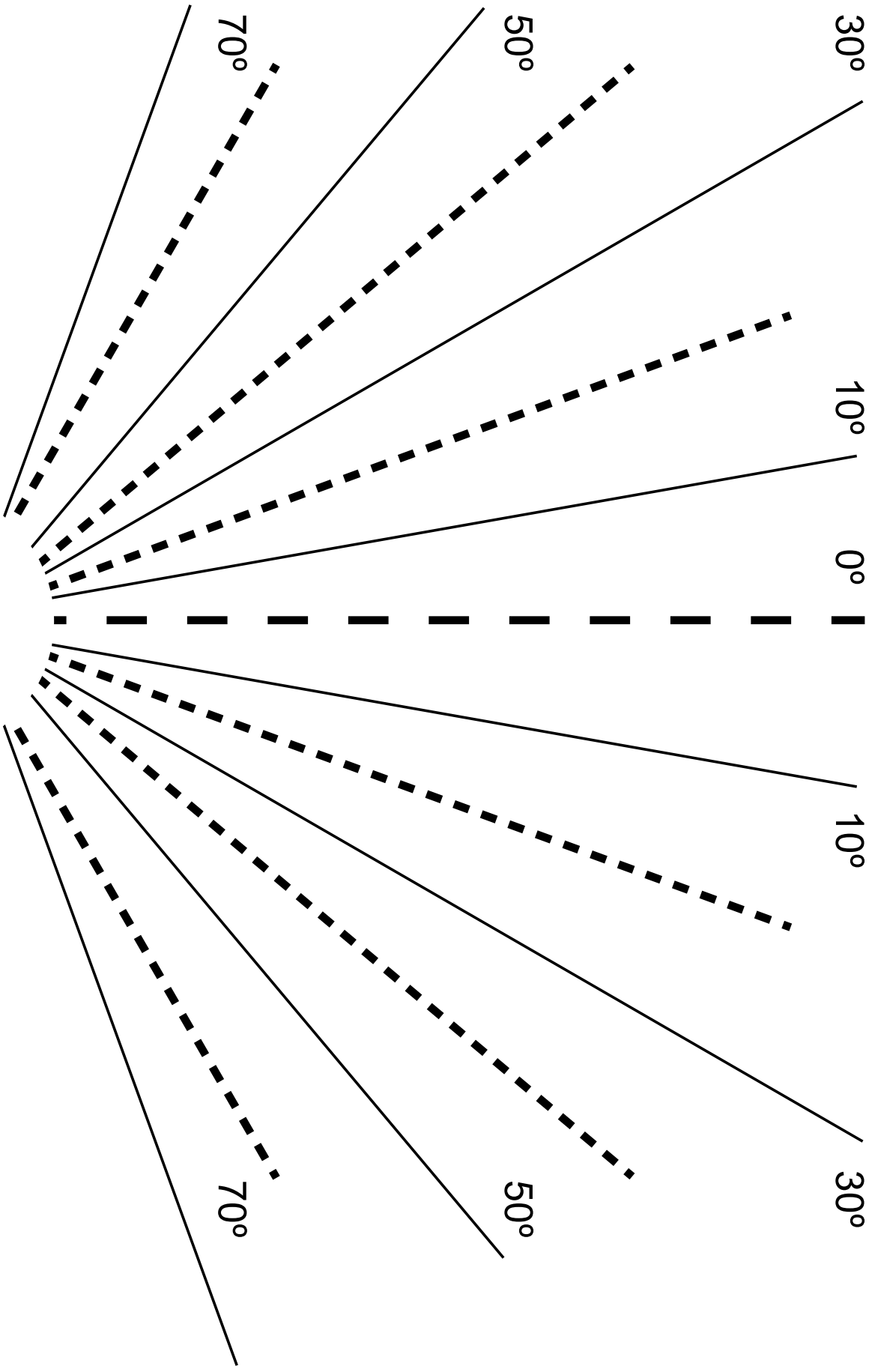
Material:

- Fixation tool
- High contrast ball 4 cm in diameter (the target) on a 25 cm stick or other attractive object
- A4 180° Angle form

Procedures:

1. **Position.** The subject should be sitting on a chair with sufficient space around it to allow the examiner to stand behind.
2. **Fixation.** The subject should fixate on an object (of contrasting background) in front of him during the whole test. When the target enters the visual field, the eyes will spontaneously move in this direction.




70°
50°
30°
10°
0°
10°
30°
50°
70°

4.5 Test your vision!

Ask a friend to wear a pair of simulation glasses and practice the tests we just described using your own assessment tools or the ones provided in this section. Take at least two measurements. Record the results in the table.

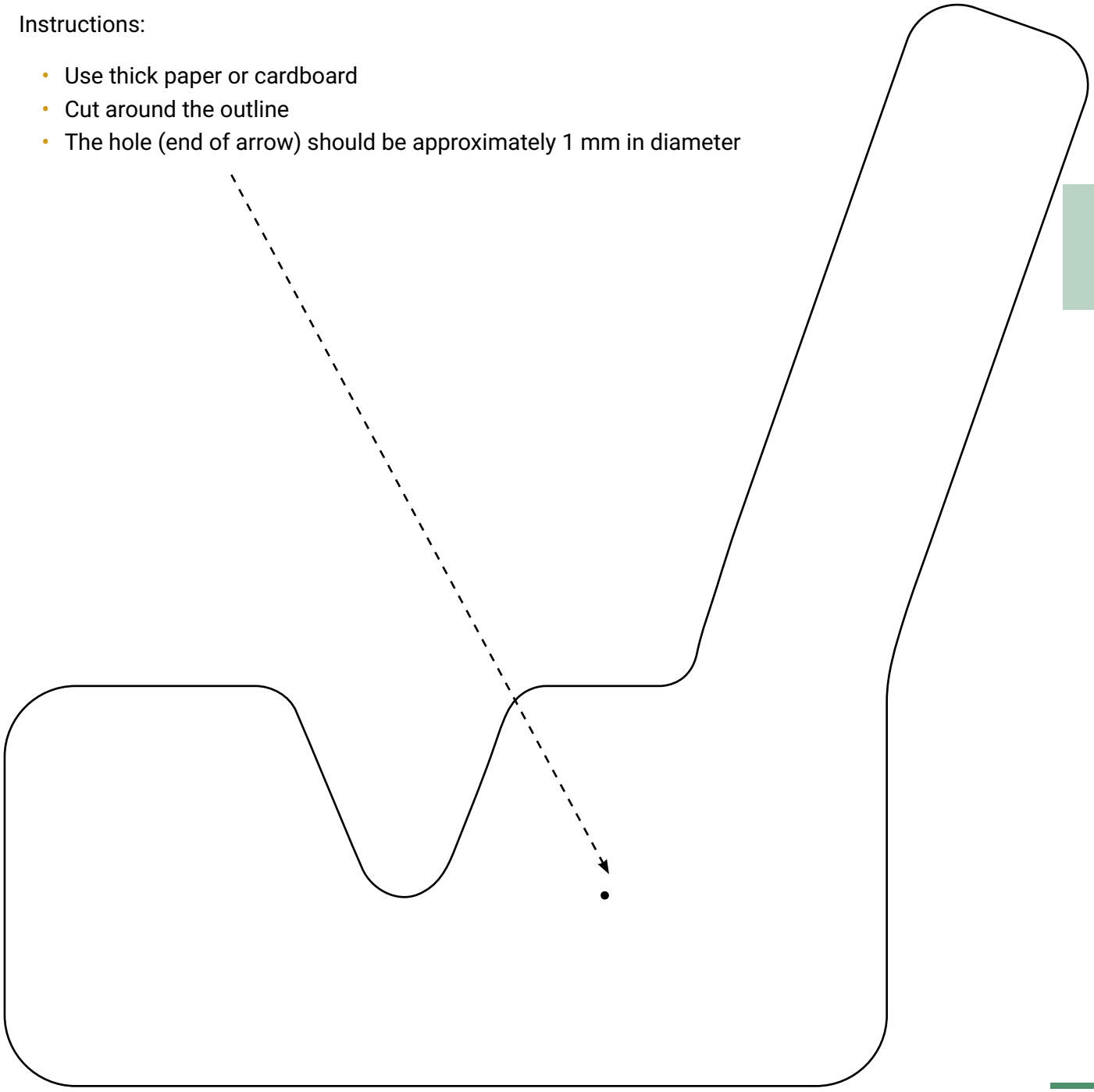
Results	First	Second
Visual acuity		
Reading acuity		
Contrast sensitivity		
Visual field		

4.6 Pinhole mask

Do you or your friend have a refractive error? Measure the visual acuity at 5 m with and without the mask and compare the results. If the subject has a refractive error, the results will be better with the mask.

Instructions:

- Use thick paper or cardboard
- Cut around the outline
- The hole (end of arrow) should be approximately 1 mm in diameter



5 MAGNIFICATION

Andrew Miller MSc MCOptom

When the eyes are not sensitive enough to see small details, making things bigger can allow them to become visible. Supplying magnification is at the core of low vision work. In this chapter, we will explore the many ways of providing magnification for people with a visual impairment (PVI).

Before we begin, it must be remembered that magnification is not helpful to everyone who has a visual impairment. For example, using magnification with a PVI whose corneas are very cloudy and irregular will make the image larger, but will not make it less blurry or distorted (Fig. 5.1).

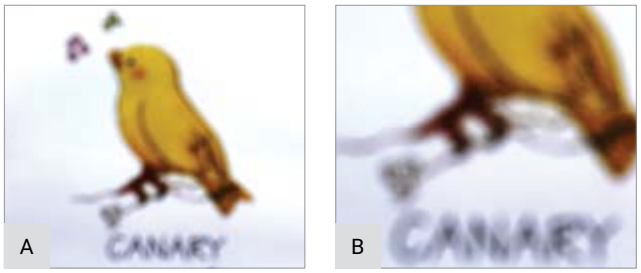


Figure 5.1 Magnification makes things bigger it does NOT make a blurred image clear. A) The image is blurred. B) The same image magnified remains as blurred but the text may be easier to decipher.

FAQ

Q: Does magnification help every person with low vision?

A: No, but it helps most of them. Before prescribing magnification you need to understand the PVI's eye condition and think how it affects their ability to see.

GOLDEN RULE

Magnification makes things bigger. That is all it does, it does not make cloudy images less cloudy.

5.1 Types of magnification

There are many ways of enlarging and magnifying things, but we can think of dividing all of these methods into four main categories.

i. Relative Distance Magnification
ii. Relative Size Magnification
iii. Projection Magnification
iv. Angular Magnification

i Relative Distance Magnification (RDM)

This type of magnification relies on decreasing the distance between the eyes and the object. This can be done optically using lenses, or physically by moving nearer.

RDM is the simplest and cheapest form of magnification. It can be done by:

- Changing a child's position in the classroom to be closer to the board,
- Sitting closer to the TV,
- Using a pair of spectacles that allows a book to be held at closer position.

Figure 5.2 Showing the effect of relative distance magnification allowing a larger, magnified image by getting closer. Also note that increasing magnification gives a decreasing field of view (less of the room is visible).

Figure 5.3 RDM is also created by allowing people to hold print closer. This can be achieved using accommodation or magnifiers.

FAQ

Q: Does holding books close to the eye damage the sight?

A: No. Holding books close or sitting close to the TV may look a little peculiar, but it provides simple relative distance magnification without damaging the eyes.

TIPS

Remember: There is a limit to how close the eye can focus without help. Spectacles or magnifying lenses allow our eyes to be able to work at a closer distance than would be possible if relying on the eyes alone.

ii Relative Size Magnification (RSM)

This type of magnification relies on changing the size of the object that is being viewed: a larger object will create a larger, magnified image on the back of the eye. The relationship is simple: if you double the size of the object, it doubles the size of the image seen by the eye.

There are many ways of producing relative size magnification:

- Printing things in a bigger font or using large print books,
- Using devices that are made bigger. For example replacing a TV with a larger one,
- Change the setup on the computer to enlarge the image on the screen,
- Enlarge worksheets on a photocopier,
- Increasing the size of your handwriting.

RSM needs some preparation, but for the right PVI it can be the most accessible method of magnification to support fluent reading.

Figure 5.4 Relative size magnification is making the object to be viewed larger. A) The watch to the left has a larger face and bigger numbers. B) Using a phone with a larger display also adds RSM. Photos: Ammen Harb.

TIPS

For people who need lower amounts of magnification, enlarging the print can provide a more fluent and natural way to read than having to use a magnifying lens. In classrooms this needs preparation but it can also be more inclusive for the child.

LIMITATIONS: In practice, this method is usually restricted to 2-3x magnification. A simple A4 sheet of paper made 5x larger with this method would be over 1.5 m long!

iii Real or Projection Magnification

At the cinema, the small pictures on the film are projected and magnified on the screen for the audience to see. This is an example of real or projection magnification.

In low vision work, the devices which produce this type of magnification include:

- Electronic aids such as a CCTV magnifier, where a camera projects a larger image of the text onto a screen,
- Using a camera on a mobile phone to produce an enlarged picture on the screen,
- Bar and dome magnifiers: these are relatively cheap and useful magnifiers (see Fig 5.5).

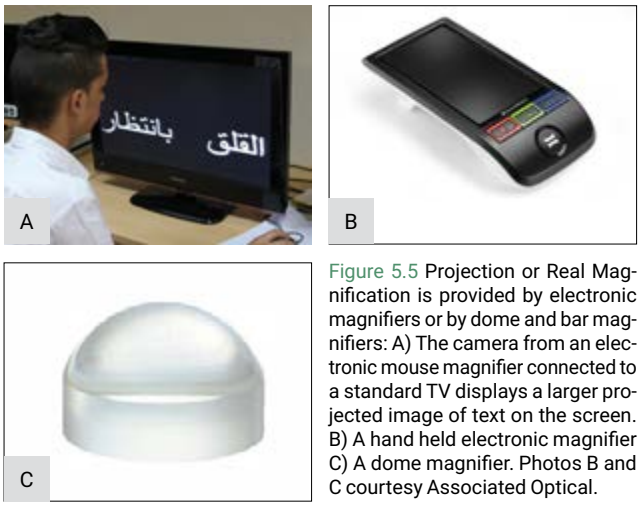


Figure 5.5 Projection or Real Magnification is provided by electronic magnifiers or by dome and bar magnifiers: A) The camera from an electronic mouse magnifier connected to a standard TV displays a larger projected image of text on the screen. B) A hand held electronic magnifier C) A dome magnifier. Photos B and C courtesy Associated Optical.

iv Angular Magnification

This final category of magnification is found in telescope systems where a combination of lenses increase the angle an image produces at the eye, without changing the distance between the observer and the target.

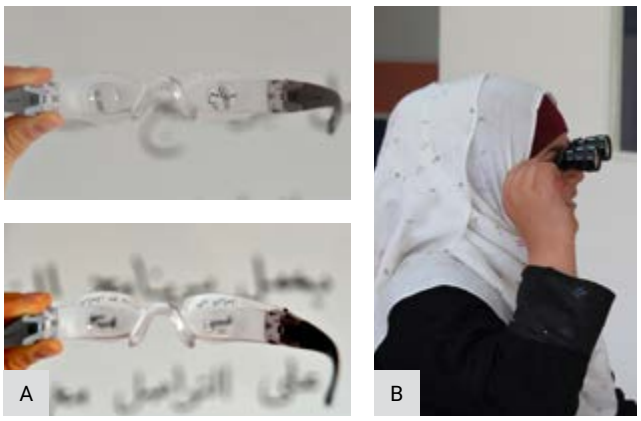


Figure 5.6 Optical devices using angular magnification. A) MaxTV. B) Binocular telescope. Photos: A) Ameen Harb.

GOLDEN RULE

There are 4 basic ways we can create magnification. Using a magnifying lens is only one of them; make sure you think about all of the others too.

i Get closer

ii Make it bigger

iii Do like at the movies

iv Don't forget telescopes

Combining Magnification

Combining two **DIFFERENT** types of magnification (e.g. RDM and Real Magnification) can create a much bigger effect than using one method alone. (see Example 1).

EXAMPLE 1: COMBINING MAGNIFICATION FROM DIFFERENT CATEGORIES

A child is struggling to read his text book when he holds it at 40 cm. The letters in the book are 5 mm high.

Two types of magnification are applied to help the child read normal size print.

1st magnification: Relative Size Magnification

His teacher photocopies and enlarges the text so it is now 10 mm high:

Magnification Created = 10 mm / 5 mm = 2x (RSM).

2nd magnification: Relative Distance Magnification

The PVI also receives spectacles which allow him to hold the book at 10 cm:

Magnification Created = 40 cm /10 cm = 4x (RDM)

The two types of magnification used are from different categories so the total effect is **MULTIPLIED.**

Total Magnification achieved = 2 (RSM) x 4 (RDM)

Total Magnification achieved = 8x

However, combining two types of magnification from the **SAME** category of magnification can actually interfere with each other and reduce the total magnification (see Example 2).

EXAMPLE 2: COMBINING MAGNIFICATION FROM THE SAME CATEGORY

A woman wants to use a pair of +6D magnifying spectacles and a +12D hand magnifier at the same time. Both of these devices produce the same type of magnification (Relative Distance Magnification)

What happens when we combine two lenses together is a little complicated and the effect varies depending on how far apart the two lenses are held.

If you combine a pair of 6D spectacles (1.5x) with a 12D (3x) hand magnifier AND the lenses TOUCH, the magnifications can be simply **ADDED UP:**

1.5 + 3 = 4.5x.

However, if the hand magnifier is held 15 cm from the spectacles, the two lenses interfere with each other and it can be shown that the total magnification falls to only 1.8x.

5.2 Prescribing magnification

Prescribing magnification involves two separate steps:

1. Deciding the type of magnification that will be delivered (see above) and
2. Determining the amount of magnification the PVI needs (see below).

GOLDEN RULE

For each task that needs magnification you should consider how much is required. Giving too much or not enough means you make the task harder.

How much magnification does the PVI need?

Magnifying devices for persons with low vision are like tools for craftsmen: a carpenter needs to assess the task in hand before he chooses the correct tool for each job. Similarly, dispensing the correct power of magnifiers depends on assessing the vision of the user (baseline acuity and accommodation) and on target activity (size and type of tasks). We will look at these factors in more details.

a. **Baseline Acuity** (What the person can see). This information is key to making a judgment of magnification strength. For near tasks you may want to measure the acuity at both:
   - 25 cm
   - The habitual reading position (the distance they normally read).

b. **The size of the object to be viewed.** Obviously, the smaller the target to be viewed, the larger the amount of magnification that will be needed. So, the same person will need less magnification if the target object is large and more magnification if it is small.

c. **Accommodation** (How close the person can still see objects clearly)**.** We have a lens inside our eye that allows us to change focus from seeing things in the distance to seeing close: accommodation refers to how flexible this lens is. As we get older our lens gets harder and changing focus is more difficult, so children can naturally hold print much closer than older people. This means that people with greater accommodation may need less magnification.

TIPS

Don't forget if your PVI has had a cataract operation this means that they will not have any accommodation at all.

d. **Spot or sustained tasks**. Spot tasks are brief tasks which require only a quick glance such as checking the time on a watch or reading the name on a medication bottle. The eyes don't have time to tire and therefore the magnification need is reduced. A sustained task is one that needs longer concentration for example reading a letter or book. The eyes will tire, so it is essential to allow extra magnification (acuity reserve) so that the eyes are not reading at their limit.

GOLDEN RULE

Magnification need depends on:

1. **What can they see at the start (baseline).**
2. **What they want to be able to see at the end (size of target).**
3. **How much help can their own eyes give accommodation.**
4. **How long do they need to see it for (spot or sustained tasks).**

Acuity reserve: This acts as a gap to prevent the effects of fatigue during sustained tasks. Nominally we should allow at least a 2:1 reserve. This means that if the PVI want to perform a sustained task, we estimate magnification as if they want to read print that is half the size of the one they really want to read.

EXERCISE 5.1

Below is a text printed in 3 sizes. Which one is the smallest text size you can read? Now read the sentence until the end. How would this feel if you had to read this for 5 minutes?

A sustained task is one that needs longer concentration for example reading a letter or book. Due to the increased duration of the tasks the eyes will tire. It is essential therefore to allow extra magnification so that the eyes are not reading at their limit

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See answer p. 105

FAQ

Q: If I prescribe too strong a magnifier will it damage the eyes?

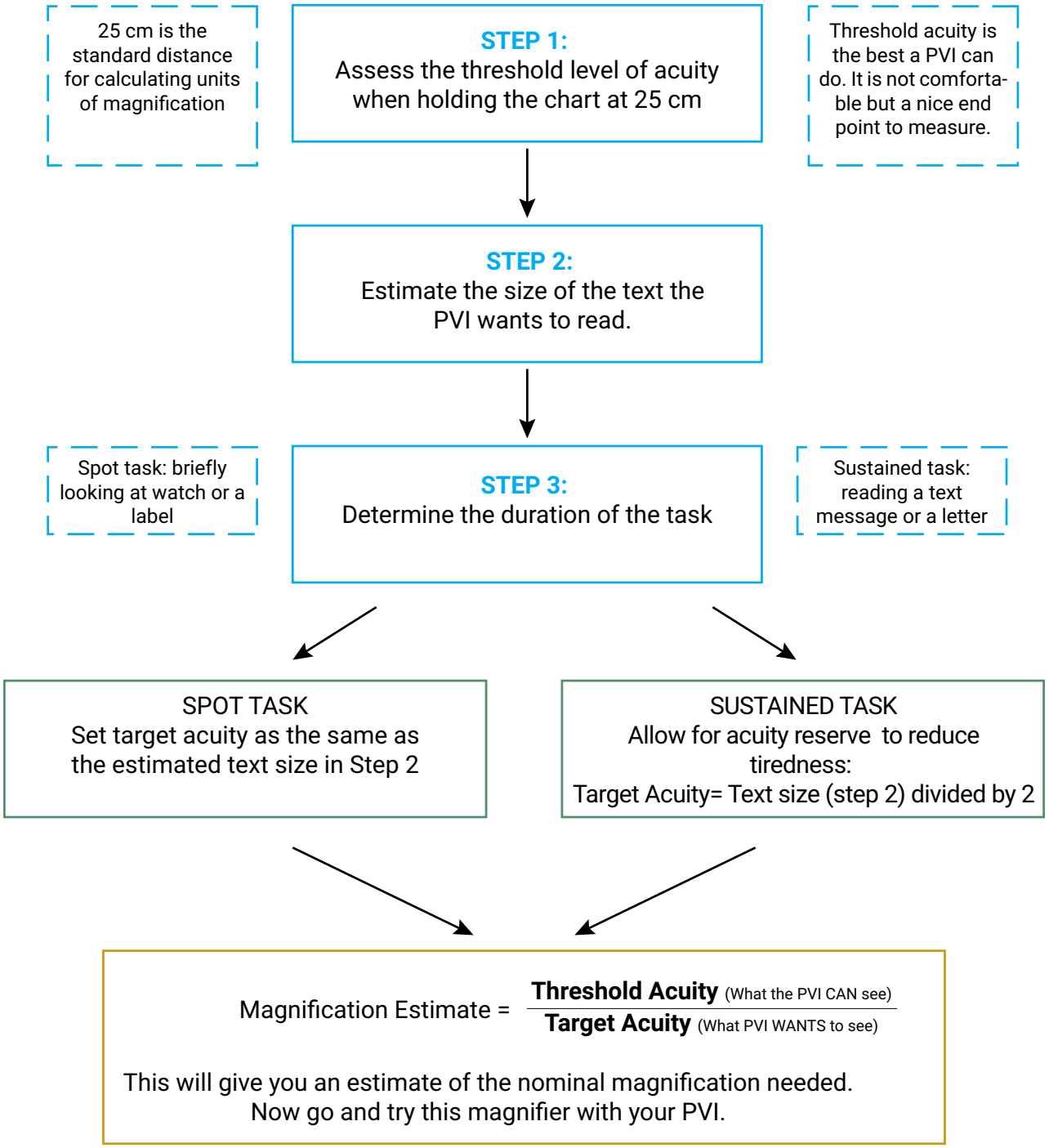
A: No, but the magnifier is harder to use giving a narrower field of view and the PVI may not want to use it!

Calculation

There are several ways of estimating the amount of magnification needed. In this text, we will consider just one method for near and one for distance.

First we need a scale so we can measure near acuity and there are many of these available (N, M, j etc). It does not matter which one you use as they all work in a linear fashion.

The example below uses the N scale (this can be equivalent to the p or point scale). This scale is approximately the same as that used on a computer to tell you the size of the font you are typing.



WORKED EXAMPLE 1

Mrs. A wants to read her book.

1. You measure threshold acuity @25cm as N24.
2. You estimate the size of print in Mrs A's book to be N12.
3. This is a sustained task so we half the estimated acuity 12/2 = 6. So the target acuity to achieve is N6.
4. Magnification Estimate= (Threshold Acuity)/(Target Acuity) = 24/6 = 4x.

Therefore, our estimate is that Mrs. A may need a 4x (16D) magnifier for this task.

WORKED EXAMPLE 2

Mr. B wants to read the name on a can of food.

1. You measure threshold acuity @25cm as N40.
2. You estimate the the letter size on Mr B's can label to be N20.
3. This is a spot task so set the target acuity the same as the estimated acuity: target acuity N20.
4. Magnification Estimate=Threshold Acuity / Target Acuity = 40/20 = 2x

Therefore, our estimate is that Mr. B may need a 2x (8D) magnifier for this task.

Come Closer

When you are first getting started with low vision work, all the calculations can feel a bit daunting. To keep things simple while you are learning, a book called *Come Closer* has been produced, which consists of passages of print in different sizes. This is based on a Scandinavian resource produced in five Nordic languages by the SEEnior project. The book is simple to use and calculates the magnification for you. It is available in Arabic, English, French, Kiswahili, Russian and Swedish and can be downloaded for free from www.visionme.org.

The book is held at 25 cm and the PVI starts reading the largest print size. He continues reading progressively smaller print sizes until he reaches the threshold. The page he stops at (the last page read) tells you the power of magnification that should be needed to just read the small 8p words printed at the top of the page.

This quick and simple method can give you a good starting point for your work. As you get more experienced you can move on to the calculation method shown above.

Figure 5.7 Come Closer reading chart. In this example, if the person can only read the 24 p text (at the bottom) but wants to read the 8p (at the top), the book shows that he needs to use 3x magnification (+12D).

Figure 5.8 Example: At 25 cm this man could only just read the 16p font (threshold acuity). To be able to "only just" read the 8p font at the top he will need 2x magnification. If he needs to read this font with more fluency you will need to allow an acuity reserve and double the magnification (4x).

TIPS

When you have more experience, as well as measuring acuity at 25 cm to complete the calculations it is useful to understand your PVI's normal situation.

Is he a child who normally reads at 10 cm or a tall adult who may normally read at 40-50 cm?

To make meaningful changes, you need to ensure that what you are offering is an improvement on what the PVI is currently doing.

Calculating Distance Magnification

When we prescribe magnifying aids for distance, we need to make a similar estimate of magnification need before we start to dispense aids. The calculation used is much simpler than for near. We have to estimate the visual acuity needed to conduct a task and then simply divide this by their current visual acuity.

STEP 1:
Measure the Snellen distance acuity in decimal

↓

STEP 2:
Estimate target acuity to achieve the task
e.g. 0.50 to recognize a face

↓

STEP 3:

$$\text{Magnification Estimate} = \frac{\text{Acuity needed}}{\text{Acuity measured}}$$

Now do a simple division!

WORKED EXAMPLE 3

Mrs C wants to read signs in the street.

1. You measure distance acuity as 0.1 (do not use logMAR for this calculation).
2. You estimate the level of vision to read the sign at a reasonable distance to be 0.5.
3. Magnification Estimate = Acuity Needed / Acuity Measured = 0.5 / 0.1 = 5x.

TIPS

You don't need 1.0 acuity to complete all tasks in the distance. Remember 0.5 acuity is good enough to allow fully sighted people to drive a car. 0.5 acuity will allow PVI to recognize faces across a room and read signs on the wall at a reasonable distance.

A weaker power telescope will be easier to use and allow a wider field of view.

Figure 5.9 The device on the left side is labelled using trade magnification (32D/4 +1 = 8 +1 = 9x), while the one on the right uses nominal magnification (12D/4 = 3x).

Labeling of magnifiers:what do the numbers mean

Visual devices for near, such as hand magnifiers, frequently are labeled with a magnification 4x, 7x etc.

Magnification is a relative measurement in that it compares the size of something at the end with something at the beginning.

EXAMPLE

In normal speech we understand that we need a comparison for things to make sense:

If I said "The tree is three times as big."

This does not make sense; we need to compare it to something else.

"The tree is three times as big as the house."

Unfortunately, not all manufacturers agree on the points of comparison they use.

i. **Nominal Magnification** (most frequently used) compares the image seen with the magnifier to the object at 25 cm (without the magnifier). It can be calculated:

$$\text{Nominal Magnification} = \frac{\text{Power of the lens (Diopters)}}{4}$$

$$\text{Or} \qquad M = \frac{F}{4}$$

So a lens of power 4D (or 4D of accommodation) will provide 4/4 = 1x or a "unit magnification". 12D provides 12/4=3 units (3x) of magnification.

ii. **Trade Magnification.** This assumes that the magnifying lens is in contact with the eye and the viewer exerts 4D of accommodation (1x). In this case: Trade Magnification = F/4 +1.
A 12D lens is said to provide 12/4 +1 =4x magnification.

FAQ

Q: How do I know whether a manufacturer's magnifier is marked in trade or nominal magnification?

A: You often don't, so you need to find out! Sometimes the magnifier has the dioptric power (F) written on it. If not, you need to consult the catalogue, or to measure the power of the lens. This can be done by measuring the focal distance of the lens or a focimeter will allow a quick approximation of power.

TIPS

So magnifiers could be labeled with the nominal magnification, trade magnification, the power of the lens, or the magnification & power.

As the magnification can be a little misleading it is easier when comparing the strength of magnifiers to look at the power in Diopters. The higher the power the stronger the magnifier, easy!

NOW YOU SHOULD UNDERSTAND:

1. What magnification is.
2. The different types of magnification.
3. What influences how much magnification is needed.
4. How to do a basic calculation of magnification needed.
5. How magnifiers are labeled.

5 RESOURCES

5.1 Estimating magnification needs

5.1 Estimating magnification needs

You need to get used to estimating magnification based on an understanding of what the PVI can read, the size of the text they want to read and how long they need to do the task for.

Remember: tasks that need to be sustained need more magnification than those only done for a very brief time (acuity reserve).

Take a piece of paper and try to estimate the magnification need for these PVI and the tasks they want to complete. The answers are on p. 104.

#	Reading acuity at 25cm What the PVI "can read"	Task	Size of the text (target size)
Near Tasks			
1	24p	Reading a text book at school	12p
2	30p	Reading a name on a medicine bottle	10p
3	18p	Seeing a date on a food label	6p
4	38p	Reading a letter	12p
5	60p	Reading a children's book	20p
Distance Tasks			
6	0.1	Reading a road sign	0.5
7	0.2	Seeing the face of the teacher	0.5

6 MAGNIFYING DEVICES

Andrew Miller MSc MCOptom

In this chapter we are going to discuss the types of aids available to deliver the magnification.

There are many different types of optical magnifiers and we have divided them into 5 categories (Fig. 6.1). Understanding each category will allow us to consider which device is the most appropriate to use for each person and task.

GOLDEN RULE

Remember magnifiers are like tools. A craftsman has many tools, each with a specific job. Similarly magnifiers should be dispensed after careful thought about the person using the device and the task they want to use it for.

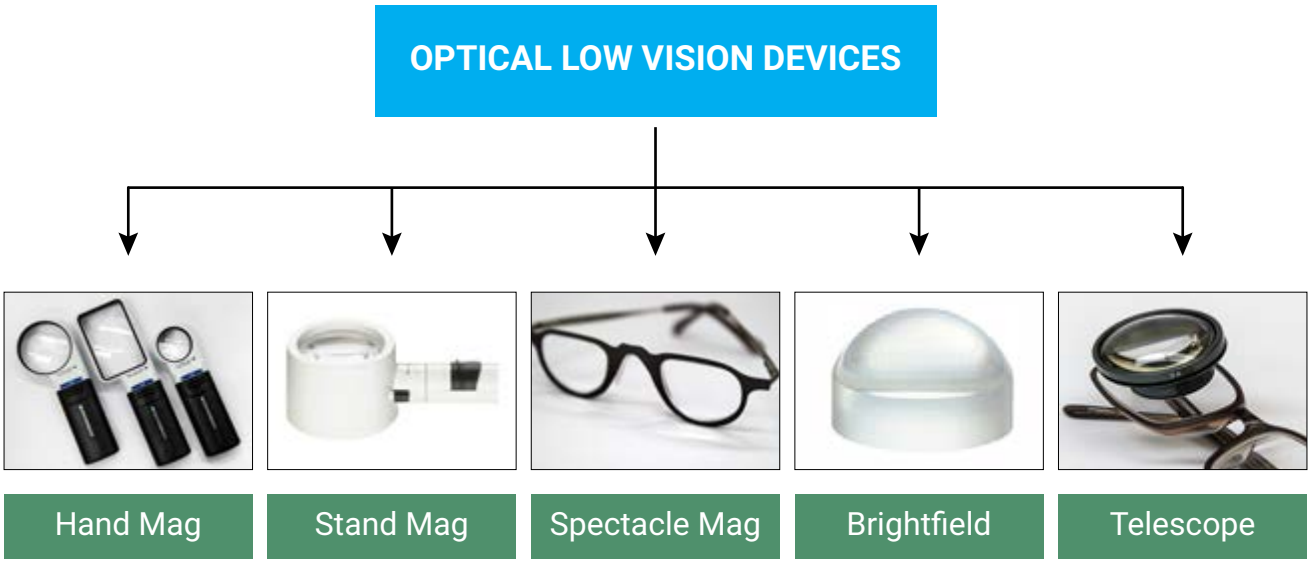


Figure 6.1 A Diagram to show the five basic types of optical low vision devices.

6.1 Optical devices for near

i Hand magnifiers

Hand magnifiers are a plus lens held in a mount with a supporting handle (Fig. 6.2). This allows the lens to be held at a distance of approximately the focal length of the lens from the target to be viewed. The image seen is larger than the object as the device optically moves us closer to the target (Relative distance magnification).

Hand magnifiers are the most common and widely used of devices, they are available in a range of different shapes, sizes, powers and with or without built in illumination.

Figure 6.2 Hand magnifiers. They come in different shapes and powers, from 4D or 1x, up to 56D or 14x.

The wide range of powers and designs makes them very versatile, helping tasks from reading mail at home to checking food labels in the shops. Because of their versatility, hand magnifiers are a key low vision device to support PVI.

Low powered hand magnifiers are relatively easy to find, easy to use and provide a wide field of view. They allow fully sighted people an easy way of enlarging items that are too small to see. However these weak devices are often not strong enough to be useful for the people we see in a low vision clinic.

As we increase the level of magnification, the field of view and focal length change and therefore the devices get much harder to use. This can frequently lead to disappointment for PVIs when they realize their expectation of a simple familiar solution may not be the reality of what they are prescribed.

Table 6.1 Advantages and disadvantages of hand magnifiers.

	Advantages	Disadvantages
Image	• Illumination frequently incorporated • Allow long working distance • Socially acceptable • Familiar (people have seen them before)	• Increased distance from the eye causes smaller field • Have to be held at correct distance from target • Need to be held still, so not ideal for long tasks
Practicality	• Portable (small and light weight) • Relatively cheap	• Not hands free • Tremors or arthritis make use very hard

Using a hand magnifier

The use of hand magnifiers depends on getting two distances correct.

- **The distance between the lens and the object.** To get a clear and optimally magnified image, the lens must be held at approximately its focal length from the object.
- **The distance between the lens and the eye.** To get a useful field of view the magnifier must be held close to the eye. The optimum distance the lens should be from the eye depends on the power of the lens and the duration of the task. When using the magnifier for a long period of time (sustained task), we need as wide a field of view as possible, meaning the lens needs to be held closer to the eye. If you plan to use the magnifier for a short time (spot task), it can be more convenient and comfortable to hold it further away from the eye.

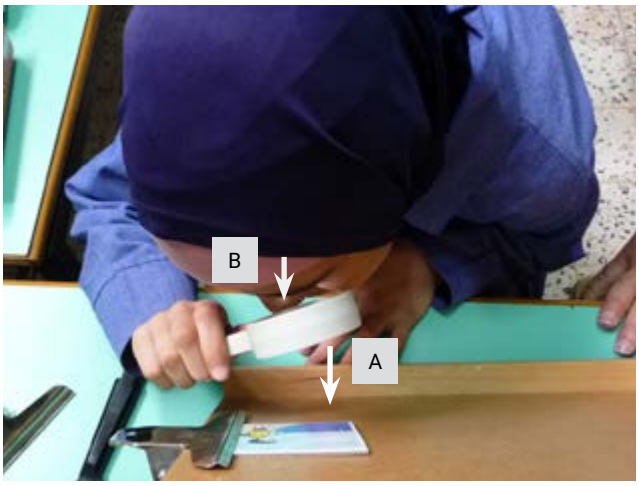


Figure 6.3 Two distances are important when using hand magnifiers: A) Object to lens distance: this needs to be approximately the focal length of the lens. B) Eye to lens distance: in this case the magnifier is used close to the eye to allow a wider field of view. This helps fluent sustained reading. For a spot task a longer eye to lens distance can often be used.

TIPS

To optimise the use of a hand magnifier, the distance the eye should be from the lens should be no more than:

- Twice the focal length for sustained task
- Four times the focal length for quick (spot) tasks

ii Stand magnifiers

People with poor grip or tremor may find it difficult to support the lens of the hand magnifier at the

Table 6.2 Optimum lens to object and lens to eye distances for a different powers of hand magnifiers.

Lens power (nominal magnification)	Object-to-lens distance (focal length)	Approximate eye-to-lens distance	
		Spot tasks	Sustained tasks
8D (2x)	12.5cm	50.0 cm	25.0 cm
12D (3x)	8.3 cm	33.2 cm	16.6 cm
16D (4x)	6.3 cm	25.0 cm	12.5 cm
20D (5x)	5.0 cm	20.0 cm	10.0 cm
24D (6x)	4.2 cm	16.8 cm	8.4 cm
28D (7x)	3.6 cm	14.4 cm	7.2 cm
36D (9x)	2.8 cm	11.2 cm	5.6 cm
40D (10x)	2.5 cm	10.0 cm	5.0 cm
48D (12x)	2.1 cm	8.4 cm	4.2 cm

STEP 1:
If possible, get the PVI to locate the start of the text with the unaided eye (without the magnifier).

↓

STEP 2:
Place the magnifier flat on the page at the desired starting point.
Show the PVI that this has no significant effect on the size of the print.

↓

STEP 3:
Keeping the magnifier flat on the page bring them to the desired eye to lens distance. This depends on the task and power of the magnifier (see Table 6.2)

↓

STEP 4:
Slowly push the page away from the magnifier to achieve the best clarity (approx. the focal length of the lens).

Figure 6.4 A flow chart to show how to demonstrate the use of a strong hand magnifier to a new user.

EXAMPLE

A lady wishes to use her 20D (5x) magnifier to check the numbers on the dials of her cooker.

This is a quick/spot task and from Table 6.2 it can been seen that the eye-to-lens distance could be 20cm.

If she moves her eye closer to the lens than 20cm she will see a wider field of view, but as you can imagine this will mean her having to bend and get much closer to the cooker and may make the task harder to complete.

Table 6.2 shows an approximation of the working distances needed to be used with different powers of hand magnifiers for quick (spot) tasks and for longer (sustained) tasks.

correct distance from the target. The solution is to build a stand around the lens that ensures the device can only be held at a fixed distance from the object where the image is the clearest (Fig. 6.5). Stands are particularly useful with higher powered lenses, as they can cause large amounts of blur and distortion when not held at the correct level or angle.

In practice (especially at weaker powers), the height of the stand is slightly shorter than the focal length of the device which requires the user to use his accommodation. Those who cannot accommodate will need to be fitted with weak reading spectacles to get best clarity from these devices. The exact reading add needed may vary with the device and the distance between the PVI and the device.

iii Spectacle Magnifiers

TIPS

When prescribing a stand magnifier to a PVI who cannot accommodate, do simple checks with a pair of ±1.00 flips or trial lenses whilst the PVI is looking through the device.

Getting the add wrong is the most common reason why PVIs fail with stand magnifiers.

Figure 6.5 Stand magnifiers. A) Illumination is particularly useful for those with central scotoma as it allows wider field of view and increased reading speed. B) A closer eye-to-lens position allows a wider field of view. C) Some stand magnifiers allow writing underneath. Photos: A) and C) Ameen Harb.

Table 6.3 Advantages and disadvantages of stand magnifiers.

	Advantages	Disadvantages
Image	• Distance fixed at focal length • Straight lens • Good up to 15x	• Need correct spectacles • Need flat surface
Practicality	• Built in Illumination • Good for people with tremor	• Bulky and heavier than other devices

GOLDEN RULE

PVIs need to be encouraged to use hand and stand magnifiers close to the eye to allow a wide field of view.

Spectacle magnifiers can be thought of as reading spectacles with an add greater than +4.00D.

In practice, spectacles magnifiers can be made with adds from +4.00 to approximately +40.00D. The increasing add allows an increasing level of magnification. Remember:

Spectacle magnifiers allow **binocular vision** at low power, but as the magnification increases and working distance decreases, it becomes more difficult for the convergence muscles to turn the eyes inward. This convergence effort can be alleviated with the use of **Base IN prisms.** Even using prism it is very difficult to keep PVIs binocular with an add higher than +10.00D.

$$\text{Magnification} = \frac{\text{F (power in D)}}{4}$$

As with the other magnifiers, the optimal distance between the lens and the object (the focal length) decreases as the power increases, and as a result even at low levels of power the PVI will have to hold objects close to the eye (see Figure 6.6).

EXAMPLE

Using Table 6.2, find the focal lengths of a +12.00D and a +20.00D add.

Use lenses from the trial set to try this out for yourself. How does it feel to have to read so close?

Figure 6.6 Spectacle magnifiers give magnification whilst leaving hands free to complete tasks. They offer a wider field of view but a closer working position than the equivalent hand or stand magnifier.

As a result, lenses above +10.00D are usually only placed in front of one eye (**monocular**), for obvious reasons the one with better vision. If the vision is similar in both eyes, then look to place the lens in front of the dominant eye.

Because spectacle magnifiers look like a simple pair of glasses, PVIs who are concerned about their appearance may be more confident about using them in public compared to other magnifying devices.

With hand and stand magnifiers, the field of view decreases as the devices are taken further from the eye. As spectacle magnifiers are worn very close to the eye, they allow the widest possible field of view for the level of magnification chosen. This increased field of view can be particularly useful when considering using eccentric reading techniques (see Chapter 8).

Table 6.4 Advantages and disadvantages of spectacle magnifiers.

	Advantages	Disadvantages
Image	• Good field of view • Wide range of magnification possible	• Needs exact reading distance • Binocularity hard
Practicality	• Socially acceptable • Both hands free • Readily available until +12D	• Short reading distance with high power may require training • Good lighting needed at close distance

TIPS

When first assessing spectacle magnifiers, it can be useful to use a stick with a small test chart on. It's easy to hold close and quickly shows you and your PVI the improvement that you can achieve with spectacle magnification.

STEP BY STEP

Prescribing spectacle magnifiers:

1. Calculate the amount of magnification required by the PVI for the task he wants to do.
2. Make allowances for the amplitude of accommodation.
3. In the trial frame start by demonstrating a power of approximately half of that calculated.
4. Measure the new level of vision and working position.
5. Increase the power by 4D. Demonstrate to the PVI the improvement in vision this creates but also show the shortening working distance.
6. Keep increasing in steps of 4D towards the calculated level of power. At each stage observe and discuss with the PVI the levels of vision achieved and the need for a closer working position.
7. Reassure and support the PVI in adapting to the new distance.

The final power prescribed should be decided based on an assessment of the levels of acuity achieved and the ability of the PVI to hold and maintain the close working distance.

iv Brightfield/Dome magnifiers

These devices come in a range of differing shapes and sizes but are most frequently seen as domes (hemispheres) or bars of plastic that sit flat an object such as a book or photograph (Fig. 6.7).

They are made of clear material that gather and concentrate ambient light to add illumination to the target. The magnification levels produced are dependent on the density of the material and the shape of the dome; in practice this is generally around 2x.

The magnifiers discussed previously (hand, stand and spectacle magnifiers) produce relative distance magnification by bringing the image closer to the observer. Importantly, brightfield magnifiers give real magnification by producing a projected and enlarged image on the page. This is particularly important when considering the use of brightfield magnifiers alongside another type of magnification. The real magnification of the brightfield magnifier can be combined with relative distance magnification (for example: accommodation) to create a higher overall magnifying effect.

For PVIs who can accommodate, brightfield magnifiers are useful in allowing them to read smaller print, or be used to provide a better working distance (see Fig 6.8).

Figure 6.7 Dome and bar magnifiers come in several shapes and sizes. They provide real or projection magnification which allows children to combine this with their accommodation (RDM) to good effect. The PVI uses their normal near correction when using this device.

PROBLEM

A child can read N20 print at 30 cm unaided. There are 3 potential solutions.

SOLUTION 1: Accommodation only	SOLUTION 2: Brightfield to help working position	SOLUTION 3: Accommodation and Brightfield
The child accommodates and brings the book to 15 cm. Magnification = 30/15 = 2x Child now reads N10 print at 15 cm	Brightfield dome allows 2x magnification. Using the dome, the child can read N10 print at 30 cm	Child can read N5 print at 15 cm

Figure 6.8 Worked example showing the usefulness of the dome in magnifying text for children. Three potential solutions are presented.

Table 6.5 Advantages and disadvantages of brightfield magnifiers.

	Advantages	Disadvantages
Image	• Low level of aberration • Image moves smoothly when the device moves • Binocularity easy, so good if nystagmus present	• Low magnification if not combined with other types of magnification
Practicality	• Easily supported on the page • Socially acceptable (looks like a paperweight or toy) • Can be used for long periods	• Can't write underneath them • Large diameter increases the field but also the weight

6.2 Telescopes

Telescopes are optical magnifying systems made up of two or more lenses.

Fully sighted people take for granted the fact that they can see things in the distance, reading signs, recognizing people and understanding facial expressions. For many people with low vision the visual world is restricted to things they can hold in their hand and bring close to their eyes. Telescopes can be rewarding devices to use, enabling the user to reach out with their vision to obtain information from further away. The use of telescopes to extend the "Visual Reach" of PVI should be encouraged from an early age to enhance and stimulate visual curiosity.

Telescopes can be broadly split into two different types :

i. **Galilean Telescopes**
These telescopes are made from a negative eyepiece lens and a positive objective lens.

ii. **Keplerian/Terrestrial Telescopes**
These telescopes are made from a positive eyepiece lens and a positive objective lens. Alone the telescope will produce an inverted image so a prism system is needed to turn the image the right way up.

The two different optical categories of telescopes work and behave in different ways (Table 6.6). Keplerian telescopes provide a better image quality and higher magnification. However Galilean telescopes are smaller, lighter and easier to use.

Keplerian telescopes need to be aligned more precisely than Galilean systems. Slight misalignment of a Keplerian Telescope means the image is lost (Fig. 6.10).

Figure 6.9 "Max Detail" Galilean systems offer a simple device which is easy to use but these are only available in low levels of magnification (approx. 2x).

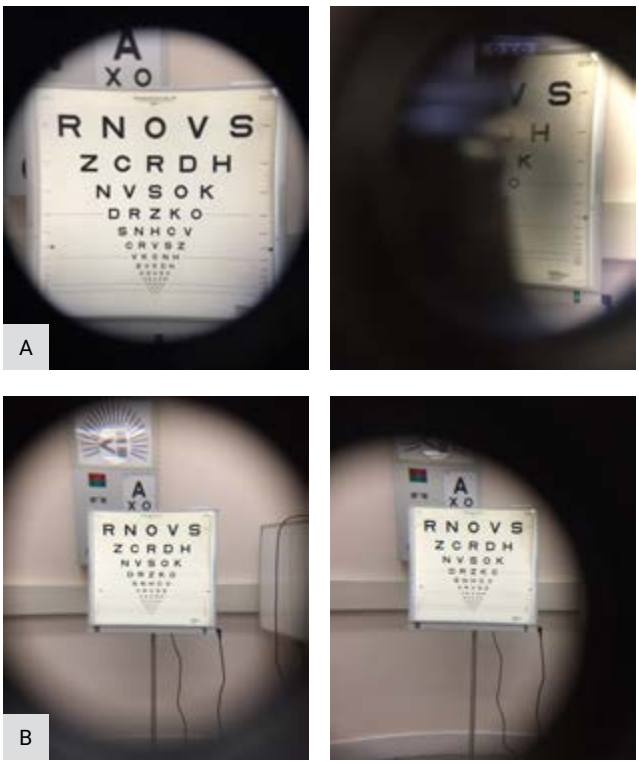


Figure 6.10 Keplerian telescopes can offer better image quality and power, but when decentred the image is lost quickly. Galilean telescopes are easier to use but have lower magnification and poorer image quality. A) Image through a Keplerian Telescope when aligned and when slightly misaligned B) Image through a Galilean Telescope when aligned and when slightly misaligned Photo: Andrew Miller.

Like all the other optical devices, people need training to be able to use telescopes efficiently. Here are some simple tips to get you started:

1. Start by allowing the PVI to hold the telescope and describe the different parts to them. Allow the PVI to feel there is an eye piece to look through and an objective lens to point towards the target.
2. For focusing telescopes, allow the PVI to feel how the focusing mechanism works.
3. Start by using a lit chart as a target. The PVI should be able to locate the chart without the telescope even if they cannot read any letters.
4. The PVI is encouraged to keep the eye looking towards the chart and then bring the telescope up to the eye.
5. The PVI should be roughly in line with the chart and have to only make small movements to align the image fully.
6. The PVI is instructed to make slow focusing movements to see if the image can be improved.
7. Repeat this exercise with a low contrast target such as the face of a family member sat across the room.
8. Sudden sharp movements of the telescope from one point to another should be discouraged and the PVI should be taught to move in a panning motion from one place to another.

Table 6.6 Differences between Galilean and Keplerian telescopes.

	Galilean Telescope	Keplerian Telescope
Image	• Poorer image quality • Limited to low powers only 2-4x • Smaller field of view • Field of view rapidly decreases as power increases	• Better image quality • Wider range of powers 3-10x • Larger field of view - • Field of view steadily decreases as power increases
Practicality	• Lighter • Smaller, shorter • Less expensive	• Heavier • Larger, longer • Expensive

Figure 6.11 A) Binocular telescope system. B) Hand held monocular. Photo: A) Ameen Harb.

Whilst telescopes are frequently thought of as ways to magnify things in the distance, they can be used to magnify things at near too.

Telescopes can also be adjusted to focus at near in two ways.

1. Placing a plus lens on the end of the telescope, “end cap”.
2. Adjust the length of the telescope.

The advantage that a near telescopes has over the other optical devices discussed so far in the chapter is that they can allow a longer working distance for the same level of magnification.

Table 6.7 Advantages and disadvantage of telescopes.

	Advantages	Disadvantages
Image	• See near, intermediate and far distances	• Need training
Practicality	• Portable	• Small field of view • Low social acceptability

TIPS

The closer the telescope is held to the eye, the wider the field of view.

Spectacle wearers should try and use telescopes as close to the eye as possible. Therefore, they should either take their spectacles off or fold the rubber eyepiece backwards to allow maximum field of view.

6.3 Electronic devices

The devices discussed so far have been optical magnifying devices which provide an enlarged image. The same job can be done in a different way using electronic magnifiers to display a larger picture of the object on a screen. An example of this is at the cinema, where a small film is projected on to a screen to show the audience a larger, magnified image.

It must also be noted that optical magnifying devices have little or no positive impact on the levels of contrast of the image to be viewed. So if an object is too small to see optical magnifiers are very helpful. But if it is too pale and faint to see, then they may be of more limited help. However, electronic magnification can be used to enhance the contrast of an image as well as the size. This can be particularly helpful for those with AMD, optic nerve problems or media opacity (cataract, corneal changes etc.).

Optical magnifier

Hello → Hello

Electronic magnifier

Hello → Hello

Figure 6.12 Optical magnifiers only allow magnification, electronic magnifiers allows control over both size and contrast.

Electronic magnifying devices can be split into:

1. **Mainstream devices**, which are aimed at the general population but may be helpful to the PVI and
2. **Specialist devices** which have been developed especially for PVI.

It should be noted that electronic magnification is a rapidly changing area of development and it is beyond the scope of this book to provide a comprehensive list of all the devices that can be of assistance.

Mainstream Devices

Over the course of the last few years, many mainstream devices are being made with built in features useful to PVI. Here are some examples:

A digital camera or a smartphone can be used to take a picture. The picture that can then be viewed with a magnifier or zoomed in on the screen to allow a more detailed view.

Standard computer operating systems allow the screen, cursor and pointer to be magnified. Screen colors can be altered to allow less glare whilst maintaining good contrast. With minimal effort typed documents can be read aloud by the computer's electronic voice, allowing the PVI to listen to the words rather than having to read them.

Tablet computers can allow books to be displayed electronically, giving the user control over the size and separation of the text. If the vision is too poor to allow the PVI to read the enlarged text, then the words can be read electronically or with a human voice (audio books).

Whilst this assistive technology is often included in standard devices, it may not be automatically switched on and the PVI may need to be taught how to use this help. It is expected that as technology becomes more readily available, teaching and demonstrating these solutions will form an increasing part of a standard low vision rehabilitation program.

Specialist Devices (Electronic Visual Enhancement Systems EVES)

Traditionally, these devices were split into large desk top and smaller portable solutions, but as technology moves on, this divide is becoming a little more blurred.

Desktop CCTV (Closed Circuit Television)

These are large desk top devices which allow a great degree of control over the levels of magnification delivered. Items are placed on a table and viewed by a high quality camera. The image is then displayed on a screen in front of the PVI.

Controls allow the PVI to vary the levels of magnification from low to high, as well as controlling the levels of contrast and color. This control allows large print to be magnified less and small print magnified more. This variety in magnification allows the field of view to be preserved as much as possible for a given text size.

Figure 6.13 CCTV allows flexible control of the levels of magnification and contrast. Devices can be desk based or portable, also for near or distance. A) The camera can point at the school board and allow the student with low vision to read the lesson content from the screen on her desk .B) The device can be used for writing, reading and personal grooming such as cutting nails. Photo: B) Ameen Harb.

Since the camera shows the picture in real time, the PVI can use his hands under the camera to write or manipulate objects. This can be quite challenging at first as the PVI has to work with his hands whilst viewing them on a screen, but with practice CCTV can be used to write or manipulate small items.

Variants of these devices use a camera that can be moved and directed down to a page or straight ahead to look at distance. This may allow a child in school the ability to magnify print on the board and also see the page of the book on their desk (Fig. 6.13).

Although they offer great flexibility, CCTV can be very costly and therefore access to these devices, even in developed countries, can be limited.

Mouse Magnifiers

These simple devices look like computer mouse but have a built-in camera which can be attached to a home television screen or a laptop. In this case the camera sits directly on the object and shows the image on the TV screen (Fig. 6.14). These devices are much cheaper than a desk top CCTV but may not have the quality and flexibility to change magnification over the same range as the recent CCTVs found in the market. Also as the device sits flat on the object, it does not allow any work underneath the camera.

Figure 6.14 Mouse Magnifiers that can be connected to a home TV to create a basic electronic magnifier system.

Portable Hand Held Electronic Magnifiers

These devices use a small 10 cm – 18 cm screen to display images from a built in camera (Fig 6.15).

Figure 6.15 Hand held CCTV allows flexible control of magnification and contrast but these devices are expensive costing 10 – 20x the cost of a simple hand magnifier. Photo Associated Optical.

Designed as a portable replacement for an optical magnifier, they make it possible to change the levels of contrast and magnification, but the restricted screen size can affect the usefulness of these devices.

Table 6.8 Advantages and disadvantages of electronic CCTV magnifiers.

	Advantages	Disadvantages
Image	• Wide variety of magnification • Increased magnification by sitting closer to the screen • Screen can be seen with both eyes (helpful with nystagmus)	• Image is at a different place to your hands (need of training)
Practicality	• Head and body position variable (you can have a relatively normal posture) • Contrast and color can be changed	• Expensive (as much as 10-20x more expensive than optical solutions). • Cannot be moved easily • Need power source

6.4 Choosing the appropriate devices

As you can now see there are lots of different ways to deliver magnification. Once you are familiar with all these different types of devices, you have to decide which is most appropriate for the PVI. You will need to consider the type of task the PVI is doing, as well as his abilities and needs.

Below is a list of just some of the things you should think about before deciding which devices to try:

- **Hands free:** Does the task need the use of hands e.g. writing, painting my nails?
- **Task working distance:** How far close or far from the PVI does the task need to be done?
- **Tremor:** Can the PVI hold their hand steady?
- **Ease of handling:** Can the PVI change the batteries? Can they hold the handle? Is the device too heavy?
- **Training Needed:** Is the PVI able to understand and act on training?
- **Portability:** Is the device for home use or other places also?
- **Lighting:** Does the PVI benefit from a good light source? Are there issues with glare?
- **Object to be viewed:** Is the task a flat surface?
- **Availability:** Can the device be imported?
- **Socially acceptable?** Might the appearance of the device be a problem for the PVI?

Table 6.9 Factors to take into account when selecting an optical device.

Person with LV	Task requirements
• Type of visual defect • Size of visual field • Stability of the hands • Ability to be trained • Need for extra light • Sensitive to social acceptability	• Spot or sustained task • Distance (near or far) • Hands (one, two or none available) • Specific or flexible working distance • Type of surfaces (flat or not) • Location (portability)

NOW YOU SHOULD UNDERSTAND:

1. *The main types of optical devices available in low vision work.*
2. *Their advantages and disadvantages.*
3. *The main electronic aids used in low vision work.*
4. *How to decide which type of device to prescribe.*

6 RESOURCES

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6.1 Reviewing visual aids

Use what you have learned to fill in the two tables below. Use √ (useful) or √ √ (very useful).

For each device, mark if it can be conveniently used for spot (short) tasks and/or for sustained (long) tasks.

Visual devices	Distance and duration of tasks					
	Near		Intermediate		Distant	
	Spotting	Sustained	Spotting	Sustained	Spotting	Sustained
Hand held Magnifiers						
Stand Magnifiers						
Spectacles Magnifiers						
Telescopes						
Video Magnifiers						

Fill in the table below with estimates and ranges from the text and your own experience.

Device	Typical range		
	Magnification	Approx. range of diameters	Comments
Dome			
Hand magnifiers			
Stand magnifiers			
Spectacles			
Monocular telescope			
Binocular telescope Max TV			
Camera on phone			

The answers are in p. 105.

6.2 Training to use near optical devices

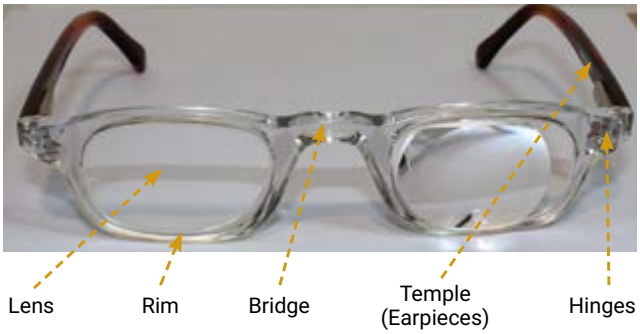
General

- Upon issuing a low vision device, the professional should do the following:
  1. Explain the benefits and limitations of the device. This can be done using a budgie stick: the person can see the size of print he sees without the device and the size he sees with the device.
  2. Introduce the names of the parts.
  3. Clarify the concept of focus or clear image and explain the focal distance.
  4. Give information on how to:
     a. Hold the device
     b. Keep the lens clean
     c. Store the devices to avoid scratching the lenses (in a pocket or a case)
  5. Stress the importance of:
     a. Using a good body posture while using the device and reading stand for long periods of time
     b. Having good lighting and no glare.

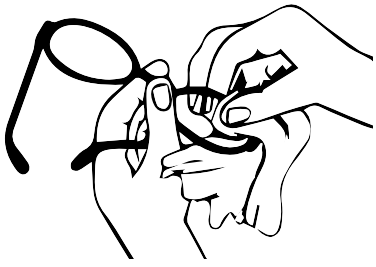
- During the training with the device, the low vision specialist should make sure:
  - The training material is relevant and meaningful to the person with low vision.
  - There is plenty of light on the object without glare.
  - He or she is aware of the specificities of the optical device (see below).

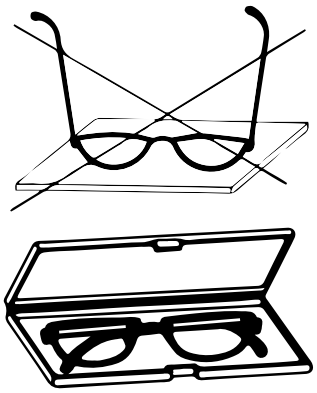
Spectacles

- **Distance between the lens and the object (focal length).** It depends on the power of the lens: focal length in cm = 100 / power in diopter. The user can find this by holding the reading material at arms length, and then moving it slowly nearer until letters are the most clear.
- **If the object or text needs to be held for a long period of time.** The person can put both elbows on the table or use a reading stand.



Keep your lenses clean and clear!

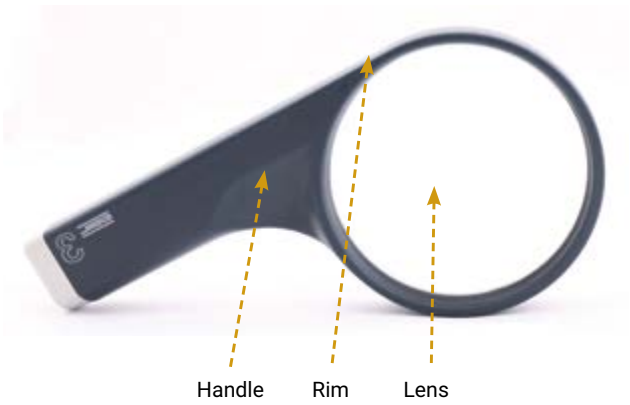




Clean lenses will make you see more and make your devices last longer.

Hand magnifier

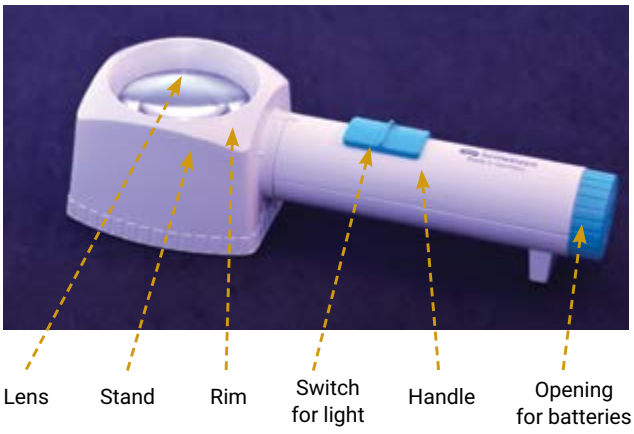
- **Distance between the lens and the object (focal length).** It can be calculated (in cm) as 100/ lens power in diopters.
  - If used for a sustained task (reading the newspaper), the distance between the lens and the eye should be within twice their focal length.
  - If the magnifier is used for a spot task (reading a label), it can be used further away (within four times the focal length).
  - Remember that increasing eye to lens distance has no effect on the magnification: it is more comfortable for the user but the field of view becomes smaller.



Can also be illuminated, see stand magnifier

Stand magnifier

- Choose the most appropriate eye to lens distance depending on the target object and the magnification:
  - Increasing the distance will give a smaller field of view but allows binocularity.
  - Decreasing the distance will give a bigger field of view but allows only monocular vision.
  - To use this device, the user will need to accommodate or in the case of presbyopia, to wear reading glasses.

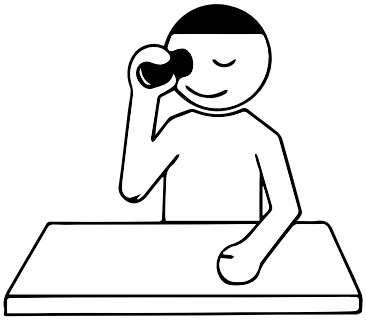


Brightfield (Dome)

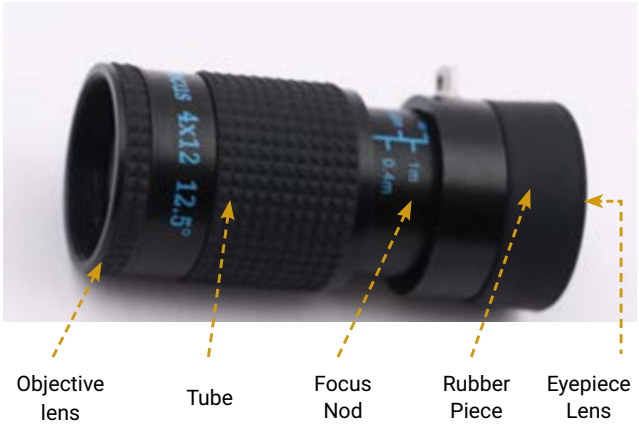
- Keep the dome flat on the page.
- Move smoothly along the page to follow the print.
- Do not use the light directly over it: it will reflect on the surface and create glare.

6.3 Training to use telescopes

Keep the monocular with you!



It will expand your visual world.



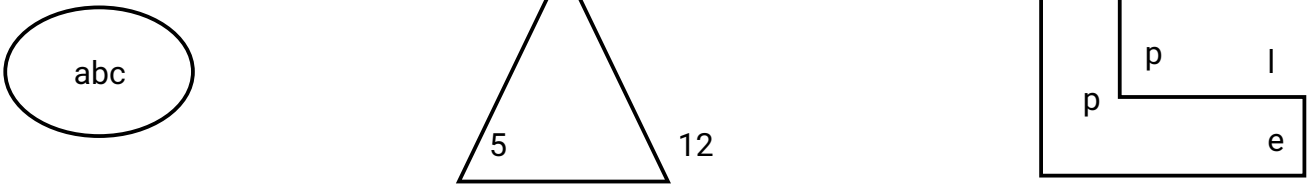
- **Choose the eye.** The user can look at a distant object without the telescope, maintain fixation, then bring the telescope to the best/ dominant eye (for children, it can be useful to start with a cardboard tube). This is the eye to which the user will spontaneously look through.
- **Choose the hand.** It is recommended to hold the eye piece of the telescope by the opposite hand of the dominant eye thereby covering the eye not being used.
- **Use with glasses.** Spectacle wearers should unfold the rubber in front of the eyepiece and put in contact with the spectacle lens: doing this doubles the field of view. On the other hand, increasing the distance between the telescope and the eye will decrease the field of view.

All telescopes:

- **Adjust the focus.** The focus of the device is a property of the lens, and to make it easier for the beginner, the examiner can set the focus of the telescope to a given target before handing it over to the person with low vision.
- Training telescopic skills can be done indoors (items on a wall or board) or outdoors. These skills include:
  - Localizing: knowing where to look
  - Focusing: good manipulation skills giving a clear image for a range of distances.
  - Spotting: combines localizing and focusing skills to see any stationary object at any distance.
  - Tracing: the ability to follow the contours of a stationary line or object.
  - Tracking: following a moving target
  - Scanning: to search the environment for an object not seen.

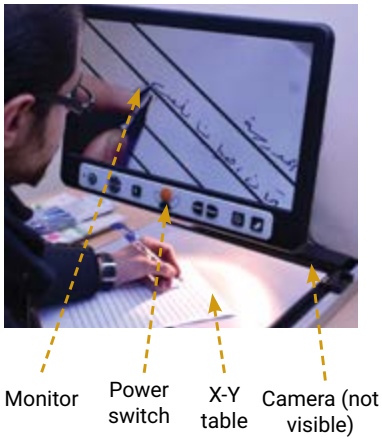
Training

You can tape a few shapes on the wall and ask the person to **scan** the wall to find them, then **trace** the lines to find the number or letter.



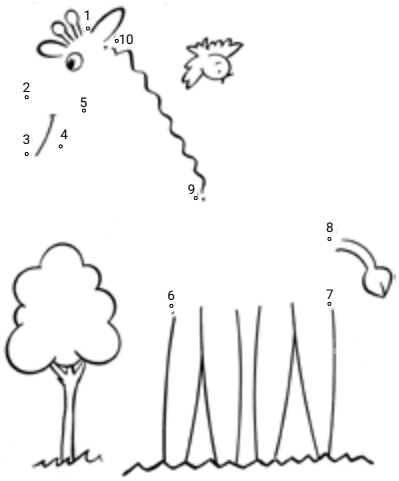
6.4 Training to use a CCTV

- **Position.** The person with LV should sit on a comfortable chair, with the screen at the level of their eyes.
- **Focus.** This is done when the image is enlarged to its maximum.
- **Magnification.** Is determined by the control switch but also by the position of the viewer: sitting close to the screen allows additional magnification (relative distance). The amount of magnification needed varies with the person and with the task: writing requires less magnification, while more magnification is needed for reading and looking at details. Higher magnification gives smaller visual field, so the user should have enough magnification yfor the needed field of view.
- **Contrast.** The user can typically choose between real color representation, black on white or white on black.
- **XY-table.** Using the table while reading needs practice. To be fluent,
- the user should be able to change line without looking at the hands.
- **Writing with the CCTV.** The user should use low magnification and look to the screen.



Training

Eye-hand coordination is a major challenge when using a CCTV. It can be practiced in the playful way using simple games.



7 NON-OPTICAL DEVICES

Frank Eperjesi PhD FCOptom

While optical magnifiers undoubtedly provide benefits for many PVI, other non-optical devices can also help to maximize the remaining vision. These non-optical aids can be used alongside and in some cases, instead of conventional optical devices. While optical devices are considered by some to be the realm of the specialist trained practitioner, non-optical assistive devices can often be discussed and recommended in a more informal way.

7.1 Task lighting

Anyone trying to do a detailed job, such as sewing or craft work, will find a light source placed near the task can be helpful in making the task easier and less tiring.

So why does more light help?

The eye conditions that lead to visual impairment frequently mean that people with low vision have weak spots in the retina (relative scotomas) which need more stimulation (light) to work. If levels of light are low, these non-working parts of the retina become larger and darker patches (scotomas) interfere and limit the residual vision. Conversely, if more light gets to these patches, the stimulation may be enough to allow the retina to work and reduce the size of the dark patch (scotoma). This is illustrated in Fig. 7.1.

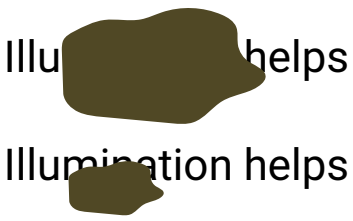


Figure 7.1 The bottom line is an example of the decrease in size of a central scotoma during reading due to increased target lighting. (illustration Andrew Miller)

For this reason, task lighting has been proven to be particularly useful to help people with age-related macular degeneration (AMD) read and do other detailed tasks. Clinical evidence also indicates that people with AMD tend to be less successful with non-illuminated optical devices.

Additional task lighting can sometimes have such a positive effect on the levels of vision that it allows the successful use of an optical device with a lower power. Lower powered devices provide a wider field of view and reduced optical aberrations, thus they are easier and more intuitive to use. In some cases optimum task lighting will allow the individual to achieve their near vision goal without the use of an optical device.

GOLDEN RULE

Lighting can be a significant help to many people with low vision but has to be applied without adding glare.

Many of the optical devices prescribed need to be used at a very close working position and this may cast a shadow over the work. Well positioned, targeted lighting can eliminate the problem and make the visual task much easier. Lighting can be helpful when reading but can also be useful for other everyday near tasks too. For example:

- Preparing food/making drinks
- Applying make up
- Seeing food on a plate
- Writing.

TIPS

Better light and illumination can make it much easier for your PVIs to manage lower contrast tasks by:

- More light passing through media opacities and therefore reaching the retina,
- Reduction in the size of the macular scotoma,
- Change in the adaptive state of the retina lowering threshold (increasing contrast sensitivity),
- Or a combination of these factors.

Increased lighting is not beneficial for all PVI. Some types of eye disease leave the person more likely to have problems with glare, meaning that visual function can be reduced with the use of inappropriate local lighting. If the person has albinism, retinitis pigmentosa or media opacity (e.g. corneal opacity), then general background lighting may be preferable over targeted task lighting.

The effect of local task lighting needs to be evaluated in the consulting room and appropriate recommendations made on a case by case basis.

EXERCISE 7.1

List eye diseases where you feel lighting may be more likely to help and diseases where you need to be more cautious when recommending local light.

See answers p. 106

Positioning and Types of Task Lights

Examples of lamps that could be used to provide local lighting are showed in Fig. 7.2. Task lights come in many forms but there are features common to most task lamps that help them work more efficiently.

Figure 7.2 Pictures to show a variety of suitable task lamps. Photo of Lamp courtesy Associated Optical

Movable

This allows the PVI control of the direction and intensity of the illumination. Changing the angle of the light can allow reflections to be moved away from the page and hence allow a clearer view.

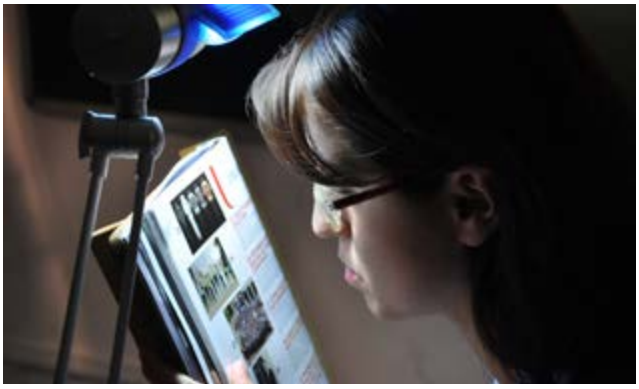


Figure 7.3 Lamps should be positioned to allow light to fall onto the task without going directly into the eye. Lamps should be positioned close to the task to increase illuminance and cold to avoid burning.

Close to the task

Maximum illuminance will be provided when the light source is placed close to the object. Illuminance falls rapidly as a lamp is moved away from the task, doubling the distance between the light source and the target will decrease the illuminance by a factor of 4. Moving the lamp 3 times further away will reduce the illuminance by a factor of 9!

Cold to touch

As the lamps are to be used at a close working position, it essential for comfort and safety that the lamps do not emit too much heat.

Lamps with a tungsten incandescent bulb or halogen bulb are often not recommended for use in low vision because of safety concerns over their heat emitting properties. They may cause discomfort or even a burn if contact is made with the face, ear or hand.

EXERCISE 7.2

Explain why lighting can help some people with low vision read more efficiently.

See answers p. 106

Compact fluorescent and LED bulbs produce an even light and generate less heat than the old style tungsten incandescent lamp so it does not become hot. The initial purchase price of a lamp with these bulbs can be slightly greater than that of a lamp with an incandescent tungsten lamp. On the other hand, running costs are less expensive as they use less electricity and have a much longer life.

Figure 7.4 Daylight can be used to help with illumination. Think about where daylight enters the room at different times of the day. Sitting positions may need to be changed during the day to make best use of daylight and to minimize glare. Photos: Ameen Harb.

Table 7.1 Differences between different illumination types. Photos: 'Electric bulb' by KMJ licensed under CC BY-SA 3.0; 'Halogen lamp macro 02' CC BY-SA 3.0; '03 Spiral CFL Bulb 2010-03-08' by Sun Ladder licensed under CC BY-SA 3.0; 'LED light bulbs at IKEA store' by Maksym Kozlenko licensed under CC BY-SA 4.0.

Type of bulb				
	tungsten incandescent	tungsten halogen	compact fluo	LED (light emitting diode)
Start up	Instant	Instant	Slow	Instant
Temperature to touch	Get hot	Get very hot	Cool	Cold
Energy efficiency	Poor	Good	Good	Excellent
Recommended	x	x	√	√

Figure 7.5 Glare. The sun reflecting on a shiny surface (pavement). Makes it difficult to see steps and dips (disability).

7.2 Filters

For theoretical purposes, glare can be divided into:

- Disability glare
- Discomfort glare

Disability glare occurs when there is too much light reaching the retina, reducing the contrast between the objects and their surroundings. It can be minimized using short wavelength cut-off filters e.g. UV and blue light absorbing filters (Fig. 7.6).

Yellow or orange filters improve contrast by blocking shorter wavelength light ('Blue Block'), thereby reducing the scatter of light inside the eye. In people sensitive to glare, these filters can improve visual comfort and possibly help with orientation and mobility skills.

With disability glare, broad wavelength absorbing filters such as grey and brown photochromic or neutral density lenses should be avoided as they may simply dull the retinal image and lead to a reduction in visual function.

Figure 7.6 Examples of short wavelength cut off spectacles (blue blockers). Note the side shields to protect from light leaking around the spectacles. Photos courtesy Associated Optical

A simple and cheap solution can be the use of a shade or broad brimmed hat. They work in the same way as the sun visor in a car, cutting off the direct dazzling light from the sun, whilst still allowing the necessary reflected light into the eye to help the person see.

TIPS

Where possible control glare at its source, when this is not possible then use protective eye wear and hats to protect the eyes.

Figure 7.7 Outdoor glare can be reduced significantly by the use of wrap round sun spectacles or a brimmed hat. A) Clip-ons. B) Cap. C) Sunglasses with top and side shields. Photos: A) Ameen Harb. B) "Baseball cap" by TexasRebel in Public Domain.

GOLDEN RULE

Sunlight can be damaging for everyone's eyes. We should all wear good quality sun spectacles which protect our eyes from short wavelength light.

Discomfort glare results in visual discomfort, but has no effect on visual acuity. It can be reduced using a broad wavelength absorbing neutral tint which affects all wavelengths equally (regular sunglasses). In these cases, there would be no benefit from short wavelength blocking filters used for disability glare. But hats, visors and side shields on the frame can still be useful in these situations.

Photophobia is associated with severe ocular pain and discomfort in the presence of light and is likely to be associated with anterior segment inflammation or disorders. The term is often used, albeit incorrectly, to describe the ocular irritation associated with discomfort glare.

In low vision, photophobia is likely to have a non-inflammatory cause such as albinism or retinitis pigmentosa. People with these conditions may benefit from a wrap round or fit over filter.

EXERCISE 7.3

A child with albinism sits in a classroom facing a window which is causing difficulty with his work.

What actions can you take to make this easier for the child?

See answer p. 106

Light/ Dark Adaptation

Light adaptation refers to the visual response when moving from a dark to a light environment (typically from inside to outside) while dark adaptation refers to the opposite: when moving from light to dark environment (typically from outside to indoor). Both functions are particular troublesome for people with cone dysfunction e.g. cone dystrophy or advanced AMD. Putting a drop-in filter (neutral grey or brown) just before going outside can lower the adaptive state of the retina. In addition, the person will find it easier to cope on removing the filter when re-entering a dark environment from a light environment. Photochromic lenses are not suitable in this situation as the intra-lens chemical reaction to light is not fast enough to prevent retinal adaptation in the light environment. In light conditions, these individuals will benefit from using specialist dark orange or red light filters.

Practical tips when prescribing filters

As mentioned, the division of glare may be useful in an academic sense as it may help you understand why one filter may have a greater effect with one person compared with another.

In the clinical setting, you have to look at both objective and subjective information to gauge which filters may be beneficial. The effect of a range of filters, such as yellow and grey tints, can be objectively and subjectively compared using visual acuity charts of different contrast or a high contrast chart under various levels of illumination. This can be completed in and out doors along with an assessment of near acuity using a variety of printed materials.

Figure 7.8 Testing sample filters can be tried in in the test room but must be tried in the conditions they are to be worn. If the tints are for use outdoors they should be tested outdoors.

As levels of glare are affected by the ambient lighting, it is useful to have simple filters that can be worn over existing spectacles for the PVIs to take and try at home (clip-on).

TIPS

Try and assess the potential benefit of filters under the conditions the PVI is having difficulties.

A short wavelength (yellow) filter is likely to be of use for people complaining with disability glare, while grey or brown lenses can reduce the symptoms due to discomfort glare.

7.3 Contrast Enhancement

We have already discussed the fact that PVI can often struggle to see things because they are too small, but they will also have difficulty seeing objects that have poor contrast and do not stick out from the background.

When things are not bold enough to see, simply making them bigger will often have only limited effect in improving visibility. For example, people with low vision will sometimes fall because they have not seen a step. This is not because the step is too small for them to see, it is because it has not enough contrast for them to see the edge.

If you identify that the PVI is struggling due to poor contrast sensitivity, the solutions you use must increase the contrast of the target.

For example: **Bold Print is easier to see**

When print becomes lighter it gets harder to see

Making it bigger may not help

When print becomes lighter it gets harder to see

Making it bigger may not help

Figure 7.9 Examples of print decreasing in contrast and the same print set on a contrasting colored background.

TIPS

Remember magnifiers make things bigger and this will help when objects are too small to see.

If the contrast of an item is causing the problem for your PVI then you MUST increase the contrast to solve this problem. Just making it bigger won't help.

In Chapter 6 we discussed that electronic magnifiers can increase contrast to help PVI identify print. These devices can be very costly and are mainly used to help with reading of printed material.

There are many simple practical examples that can be used to help people who are struggling with reduced contrast.

- Contrasting edges can be painted on to stairs to show people with low vision the treads.
- Colored tape can be used to highlight the edge of a table.
- Dark felt tip pens produce writing of higher contrast.
- Colored chopping boards can be used in a kitchen to highlight food.

Adapting tasks by changing contrast can be a powerful tool in supporting people with low vision. Often the adaptations that help can be simple cheap and readily accessible. You must use your imagination to come up with solutions that are relevant to the PVI you are working with.

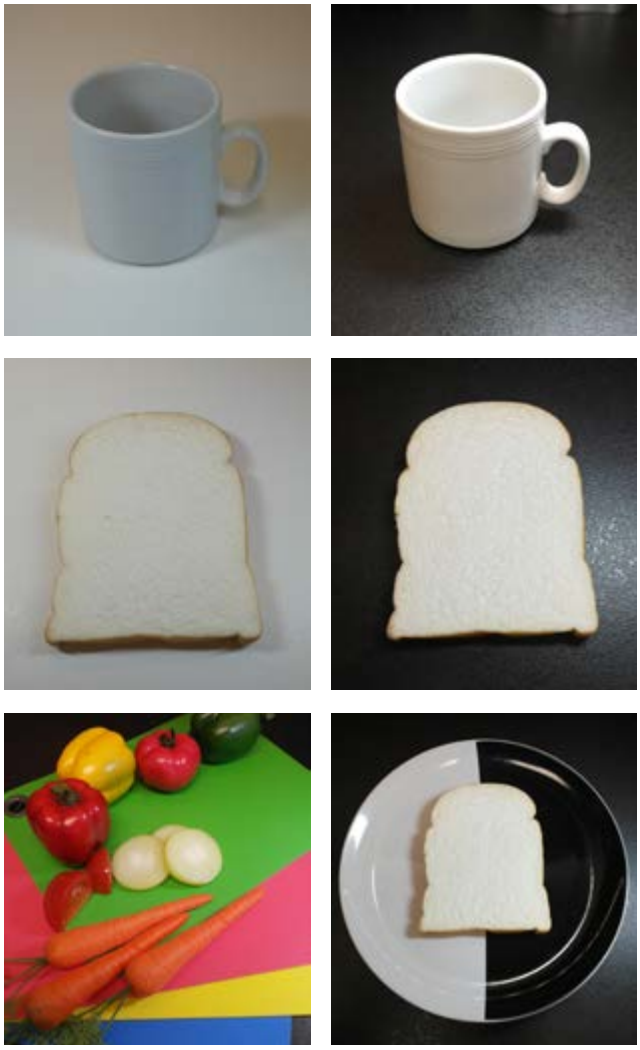


Figure 7.10 Examples of poor and better contrast. Adapting contrast can allow people with Low Vision to see edges of the target better.

7.4 Typoscopes

A typoscope is a piece of flat card or plastic, usually black, with one or more pieces cut out to reveal sections of print on a page of text or other reading material. When placed on text, the typoscope reduces the scattered light entering the eye thereby helping reading rate and fluency in those sensitive to glare. As a result, typoscopes can be particularly useful for a person with media opacities, albinism or retinitis pigmentosa when attempting to read dark print from a white background.

Typoscopes can be homemade by the user, with a variety of sizes, slit widths and heights, for use in different reading tasks (Fig. 7.11). They produce a similar effect to the negative contrast mode (white text on black background) available on many electronic vision enhancement systems. Typoscopes have the added advantage that the lower edge of the opening provides a reading guide which assists the person to locate the next word and when tracing from the end of one line of text to the beginning of the next.

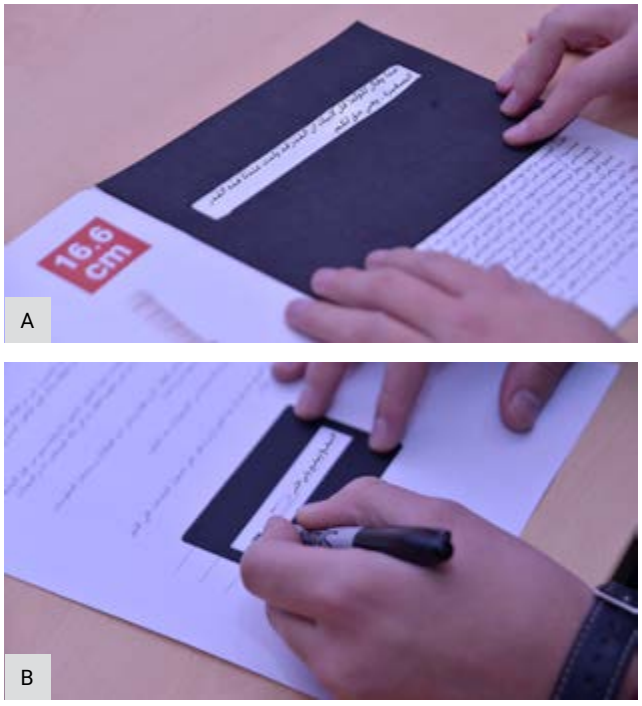


Figure 7.11 A) Typoscopes decrease light scatter and glare from white paper. B) Smaller signature guides can be used to allow people to better target where they need to sign documents.

EXERCISE 7.4

List eye conditions where a typoscope is likely to help with reading.

See answers p. 106

7.5 Large print

A lot of reading material can now be produced in a "Large print" format. The larger print decreases the level of magnification needed and can thereby make it easier for users to read. If print is made to an appropriate size, some users will be able to manage without using any other form of magnification which can be very liberating.

Using larger print means creating larger worksheets or heavier books which limits the levels of magnification that can be created by this method (see Fig 7.12).

Standard Print

The cat sat on the mat

3x larger than standard print

The cat sat on the mat

6x larger than standard print

The cat sat on the mat

Figure 7.12 The effect of increasing text size 3x and 6x standard on the field of view.

Large print can be produced in several ways:

- Commercially, such as religious books,
- Using electronic readers to enlarge the text (e.g. tablet computers or e-readers),
- For personal correspondence family members could be advised to word-process and print documents in larger print. Alternatively people can write larger using a felt tip or fiber tip pens.
- Some standard sized texts, such as a school worksheets, could be simply enlarged using a photocopier. Caution has to be exercised as repeatedly photocopying can reduce the levels of contrast of the text.

7.6 Writing guides and Reading stands

Writing guides or thicker lined paper can help a PVI write in straight lines and produce more legible writing (Fig. 7.13).

Figure 7.13 A writing guide with elastic strings to keep text straight when writing.

Devices with a short working distance such as spectacle magnifiers or stand magnifiers should be used with a reading stand or clip board. A clip board will allow the PVI to keep the task steady (keep the focal length) and maintain a good posture.The reader could also hold reading material with the elbows tucked into the sides, this allows the reading material to be held steadily and brought to the focal length of the device (Fig. 7.14).

Figure 7.14 Using a clipboard or table top to allow text to be held closer for longer.

Reading stands are especially useful with hand magnifiers. These devices have the advantage of being low cost and readily available (Fig. 7.15).

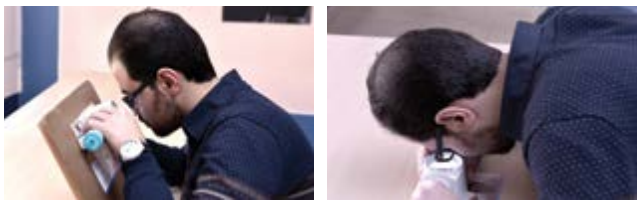


Figure 7.15 Improved posture (left) using a reading stand. Photos: Ameen Harb.

EXERCISE 7.5

How would you help someone wishing to write?

How would you help someone with 0.1 (6/60) acuity better see to make a cup of tea? *See answers p. 107*

7.7 Daily living aids

There is a multitude of simple aids that can assist PVIs to complete a range of everyday tasks more easily.

These can be specialist devices such as an alarm that tells when your cup is filled to the top, or mainstream items that have been adapted to help make best use of residual vision such as a thick felt tip pen.

We encourage you to use your imagination to adapt items that can be sourced locally to help PVIs.

Table 7.2 Some examples of specialist aids and mainstream devices that can help PVI.

Specialist Device	Mainstream Device
 Talking Clock	 Watch with a clear high contrast face
 "Bump ons" are high contrast raised tactile dots used to highlight important buttons or switches	 Black felt pens allow high contrast print

NOW YOU SHOULD UNDERSTAND:

1. *Why light can help some PVI.*
2. *How to place a light to help a PVI.*
3. *The advantages and disadvantages of different light bulbs.*
4. *The effect of glare and ways to minimize its effect.*
5. *The availability of mainstream and specialist aids for daily living.*

7 RESOURCES

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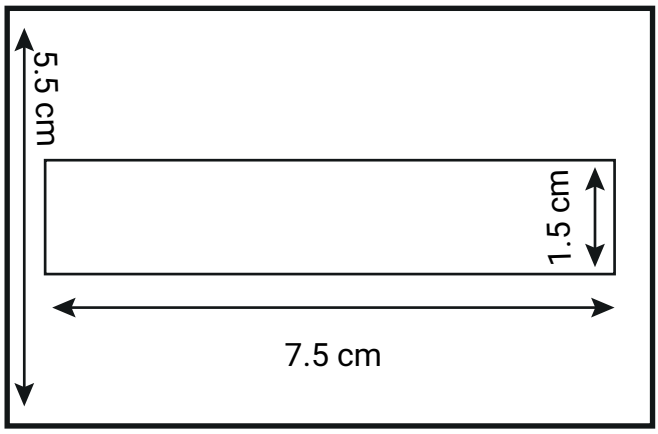
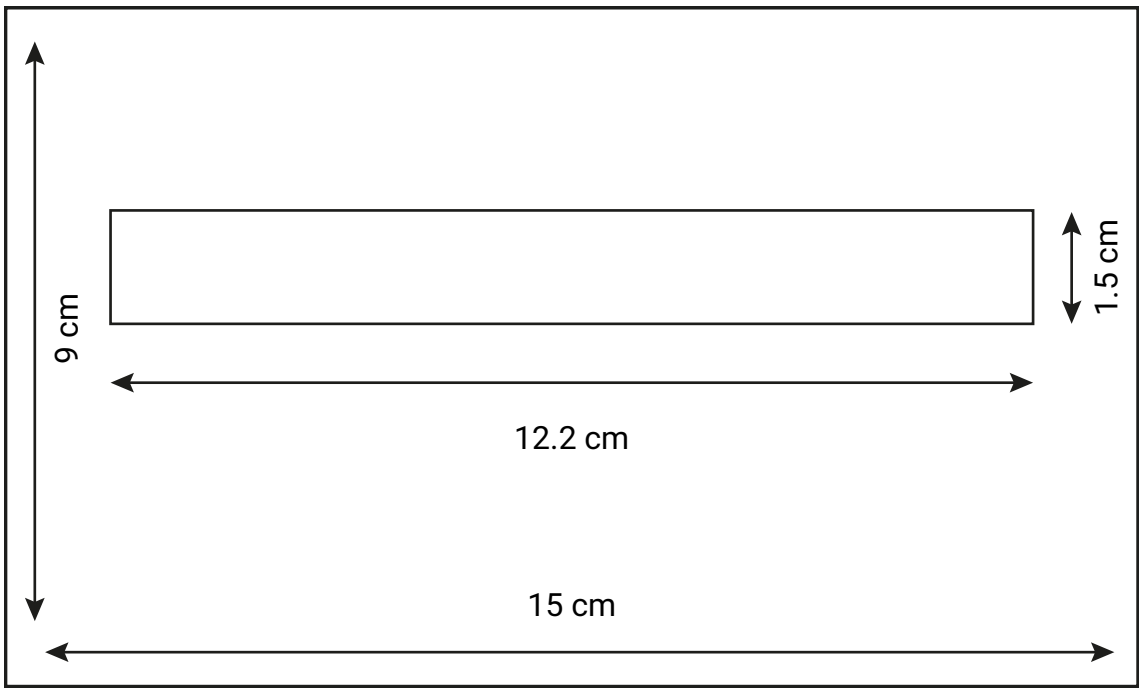
7.1 Signature frame

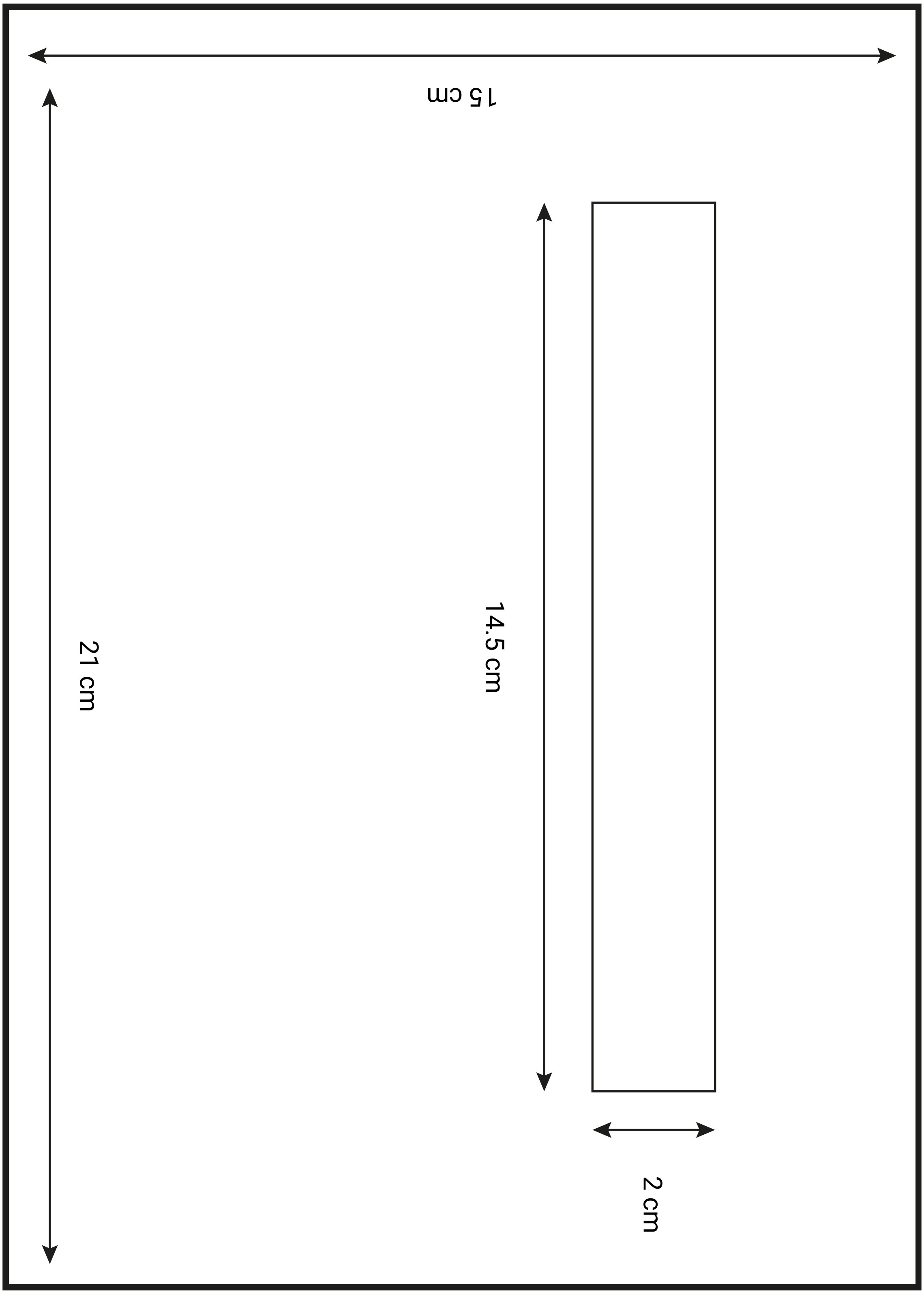
It should be made of cardboard thick enough to make it easy to feel the opening and preferably a contrasting color to make it easier to locate it on a page.



7.2 Typoscope

Same principle as the signature frame, but for reading. It can be made to allow the whole line to be read, or only part of it. It should also be of a dark color to decrease the glare of the paper.




15 cm
21 cm
14.5 cm
2 cm

7.3 Making a reading or writing stand

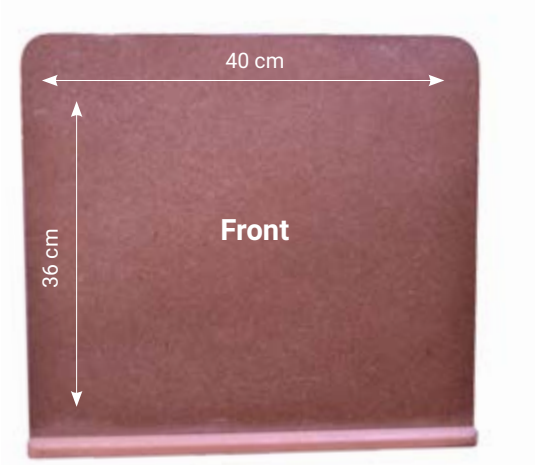
Front side

- Wooden board (40 x 36 cm)
- Wooden edge (40 x 2 cm)

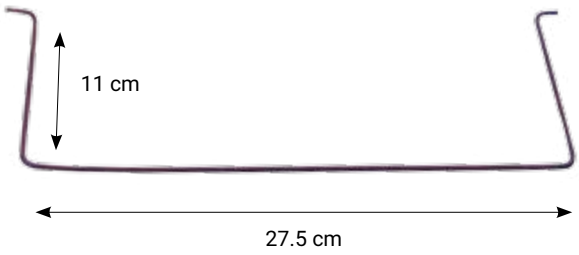
Back side

- 2 wooden edges (36 cm) with two holes each (2.5 mm) for the metal bar
- 2 wooden beams (32 cm) with 5 groves
- Flexible metal bar (42 cm)
- Cylindrical wooden beam (25 cm)
- 2 screws
- 2 metal ring for the screws
- 2 rubber rings
- 2 wooden rings

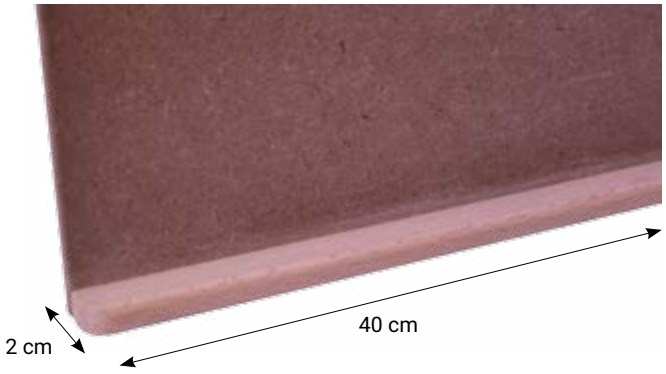
Wooden board

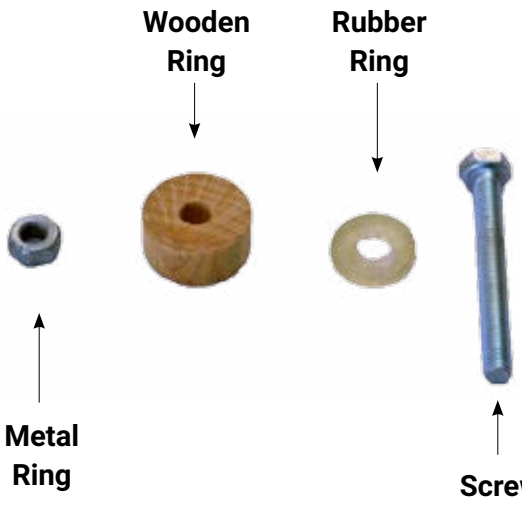


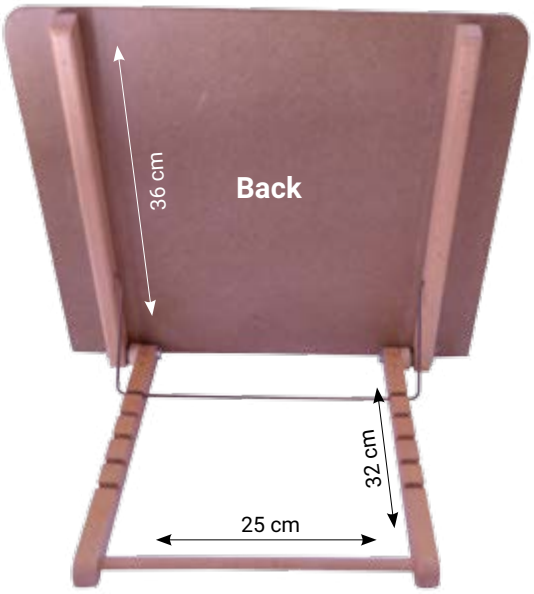
Metal bar



Wooden edge



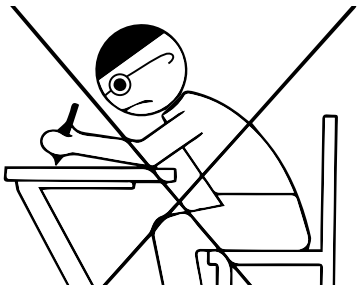




7.4 Reminders

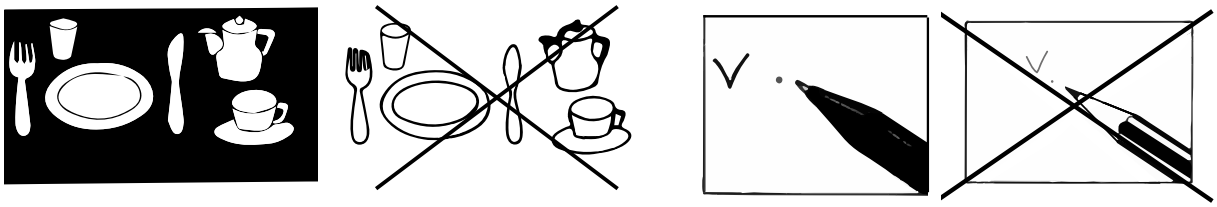
Make copies of these sketches to remind the PVI of some of the simple things they can do to make their lives easier.

Think about your posture



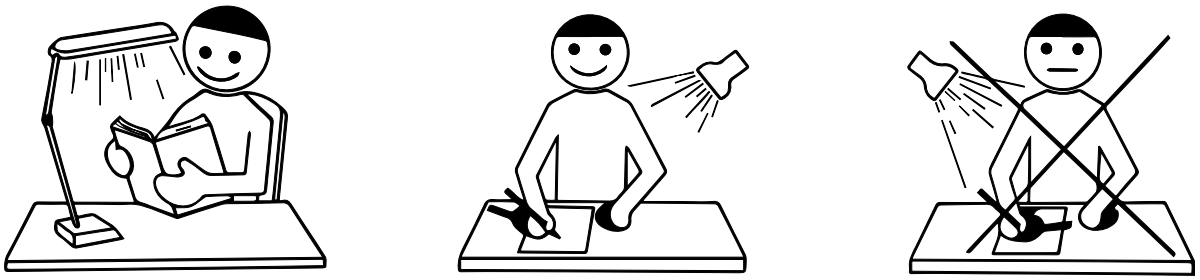
A good posture will keep you working for a longer time and avoid back or neck problems.

Think about the contrast!



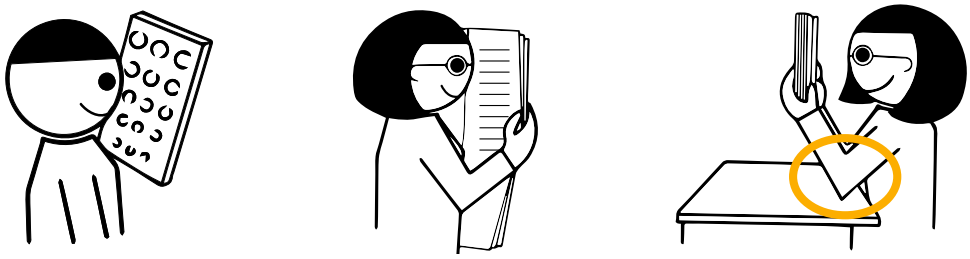
A good contrast between the object and its background makes you see more.

Think about your light!



Optimal lighting makes you see more.

Come closer and you will see more!



Moving closer to objects makes them look bigger.

8 LOW VISION TRAINING

Krister Inde MA, PhD hc

GOLDEN RULE

It is not harmful to use your eyes or to train your vision. Indeed training the eyes can allow the PVI to see more.

This chapter explores some of the opportunities to train residual vision to make better use of the sight that remains. People with low vision are not all the same; it is not correct to say that all PVIs should have more light, bigger letters or be assisted in the same way. The truth is that there are many types of needs which differ from one individual to the next.

EXAMPLE

Some PVIs say:

"Why is it that sometimes things appear and disappear" or "Why do some PVIs hold their head in a certain way?"

Understanding the characteristics of impaired vision will enable you to train the PVIs to use their reduced vision in a more efficient way.

In older days, good hearted but poorly educated teachers felt that PVIs were at danger of losing sight if they used their remaining vision. We now know that using the eyes cannot harm them or make the visual conditions worse. It is in fact the other way round: in order to see more, PVIs need to use and train their residual vision to be more effective in school, at work, at home and for pleasure. Even if the eye condition is progressive, it is worth the effort to use the vision while it is there; this is especially true for children.

GOLDEN RULE

Many eye diseases will cause the vision to progressively decline, so you have to explain to your PVIs that you cannot guarantee how their vision will be in the future. However you can assure them that their vision will not decline due to use or training.

Many PVIs will have to get closer to things in order to see them more clearly. We must support and encourage them to be confident in moving closer to see, even if this will make them look different. You have to empower the PVI so they know that they have a right to be different in order to see more.

TIPS

Although using vision will not harm the eyes, low vision training can make a person tired or give them a "training ache". There is also a term called vision asthenia, which means "vision fatigue".

This can be reduced by dividing work into short training sessions with more pauses in the beginning and increasing the work over a period of some weeks or months.

Training the eyes is just like training other parts of your body!

8.1 Five types of low vision

In order to make low vision training more structured, it can be helpful to think about eye problems being divided into five groups of symptoms:

i. Central visual field loss (central scotomas).
ii. Uncontrolled eye movements (nystagmus).
iii. Peripheral restrictions (tunnel vision).
iv. Low or reduced visual acuity only.
v. Other visual field defects (quadrantanopia and hemianopia).

We will look at each of these groups in turn to recognize the:

- Characteristics, symptoms and associated eye diseases,
- Training methods and needs.

i Central visual field loss

Characteristics

People who lost the use of the central area of the retina (macula) usually have a visual acuity below 0.1 (6/60 or 20/200). Their central scotoma interferes with their ability to see details and discriminate colors, which results in problem when:

- Reading,
- Recognizing people,
- Looking at signs and landmarks in unfamiliar places.
- Inspecting untidy clothes or the home's need for cleaning,
- Orientation, cycling and driving

TIPS

Diseases commonly associated with central vision loss:

- Macular Disease
- Cone Dystrophy
- Stargardt disease

Training needs

In order to read well, it is essential to have a clear and large enough image in the central part of the retina (macular). It is possible to read outside the macula, but here the sensitivity is far lower and this makes it necessary to magnify the letters to compensate for the decreased sensitivity.

If there is a central scotoma, the PVI cannot use fixations the way sighted people do, but they can be trained to use areas outside the macula to view objects. This is called **eccentric viewing**. This method is dependent on the ability to find other areas and make the PVI aware of them. These areas are called the **Preferred Retinal Locus**, (PRL) or the **Best Retinal Area**, (BRA).

There are four basic steps to train eccentric viewing (described in more details at the end of this chapter, in Resources 8.4):

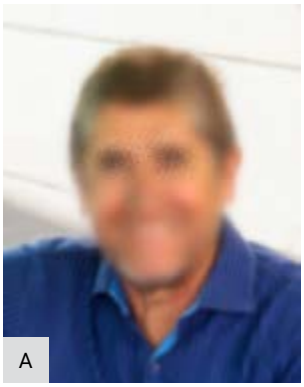
1. Identify the Best Retinal Area (see Resources)
2. Chose a fixation area that allows the text to fall on the BRA.
3. Compensate for the lower resolution of the retina in the BRA by using magnification, (spectacle magnification or a CCTV is ideal for this.)
4. Hold the eye still and move the text when reading – try not to move the eyes – this is the **steady eye technique**.

GOLDEN RULE

To read with eccentric viewing you need magnification to be able to identify the letters. In most cases more than 6X.

The quick brown

Figure 8.1 Large print with guide lines above and below the text. PVIs with a BRA below central fixation can fixate on the guide line above the print in order to read the text with the BRA. PVI are asked to move the text and keep the eye still on the lines.



Gaze shifted upward **Gaze shifted downward**

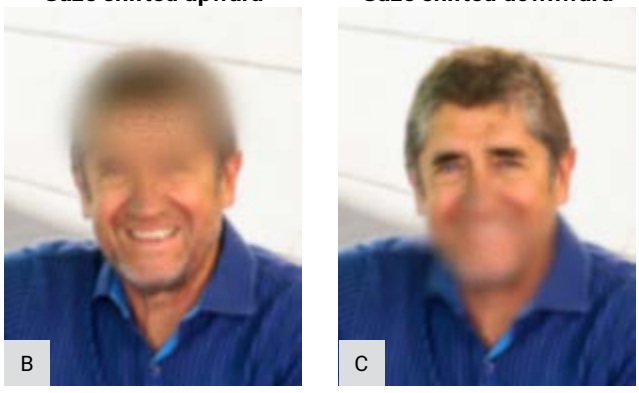


Figure 8.2 Simulations of central scotomas. A) Face as seen with the scotoma centered on the middle of the face. B) PVI shifts gaze and scotoma upwards to reveal lower detail of mouth. C) PVI shifts gaze and scotoma downwards to reveal upper facial characteristics.

Eccentric viewing works best when PVIs are trained to hold and sustain the use of the fixation angle to keep the words in the BRA. This means training the eyes to have optimal fixation stability, which takes time and effort. We need to train PVIs to hold their eyes still and sliding the text in from the side as it is read. This training will reduce the tendency to

saccade and allow the PVI to hold the fixation in the BRA for longer allowing better reading speed. Research shows that the crucial point for success is the fixation stability rather than the exact use of the BRA.

One PVI said after training: "When I look at things, I do not see them, but when I don't look at them, I see them better!"

TIPS

Steady eye technique is a very useful method when using magnifiers for all PVIs. Keeping the magnifier still and moving the print allows a smoother image and more fluent reading speed.

Each PVI might have more than one useful area in the retina they can use for different daily activities. If the PVI has a BRA in the lower part of the retina, he needs to LOOK UP in order to be able to detect objects in front of him! For example, he may need to look over people's heads to better recognize them.

ii Uncontrolled eye movements

Characteristics

In most cases, PVIs with uncontrolled eye movements or **nystagmus** have had this problem from birth. Nystagmus can be associated with several eye diseases, for example congenital cataract, albinism, achromatopsia and other congenital eye conditions.

The "wobbly" eye movements can be horizontal, vertical or rotational. Frequently, the amount of wobble or **amplitude of nystagmus** will increase if the PVI has to fixate something with one eye or is particularly tired or unwell. The amount of wobble can also change depending on the way the PVI is looking. People will often naturally adopt a slight turn or tip of the head in order to reduce the amount of nystagmus and therefore give themselves a better level of acuity. The angle of vision where the amplitude of nystagmus is lower is called the **null point**. If the PVI can learn to keep the eyes in the optimal viewing angle – where the nystagmus is lower – the visual efficiency will increase.

GOLDEN RULE

For people with nystagmus, looking with the head turned to one side may look a little unusual, it is essential that you do not discourage this as it is a valuable coping strategy allowing better vision.

TIPS

Diseases commonly associated with nystagmus:

- Albinism
- Congenital cataract
- Childhood squint with amblyopia
- Achromatopsia

Training needs

Here are some rules to consider during low vision training of children and adults with low vision and nystagmus.

1. Find the optimal visual angle where the nystagmus frequency is as low as possible.
2. Avoid monocular occlusion – consider devices that allow both eyes to be open and used, even if they do not work together. For example: domes, CCTVs, binoculars and spectacles.
3. When reading, move the head and the text, not the eyes. The eyes will keep on "wobbling" but less.

GOLDEN RULE

Encouraging the use of visual aids at a young age enables children with low vision to use devices more frequently and effectively later in life. Expanding their visual reach helps children develop their interest and understanding of the visual world around them.

iii Peripheral restrictions

Characteristics

People with **tunnel vision** or peripheral restrictions may still have central vision that is quite good. The visual acuity recorded on a test chart could be relatively normal. However, because they cannot see to the sides they do not have an overview of spaces around them. This can make it very difficult to orientate themselves in unfamiliar places, cope with an object that is moving, or even walk without bumping into obstacles.

Since the peripheral retina controls vision in low light, the functioning of PVIs with tunnel vision is totally dependent on the level of light. When the light is good, they can read or look at things with their central vision. However, when the light is very low or at night, they may be functionally blind (night blindness). You could say that PVIs with normal central vision and restricted peripheral vision are partially sighted during the day, but functionally blind when the light is low. PVIs in this category

may need training with both optical and compensatory devices to help with their visual disability. Compensatory devices such as white canes, guide dogs or a friend to guide them in unfamiliar environments can be of significant help.

Reading can also be a problem for people with restricted visual fields: if they use normal saccades they will lose large sections of the text (the fixation field is too small). They might fail to get an overview of the printed page, and struggle to change lines accurately as they may not see the beginning of the next line when they reach the end of the previous line of text.

TIPS

Diseases commonly associated with peripheral restrictions:

- Retinitis Pigmentosa (RP)
- Laser treated diabetics
- Glaucoma

Training needs

1. **Magnification**. If magnifiers are needed to compensate for lower visual acuity, the PVI should use the lowest possible magnification to allow the best retention of usable visual field. If the magnification is exaggerated the already poor central visual field will be even more restricted.
2. **Contrast.** In some cases where the central acuity is preserved, the contrast sensitivity may be still be poor. In these cases it is vital to ensure contrast is maintained by using good quality print or electronic screens.
3. **Scanning**. To compensate for the missing field of view, the PVI should look in a systematic way (left to right or top to bottom). When reading, the PVI should first scan the page to get an overview of width, layout, texts and pictures.
4. **Reading technique**. If the remaining central vision is greater than 7 degrees, normal reading saccadic techniques can still be used. With smaller areas of residual central vision the PVI must use shorter fixation movements (saccades) than used in normal reading behavior. This will reduce the reading speed, but can allow the PVI to navigate the page more reliably.
5. **Tracing**. A PVI with restricted periphery cannot easily find the beginning of the next line and may skip lines.To help, a thumb can be used to mark the beginning of the line being read, or a piece of contrasting card laid on the page can be used to highlight the current line. Fig 8.3 shows a line tracing method that can be used to improve line change accuracy either for people with peripheral field restrictions, or for PVI using strong magnifiers. Another more technical way to solve the problem of tracking can be achieved by electronically scrolling text on a screen. This means the PVI views a continuous "tickertape" of text and does not have to change lines or saccade along the screen. The text size can be chosen to balance the residual vision with the remaining field.

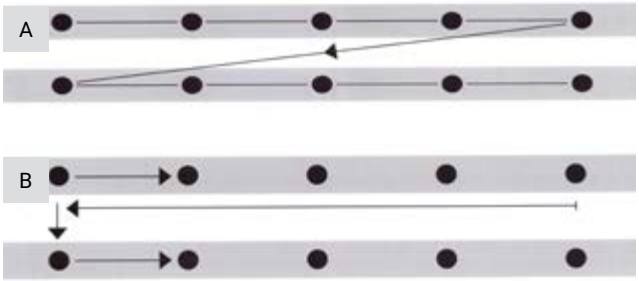


Figure 8.3 Schematic diagram illustrating the way normal readers change lines and the strategy people with low vision can use, that is coming back to the start of the line then down the next line. A: Normal reading eye movement: To change lines the person makes a long and accurate saccade to find the beginning of the next line. B: Changing lines with peripheral field restriction: The PVI uses the line already read as a guide to trace back to the start and then drops down to find the new line.

iv Low visual acuity only

Characteristics

This group includes PVI with reduced vision who still retain normal fields of vision and normal eye movements. In this group there may be a less developed central visual field loss or no central scotoma at all. Normal reading techniques can be used with magnification to compensate for the low visual acuity.

TIPS

Diseases commonly associated with low vision only:

- Cataract
- Optic Atrophy
- Early AMD

Training needs

1. **Magnification**. Help the PVI to find and use the best magnifier for each task: spectacle magnifiers for reading, hand magnifiers for spot reading in shops or when setting the temperature of the oven and lower magnification devices for handwriting.

2. **Illumination**.Good ambient and task lighting will be useful, but beware of light glare.
3. **Posture**. The PVI should use reading stands or leaning table tops to avoid ergonomic problems, especially when writing.
4. **Reading.** When the eye-text distance is closer than around 10 cm, the PVI could combine text and head movements and still use central vision with normal reading behavior. If the disease progresses and BCVA falls to around 0.1 or lower, the person is now defined as a person with central field loss, i.e. first of the five groups.

v Other visual field defects

Characteristics

Damage to the visual cortex or the optic nerve cause people in this group to have a variety of visual field defects. The defects in this group are more or less complete restrictions in both eyes located to the left or right hand side of the visual field (homonymous). In many cases, the PVI have good visual acuity, but have lost half of their side vision (hemianopia) or a segment of the visual field on both sides (quadrantanopia).

TIPS

Diseases commonly associated with hemianopia:

- Stroke
- Brain tumors
- Traumatic brain injuries

Training needs

1. **Orientation and mobility**. Train the PVI to move the eyes and the head into the blind area. By repeating this movement the person will be better aware of objects outside of their static visual field. It is important to train to move the eyes and the head frequently to the blind side to avoid bumping into chairs, bikes or other obstacles.
2. **Explorative Saccadic Training** can be done by making the PVI look at objects in the lost visual field by moving the eyes only, not the head. This can be done by standing behind the PVI and pointing at words or objects on the wall or a computer screen.
3. **Reading**. In cases of hemianopia, the PVIs can turn the text 90° and use vertical reading (top to bottom). A text that scrolls on a computer screen can also be helpful.

8.2 Training children with low vision

Another important area of training that should be mentioned is with regard to the differences between children who are born with VI (congenital low vision) and those who acquire low vision after some years of being fully sighted (adventitious visual impairment).

Typically, children who had good vision for some years have developed enough skills to allow them to use their vision optimally. This is unfortunately not the case for those born with low vision.

If vision is very poor from birth, children may prefer to touch than to use their vision. For this reason, children with LV from birth should be supported to see as much as they are able to. They may need to be encouraged to move closer to objects, or to use magnification to allow them to get a better visual understanding.

Because they never saw beyond close range, children born with VI have to learn the relationship between objects and space. For example, using a telescope from a young age, can make children expand their visual reach and become more interested in what is happening around them and will develop concepts and coping strategies useful in later life.

TIPS

It is easy for sighted children who explore and learn with their eyes to quickly learn new ideas and concepts.

Imagine being born visually impaired, how would you understand what an elephant is or know what a rocket looks like?

The child with low vision should use a telescope in order to increase visual reach!

GOLDEN RULE

Introducing devices to children as young as 3-4 years old has shown to have great impact of their willingness to use devices later in life.

It is important that the child understands that it is their right to see things like others do.

Children born with low vision often need to be encouraged to use their vision and need training to develop basic visual behaviors. Children with low vision should be able to:

1. Attend and focus towards an object. Fixate and follow the object if it is moving, shift gaze or scan.
2. Examine an object to observe the details, identify it, and match similar objects, often using their remaining vision in conjunction with other senses like touch, smell and hearing.
3. Train the ability to direct the hand towards an object and reach for it. Learn to turn and move towards a visual target.
4. Train to use visual memory to save and recall images of what is around them. This can help children to remember a route or a sign seen earlier using the telescope.

These skills can be developed if the child is supported through adequate stimulation and systematic training to develop greater efficiency in the functional use of their vision. A good vision stimulation program should take into consideration the followings parts of functional vision:

- **Visual desire:** A feeling of joy and desire in seeing, even if the picture is poor.
- **Visual confidence:** When the child can make the right decisions at the right time using few visual and other cues and when he knows how to use vision and devices well enough.
- **Visual efficiency:** methods that improve the use of residual vision with higher skills such as scanning and tracking.
- **Visual memory:** to learn to interpret poor images correctly by comparing them with older "stored" images.
- **Visual strategies:** to know what technique to use in relation to the problem.

Figure 8.4 Developing visual confidence. To motivate children with low vision to use their remaining sight, they should be offered opportunities to do visual tasks that are fun for them.

Responsibilities of resource teachers of children with low vision:

1. **Stimulate the use of vision:** to provide opportunities for the child to use his vision and improve his visual skills.
2. **Develop compensatory strategies:** to help the child access the regular curriculum using his vision and/or his other senses.
3. **Adjust the environment:** to help the child use low vision devices or other aids, to modify the classroom to the child's needs, and to choose suitable work materials.

EXERCISE 8.1

Imagine you are the classroom teacher working with a young child with albinism. What sort of adaptations to the classroom can you make to help the child?

Imagine you are learning about farms. Your student cannot see the pictures at the front of the classroom; how can you help him learn about what equipment and animals are found on a farm? *See answer p. 107*

NOW YOU SHOULD UNDERSTAND:

1. *The five types of low vision defect.*
2. *The characteristics of the defect.*
3. *The training needs for PVI with the defects*
4. *Some of the special needs associated with children with VI.*

8 RESOURCES

8.1 Try how it feels

A

Eccentric Viewing (EV) means that a PVI uses an area outside the middle of the retina to view an object. Unfortunately, "side vision" does not give the same detailed information as normal central vision due to the lower sensitivity of the peripheral part of the retina. Try it!

1. Look straight at a friend's face.
2. See how well you recognize the details, what color are their eyes? Are they smiling? Do they wear spectacles?
3. Now move your gaze up in the hair and try to view the face with the lower part of your vision. You can still see them but can you still recognize them?
4. If you move closer the details become more evident. Can you recognize the person now?
5. Is it better when you look at the chin or one of the ears?

B

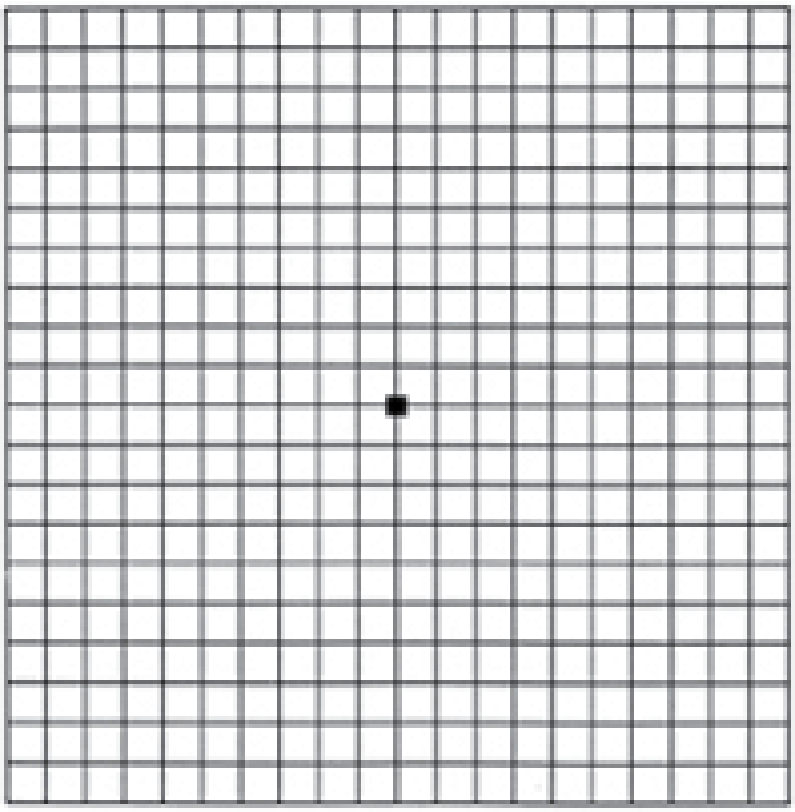
Using fixation lines to help PVI maintain their angle of fixation away from the center can be useful while people are training to use EV while reading (Figure 8.1).

Try this with some large print first and then with smaller print. You will see that the peripheral area of your vision is not sensitive enough to read unaided. If you hold the page closer the image will be magnified and make it easier for you.

When holding things closer children can often use their accommodation, older people may need loupes or magnifiers.

8.2 Amsler grid

The Amsler grid is commonly used to monitor the function of the central retina in patients with age related macular degeneration (AMD). It helps identifying central scotomas.



How to use the Amsler grid

- The person should be wearing his or her reading glasses.
- The test is done one eye at a time (the other eye is covered).
- The person holds the chart approximately 30 cm away.

Instructions:

i. Can you see the spot in the middle of the chart? (If the answer is no, a chart with diagonal lines from the corners can be used to help fixation.)

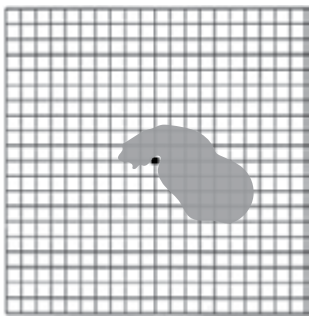
ii. Keep looking at the spot in the middle of the chart. Can you see all 4 corners of the chart while looking at the dot? Can you see all 4 sides of the chart while looking at the dot?

iii. While looking at the dot are there any squares missing or interruptions of the grid, like holes?

iv. While looking at the dot is there any distortion of the horizontal or vertical lines.

v. Using a pen trace the areas of loss or distortion reported by the PVI (see example).

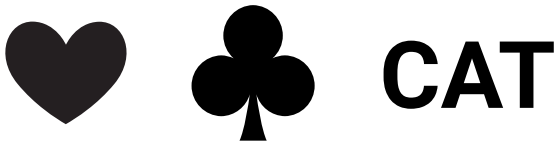
vi. Look at the areas of loss and try to identify the better areas of remaining vision. In the example shown, the area of vision above and to the right of fixation is worse and the area of vision below and to the left (between 6 o'clock and 9 o'clock) is better preserved and a potential "BRA".



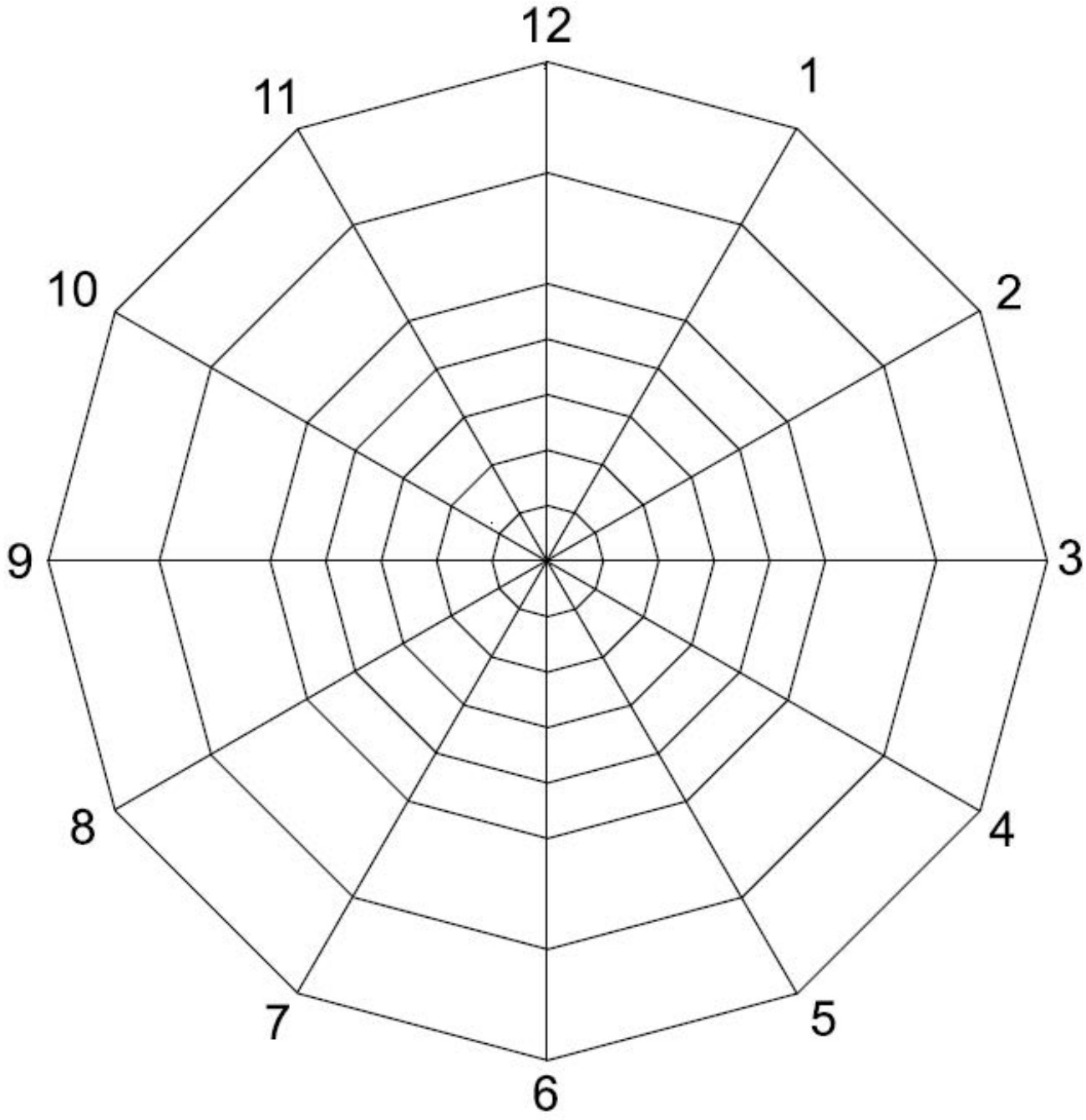
8.3 BRA test

The Amsler Test is designed to demonstrate the areas of central vision loss, whereas the BRA test helps you and your PVI to find an angle of gaze outside the middle which allows a better and clearer visual perception.

1. The testing distance can be adapted based on the levels of acuity of the PVI.
2. The chart is set with a symbol or short word in the center.
3. The PVI should not look directly at the symbol in the middle but should be asked to look around it: at 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock. A pen can be used to direct and hold the gaze.
4. The PVI is asked to compare their ability to see the symbol in the four positions of gaze. The PVI should be encouraged to think about both the detail and width of vision.
5. If the symbol is more visible in one or more positions, the areas in-between should be explored. For example, if the PVI is more aware of the symbol when looking at 12 o'clock and 3 o'clock the vision should be tested again at 1 o'clock and 2 o'clock.
6. Select the central target based on the interest and abilities of the PVI:



BNP-test



SEE NIOR

* BRA test kindly reproduced with the permission of Mr. Krister Inde MA PhD hc. Please note that "BNP" is Swedish for "BRA"!

8.4 Eccentric viewing training

Step 1: Identify the Best Retina Area.

There are several methods available to identify the Best Retina Area (BRA). In each case, the test should be done using the best eye.

Step 2: Choose a fixation area.

If the tests above (8.2 & 8.3) have identified an optimal area where it is possible to see better or wider vision, you can demonstrate to your PVI the improvement in using the area away from the center of vision. One way of doing this is to use large print with guide lines to help people maintain an off center eccentric gaze.

This example is for reading. PVIs with a central scotoma may need to use different fixation angles to see faces, signs and when walking. You should help them find where they should fixate to see better for each task. These areas are called Functional BRAs.

Step 3: Compensate for the lower resolution using magnification.

As discussed in Chapter 5, there are various options to achieve magnification.

It must be remembered when using optical devices, as the level of magnification increases, the width of the visual field decreases. So we should use magnifiers which are the weakest ones possible to achieve the sustainable reading of the print. Remember also that large print may be a good option too!

Step 4: Normal reading strategies and "Steady eye technique".

For a fully sighted person, normal reading involves small, fast movements of the eyes (saccades) with pauses or fixations during which reading takes place. The time involved in reading can be divided into:

- 95% fixations,
- 4% saccades (fixation movements of the eyes),
- 1% changing lines.

The amount (letters or words) read in one fixation depends on the size of the fixation field: the wider the fixation field, the more letters will be read in one fixation. The fewer fixations are used, the faster the reading.

When a fluent reader loses his central vision, the eyes automatically will keep using saccades when moving along the print. So the PVI will have to constantly readjust to find the BRA between each fixation movement. This slows down reading speed and fluency. To counteract this problem, the PVI is asked to hold the eye steady and instead move the page in front of the eye. This reduces re-fixation movements and allows the PVI a better ability hold the BRA in place over the words to be read.

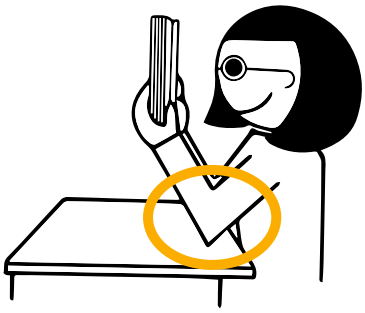
8.5 Instructions for reading

General Guidelines

- Provide good illumination and no glare
- Ensure comfortable posture using reading stand or a leaning table top.

Low Visual Acuity

The steady-eye technique should be used for short reading distances. This strategy involves moving the text instead of the eyes. The following instructions are for the reader:



1. Set the required eye-book distance based on the focal length of the spectacles.
2. Rest the elbows on the table or against the sides of the body.
3. Move the book as you read, keeping the fixation of the eyes at the same point in space and the reading distance unchanged.
4. When reaching the end of the line you can either:
    a. Trace back to the beginning of the same line then go down to next one (Figure 8.3).
    b. Put a finger at the beginning of the line you are reading, so when moving to the next line you just need to move the finger one line down.

Central scotoma

People using eccentric viewing need:

- Magnification to compensate for the lower resolution of the retina in the best retinal area (BRA).
- Tools such as the BRA chart.
- Training to use the BRA efficiently:
    a. Choose a fixation area (typically above or below the line) that allows the text to fall on the BRA.
    b. Hold the eye still and move the text when reading (see above the Steady eye technique).

Nystagmus

- Find the optimal visual angle where nystagmus frequency is the lowest.
- Avoid monocular occlusion which tend to increase the amplitude of the nystagmus
- The reader should avoid moving the eyes when reading.

Small central visual field (tunnel vision)

- It is recommended to offer the lowest possible magnification to maximise the remaining field.
- The reader should:
    - Scan the entire page before starting to read to orient himself on the content to be read.
    - Use normal reading, but with shorter fixations than those used by normal readers.
    - When reaching the end of the line the reader can either (as in the steady eye technique above):
        a. Follow the line just read back to the start then look down to next one.
        b. Put a finger at the beginning of the line being read and move the finger down when the eyes reach the end of the line.

8.6 Guidelines for writing

General Guidelines:

- Consider lower magnification devices to allow for more distance between the paper and the eyes
- A number of simple tools can be used by person with low vision for writing such as:
  - Felt-tip pens
  - **Bold** line paper (next page)
  - Typoscope and signature frame (Resources 7.2)
  - Reading stand to bring the paper closer rather than bending over the paper (Resources 7.3)
- Lighting has to come over the shoulder of the non-writing hand to avoid shadow from the writing hand on the page.

Special tips:

- The writer can place the index finger of the non-writing hand at the end of last written letter and place the pen tip next to the finger to start writing the next word.
- The quality of the hand writing can improve with simple exercises such as:
  1. Tracing with a pen tip along given path like dotted lines shapes and letters.
  2. Tracing in mazes and circling word in search puzzles.
  3. Copying letters and small words.

8.7 Bold lines

9 WRAPPING UP

Andrew Miller MSc MCOptom

9.1 Your work as a low vision optometrist

In this manual we have given you information and tools to allow you to begin providing low vision services.

You should be able to understand, advise and act on:

- The resources you need to start low vision services
- The diseases that cause visual impairment
- How to take an assessment of need from the PVI
- Testing visual function
- The optical and non-optical aids that can support people with low vision
- Basic adaptations to the environment
- The training needed to support the best use of residual vision.

GOLDEN RULE

Imagine yourself with the same problems as your PVI. Only now can you understand the help that they may need.

9.2 Other services and team work

This book is not designed to provide a guide to all of the assistance a PVI may need. Providing comprehensive services for PVI is a team game and requires experience and expertise from many different professions. For example:

- Teachers
- Occupational therapists
- Optometrists
- Ophthalmologists
- Mobility trainers
- Rehabilitation workers
- Habilitation workers
- Social workers
- Family & Friends

More developed low vision services have integrated pathways of services where PVI are supported by a stream of professionals specialized in specific areas of care. Depending on where in the world you are working, your access to support from colleagues will vary. This will obviously have an impact on the work that you are doing, however this should not be an excuse for doing nothing!

EXERCISE 9.1

You are helping a child with visual impairment and have supplied some magnifying devices for use in the classroom and at home.

Who else should you work with to best support the child?

See answers p. 107

When you are providing low vision services, it is important you don't work alone. You need to think about who would benefit from understanding your findings. You may want to pass information along to family members, teachers, employers and others.

If you have found that a PVI has low contrast sensitivity and you have recommended contrast enhancement, think about who is going to be able to deliver these changes to support the PVI.

GOLDEN RULE

Sharing information can allow PVI to receive better and wider support.

However it is important that information is only shared with the consent of the PVI or their family.

9.3 Conclusions

Working with PVI can be an incredibly rewarding and satisfying job. If you use your knowledge and do your best to understand the PVI, you will be able to make them more independent and better included in society. Let's go! Start using what you have learned with confidence and you can make a positive difference for the people with visual impairment in your own community.

EXERCISE

Spend some time wearing a blindfold to understand the mobility challenges for PVI.

How do you feel in areas where you are familiar?

How would you feel going outside?

What happens if someone moved a piece of furniture or left a pair of shoes on the floor?

9 RESOURCES

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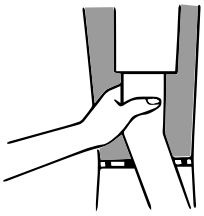
Yosur Qutishat MSc, BSc (OT)
Sami Shublaq MSc, BSc (Optom)

9.1 Learn to be a sighted guide

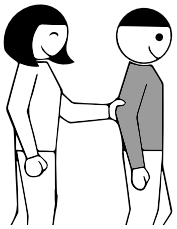
You are likely to receive people who have very poor vision so it can be useful to be able to guide them from place to place in a way that is both helpful and respectful.

The standard way to do it is the Sighted Guide Technique. Below we will show you 4 of the basic points to get you started.

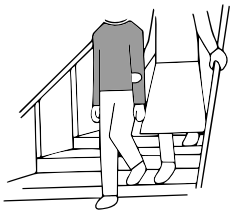
1. Introduce yourself to the PVI using their name if you know it. Let the PVI stand next to you, half a step behind, and take your arm just above the elbow. THE PVI SHOULD BE LED, NEVER DRAGGED OR PUSHED.



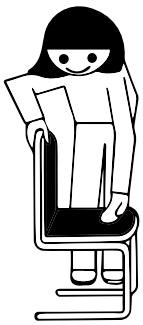
2. Walk steadily at the pace needed by the PVI. As you walk along tell them about steps or kerbs as you approach. Remember to inform them if the steps go up or down.



3. When going up or down stairs pause at the first step. The PVI should be on the side with the handrail. Assist them to find the hand rail and the edge of the first step before moving on. Let the PVI know as you are reaching the last step.



4. When approaching a chair place your hand on either the seat or the chair of the back of the chair. Allow the PVIs hand move down your arm to find the chair.



9.2 Template of a recording form

The form provided here is only a template. You need to adapt it based on the test and services available.

Name: _____ ☐ Male ☐ Female **DOB:** / / **Age:**_____

Address: _____ **Tel:** _____ **Tel:** _____

Family History: ☐ No ☐ Yes, _____

Referral: _____ **School:** _____ **Grade:** _____

Diagnosis: _____

_____

Medications: ☐ No ☐ Yes, _____

Done Operations: ☐ No ☐ Yes, _____

Cataract: ☐ No ☐ Yes (OD, OS, OU), ☐ Congenital ☐ Acquired ☐ Phakic ☐ Aphakic

Visual Aid: ☐ None, ☐ Regular spectacle, ☐ Reading spectacle, ☐ Magnifier: _____, Used: ☐ Yes ☐ No

Ophthalmologist: _____ ☐ Clinic, ☐ Centre _____, ☐ Hospital _____

Functional Problems

☐ Reading
☐ Watching TV, inch, dis: _____
☐ Doing house work
☐ Writing
☐ Moving indoors
☐ Playing
☐ Using cell phone, tablet, laptop, etc.
☐ Moving outdoors
☐ Shopping
☐ Seeing the board
☐ Moving from in to out & vice versa
☐ Eating
☐ Recognizing faces
☐ Managing money

Disturbed by sun/light: ☐ Yes ☐ No, **Uses sunglasses:** ☐ Yes ☐ No _____, **Helpful:** ☐ Yes ☐ No _____

Notes: _____

_____

_____

Examiner: _____ **Date:** / /

New Refraction			
Eye	Sph.	Cyl.	Axis
OD			
OS			

Conclusion on old Px:

☐ Keep ☐ Change ☐ No need to correct ☐ Emmetrope

Own Glasses: ☐ Old ☐ New Date: / / From: _____			
Eye	Sph.	Cyl.	Axis
OD			
OS			
ADD			

Visual acuity

Near								
OD			OS			OU		
M	Dis	V.A	M	Dis	V.A	M	Dis	V.A

Distance								
OD			OS			OU		
M	Dis	V.A	M	Dis	V.A	M	Dis	V.A

Actual reading ☐ Come Closer, ☐ Single letters, ☐ Numbers		To Reach: _____	
P size	Distance	Addition	Distance

Visit Date	Aid/s	(D)	Acuity	Comments	Liked	Issued

Notes: _____

Non optical aid: ☐ Felt tip pen ☐ Bolded lines paper ☐ Reading stand ☐ Typoscope ☐ Other, _____

Next visit: ☐ Follow up ☐ Near training ☐ Distance training ☐ Trying filter ☐ Other, _____

Examiner: _____ **Date:** / /

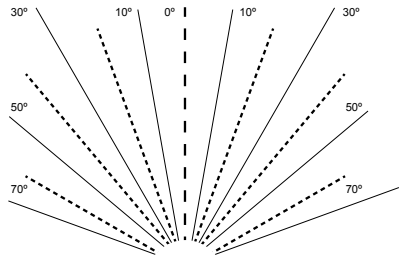
Contrast sensitivity

☐ Normal ☐ Moderate loss ☐ Poor

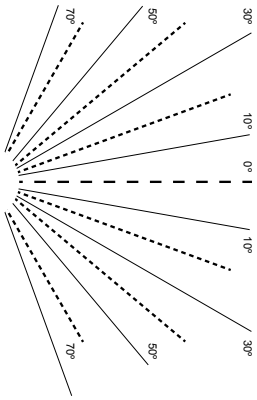
Notes: _____

Visual field

Horizontal: ☐ Normal ☐ Restricted



Vertical: ☐ Normal ☐ Restricted



Color vision

☐ Normal ☐ Poor

Notes: _____

Examiner: _____ **Date:** / /

Training Sheet

Session no: _____ Date: / /

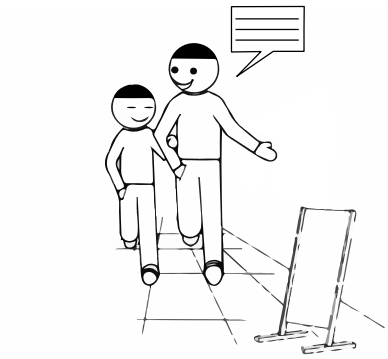
	Reading Training								
	Aid	Single letters	(p)	Single words	(p)	Paragraphs	(p)	Text	Performance
Near								☐ Arabic ☐ English	☐ Good ☐ Fair ☐ Poor ☐ Needs further training

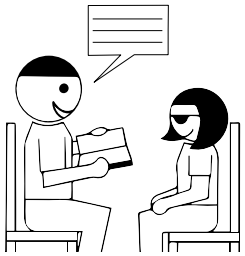
	Telescope Training				
	Aid	Distance	Skill	Place	Performance
Distance			☐ Focusing ☐ Tracing ☐ Tracking	☐ Indoor: _____ ☐ Outdoor: _____	☐ Good ☐ Fair ☐ Poor ☐ Needs further training

Notes: _____

9.3 Simple advice to parents of young PVI

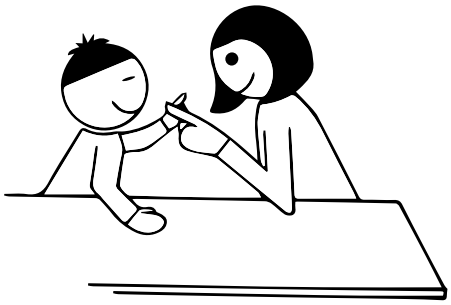
Be clear!

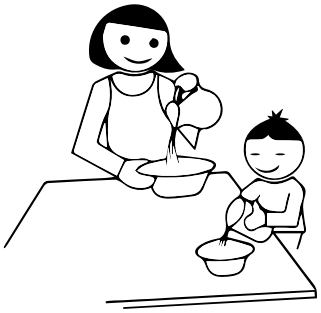




The world will be easier to understand if you describe it and explain what is happening.

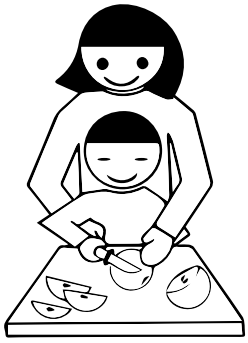
Let him copy what you do!

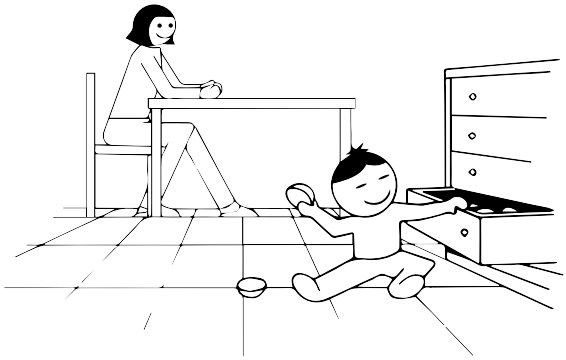




It is fun and your child will learn better.

Let him do it!





Trust him: if you give him time, your child can play and do things like other children.

9.4 Simple advice to school teachers

If you have a student with vision impairment in your classroom:

General Courtesy

- Speak to the class upon entering and leaving the room or site.
- Call the student with vision impairment by name if you want their attention and talk to them directly.
- When communicating with a student who has vision impairment, always identify yourself and others who are present. Don't assume that the student will recognize you.
- Let the student know verbally if you need to move, leave or end a conversation.

Preferential Seating

Your student should be seated near the front of the class to hear clearly what is being presented.

Teaching

- Do not use phrases that require sight to understand, like "look at this" ." The entire class will benefit from enhanced verbal descriptions.
- Read out loud as you write on the board and spell out words that may be confused with others sounding the same.
- Allow the student to tape-record lectures or use a note-taker.
- Make sure the student receives all the handouts in a useful format.

Exam Accommodations

- Allow more time.
- Offer a quiet and private environment.
- Provide a reader with the appropriate reading and language skills.
- One possible method is to record test questions on tape and have the student record his/her answers on tape.

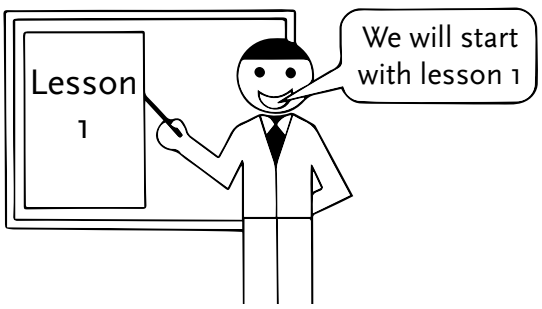
General

- You should not modify academic standards for students with vision impairment. All students must meet the required level of understanding and performance competencies for the course, although there may need to be modifications in the evaluation or testing method.
- If you have problems when teaching a student who is visually impaired, first decide if the problem is related to the disability or is a problem that any student could have. Consult with the student if you have concerns about accommodations or his/her learning.

Give the best seat!

The student with a visual impairment can see and hear more.

Say what you write on the board!



It will benefit every student in the class.

Glossary

wiki refers to definitions found in www.wikipedia.org.

Aberration: A distortion in an optical system. If a magnifier has aberration, only few letters in the center of the lens will be in focus, while the rest of the text is blurred and distorted. It is caused by the failure of rays to converge at one focus.

Acquired: It is said of a disease which is not caused by heredity but to the environment such as infections or traumas.

Activities of Daily Living (ADL): The actions a person does on a day-to-day basis. These activities vary with age and gender and typically include: eating, bathing, dressing, grooming, taking medications, shopping, using the telephone, leisure time activities and managing money.

Acuity reserve: The fact of increasing the amount of magnification estimated to take into account the duration of the task. When the person with low vision will use the devices for long periods of time such as reading the newspaper or studying (sustained tasks), the magnification is doubled (2:1) to take into account the eye fatigue.

Adventitious Visual Impairment: Loss or impairment of vision that occurs after birth. This may be a result of disease, infection or trauma.

Agnosia: The inability to recognize objects, persons, sounds, shapes, or smells while the sense involved and the memory are functioning (wiki). Visual agnosia occurs when the ventral visual pathways are damaged.

Amblyopia: Also called lazy eye, amblyopia is the decreased vision in an eye that otherwise appears normal (wiki). It occurs when the visual acuity does not develop in the dynamic visual growth period before the age of 5 to 7. This results in a significant difference in acuity between the eyes.

Assessment of Need: A structured process of gathering information that shows the areas where the PVI needs help.

Ataxia: Neurologic sign affecting voluntary muscle movements (wiki). Visual ataxia occurs when the dorsal visual pathways are damaged.

Best Retinal Area (BRA): The place on the retina that can be trained by eccentric viewing for resolution or detection of visual objects when the central retinal area is damaged.

Bifocal: A lens with two different optical powers, for example the top part to correct the refractive error and the lower part to magnify.

Binocular: Binocular vision is when both eyes are used together. Binocular spectacles or telescopes are devices that provide one lens for each eye.

Bioptics: Bioptic telescope are head-mounted eyeglasses that provide distance magnification and allow persons with low vision to drive cars (in places that allow it).

Blind: In this book, we use the term blind for people who have no useful vision instead of criteria based on visual acuity.

Blind spot: An area of the retina where the optic fibers gather together to form the optic nerve. It has no photoreceptors and is therefore not sensitive to light.

Congenital: A birth defect or a condition existing at or before birth regardless of the cause (wiki).

Constant contact technique: Using the cane in a side-to-side motion while maintaining a constant contact between the cane tip and the walking surface.

Contrast: object and its background.

Diagonal technique: Holding the cane diagonally across the body as protection for obstacles in front the body and to gather information on the ground.

Diopter (Also Dioptre): Measure of the power of a lens.

Eccentric viewing: The use of the retinal area outside the macula for viewing in the case of central vision loss. This causes the persons to look 'side ways' using the next best area of the retina (see BRA).

Emmetropia: When the eye is looking far away (the lens is relaxed) and the image is formed directly on the retina (no refractive error).

Focal Length: The focal length of an optical system is a measure of how strongly the system converges or diverges light (wiki).

Filter lenses: Colored lenses that block certain part of the light spectrum to decrease the quantity and make up of light reaching the eye. Used to reduce the effects of glare.

Glare: Difficulty seeing in the presence of bright light (directed or reflected). The blinding effects of very bright light reflecting on shiny surfaces.

Hand Magnifier: A single lens mounted in a frame with a handle.

Hereditary Eye Disease: An eye disease that is transmitted by the genes of one or both of the parents.

Hyperopia: or **far sightedness** is a defect of vision caused by the light which does not directly focus on the retina but behind it (for example when the eyeball is too short or the lens cannot become round enough) causing difficulty to focus on near objects (wiki).

Landmarks: Permanent features in the environment which can be used by a person to determine his or her position in space.

Low vision: A person with low vision is one who has an impairment of visual function for whom full remediation is not possible by conventional spectacles, contact lenses or medical intervention and which causes restriction in that person's everyday life". Low Vision Services Consensus Group (1999) www.lowvision.org.uk.

Magnification: The process of enlarging something.

Mobility: Walking or moving from place to place.

Monocular: When only one eye is used (monocular vision) or when a device supports only one eye.

Myopia: Also near-sightedness and short-sightedness, it is a condition of the eye where the light that comes in does not directly focus on the retina but in front of it, causing the image that one sees when looking at a distant object to be out of focus, but in focus when looking at a close object (wiki).

Null point: A position of the gaze in which the eyes of someone with nystagmus are the most stable.

Nystagmus: Involuntary eye movement, acquired in infancy or later in life that usually results in reduced vision.

Optotype: A shape or letter used in the determination of vision and visual acuity.

Orientation: Knowing a given position in space in relation to other objects or places.

Photoreceptors: A specialized type of neuron found in the retina that is capable of converting light into signals that can stimulate biological processes (wiki).

Photophobia: Discomfort or pain to the eyes due to light exposure (wiki).

Preferential looking: A technique to assess vision in non-verbal persons. It uses the assumption that the eyes will be attracted towards the most attractive stimulus (when visible). It is measured by observing the eye movements.

Presbyopia: A condition associated with aging in which the eye exhibits a progressively diminished ability to focus on near objects (wiki).

PVI: People with visual impairment.

Refraction: The determination of refractive error.

Refractive error: When the light entering the eye does not focus on the retina. If no correcting lenses are provided, it can cause reduced visual acuity.

Retina: The third and inner coat of the eye which is a light-sensitive layer of tissue. The optics of the eye create an image of the visual world on the retina (through the cornea and lens), which serves much the same function as the film in a camera (wiki).

Scanning: Systematic use of head and eye movements to search the environment for specific objects.

Scotoma: A partial alteration in the field of vision causing a loss of visual acuity. Can be located anywhere on the retina as a “scar” leading to partial or no vision in this area.

Sighted guide: Technique used when a sighted person walks with a person with visual impairment.

Spectacle magnifiers: Spectacles with a reading add greater than +4D to offer magnification.

Spot task: An activity that is carried out only briefly, for example reading the label on a container.

Stand Magnifier: A single lens mounted in a frame which allows it to be supported at a fix working distance.

Styrofoam: A kind of expanded polystyrene that can take various forms. It is used to make basic assessment tools.

Squint: See strabismus.

Strabismus: A condition that prevents a person from directing both eyes simultaneously towards the same fixation point. The eyes are not properly align with each other and binocular vision is compromised (wiki).

Sustained task: An activity that is carried out for long periods of time, for example reading a book or studying.

Syndrome: A set of medical signs and symptoms that are correlated with each other and, often, with a specific disease (wiki).

Telescope: Multiple lens system to magnify.

Tracing: Following a stationary line with your eyes like shorelines , curbs, the top of hedges.

Tracking: Following visually a moving target such as a person walking or a car in the street.

Threshold acuity: The smallest details a person can see for a short period of time.

Tunnel vision: Loss of peripheral vision with retention of central vision, resulting in a constricted circular tunnel-like field of vision (wiki).

Visible Light: The portion of the electromagnetic spectrum that is visible to the human eye. A typical human eye will respond to wavelengths from about 390 to 700 nm.

Vision rehabilitation: Process of restoring functional ability and improving quality of life and independence in an individual who has lost visual function (wiki).

Visual acuity: Clarity of vision or the ability to see details. It is a subjective measure which can be effected by optical and pathological problems

Visual impairment: Visual impairment, also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses (wiki). People use different definitions of visual impairment. In this manual, we use the term visual impairment for both low vision and blind. In some places, it is used for low vision only.

Visual stimulation: The action of using vision to make it more efficient. For example scanning techniques, or helping vision develop in young children by presenting attractive visual targets to look at.

VR services: Vision Rehabilitation Services, a collection of services designed to support and enable people with visual impairment to manage their sight loss.

Answers to Exercises

Chapter 1

RESOURCES 1.1: TEST YOUR KNOWLEDGE

#	Statements	True	False
1	Children who still have a little vision should not use it too much; so that the vision does not get worse, (Vision will wear out if it is used too much).		X
2	Most children with low vision have also other problems.		X
3	Reading on a computer screen or by holding a book very close to the eyes or sitting close to the television will harm the eyes.		X
4	Any child wearing glasses has low vision.		X
5	Reading or sewing in a dim light will not damage vision.	X	
6	Electric lighting is bad for the eyes.		X
7	Low vision or blind people can hear better than sighted people.		X
8	A child with one good eye and one bad eye has low vision.		X
9	The distance is not very important to understand visual functioning.		X
10	Visual skills develop automatically in children with impaired vision.		X
11	Functional vision can be improved with training.	X	
12	Changing the physical environment can benefit people with visual impairment.	X	
13	Children with low vision should learn Braille.		X
14	The person who wears spectacles sees less than the others do.		X
15	Every person with low vision sees the same way.		X
16	Blindness and low vision are synonyms.		X
17	No need to verbally inform the person with VI before touching him.		X
18	Persons with VI may have cognitive or hearing problems; this is why people tend to talk over their head instead of addressing them directly.		X
19	Leaving things thrown around and changing the furniture arrangement without telling the person with VI will affect his mobility.	X	
20	People with VI can be trained to estimate the size of a room using only their hearing.	X	
21	It is not acceptable to take things off the hands of person with VI in order to save time.	X	
22	Describing the details and explaining what is going around is a priority when communicating with persons with VI.	X	

Chapter 2

EXERCISE 2.1

A person who comes to your Center has had laser treatment to her eyes due to problems caused by diabetes.What sort of vision problems may the PVIs have because of the treatments?

ANSWER

Patients who have had pan retinal laser treatment will have multiple laser burns in the peripheral retina leaving many patchy gaps in the peripheral vision. The laser burns can preserve the precious central vision, but as the patients have more laser burns they lose more peripheral vision. Lack of peripheral vision causes:

- Tunnel vision: patients are unaware of what is to the side and below eye level. This causes problems with trips, falls and mobility.
- Poor dark adaptation: reduced visual function at night or in low light.
- Glare: they may benefit from filters.

Chapter 3

EXERCISE 3.1

Imagine you are 10 years old. Write down 5 things that you would find most difficult if you suddenly couldn't see. Now imagine you are 70 years old. What would be the things you think you would struggle with if you suddenly couldn't see? How do the needs of a 70 year old PVI differ from a 10 year old?

ANSWER

You should always approach each PVI as an individual with unique needs However there are general principles that we can apply that can help us manage and understand PVI better.

Challenges typical for Younger PVI

- Seeing the board
- Reading in class
- Finding my friends
- Playing with my friends
- Playing sport
- Using technology
- Getting a job

Challenges typical for Older PVI

- Cooking for myself
- Going out independently
- Shopping
- Putting on makeup / shaving
- Seeing my family
- Watching the TV

The answers in the table above are just examples, you may have come up with many others that you feel are relevant. It is important that you think about the PVI's needs in context with their age, background and lifestyle.

Chapter 4

EXERCISE 4.1

A child cannot verbally identify a particular optotype correctly at any size despite correctly identifying different optotypes which are smaller. What do you think is the most likely explanation for this?

ANSWER

The child can see the optotype but does not know its name.

To get accurate acuity readings it is important that you are using charts that are recognizable to your PVI. Children develop at different rates and their ability to recognize and identify shapes and letters differs too. Make sure you are testing the ability to see the shape, not the child's reading development. If a child can't recognize the symbols used in the test they can be given samples to learn at home or provided with a key card he can hold and match the optotypes as he reads them at distance.

EXERCISE 4.2

Think about some things that you regularly use. What size would you expect them to be?

- *Religious text*
- *Children's book*
- *A label on a tin*

To find out, print a page with Times font of different sizes and use a ruler to compare the sizes.

ANSWER

These will vary from country to country. Take the reading chart you use and put it along side everyday items and measure the size of the print. It is also useful to have some everyday items in the testing room so you can test magnifying devices in practical situations.

Chapter 5

EXERCISE 5.1

Below is a text printed in 3 sizes. Which one is the smallest you can read?Now read the sentence until the end. How would this feel if you had to read this for 5 minutes?

ANSWER

As you can tell, the eyes can work close to their limit for a short time (spot tasks) but not for long periods of time (sustained tasks). It is important therefore to leave an acuity reserve for tasks which are to be sustained for a length of time.

RESOURCES 5.1 ESTIMATING MAGNIFICATION NEEDS

ANSWER

#	Reading acuity at 25cm "Can read"	Size of object (target size)	Type of task (sustained or spot) Sustained tasks need an acuity reserve to stop the PVI tiring	Target acuity (For a sustained task half the target size) "Need to Read"	Magnification Estimate = Can read/ Need to Read (answer to nearest whole number)
			Near Tasks		
1	24p	12p	Sustained	6p	4x
2	30p	10p	Spot	10p	3x
3	18p	6p	Spot	6p	3x
4	38p	12p	Sustained	6p	6x (6.3X)
5	60p	20p	Sustained	10p	6x
			Distance Tasks		
6	0.1	0.5	Spot	0.5	5x
7	0.2	0.5	Spot	0.5	2.5x

Remember that these are estimates to be used as a guide to help with your prescribing. You need to evaluate each PVI to evaluate whether the the levels of magnification calculated produce the desired effect.

Chapter 6

RESOURCES 6.1 REVIEWING VISUAL AIDS

ANSWER

Visual devices	Distance and duration of tasks					
	Near		Intermediate		Distant	
	Spotting	Sustained	Spotting	Sustained	Spotting	Sustained
Hand held Magnifiers	√ √	√	√			
Stand Magnifiers	√	√ √	√			
Spectacles Magnifiers	√	√ √				
Telescopes	√		√ √		√ √	
Video Magnifiers	√	√ √			√	√

Device	Typical range		
	Magnification	Approx. range of diameters	Comments
Dome	2x	50mm – 90mm	• Sits flat on page, • As device gets larger field of view increases but magnification does not. • Field of view changes little irrespective of head position
Hand magnifiers	2x – 14x	30mm -100mm	• Large range of different shapes and sizes. • Large range of powers • Higher powered lenses are smaller • Larger diameter lenses are lower powers • Lenses can be shaped to be smaller to be more discrete
Stand magnifiers	2x-20x	30mm -100mm	• Large range of different shapes and sizes. • Large range of powers • Higher powered lenses are smaller • Larger diameter lenses are lower powers • Holds the lens steady to allow better fluency • Bigger and bulkier than other aids
Spectacles	2x-10x		• Appear to be a normal pair of spectacles • Can make the eyes feel strained if not used properly • Medium and Strong powers use a very close distance
Monocular telescope	4x -10x		• Allow magnification over a distance • Need to hold still • Telescope reduces the field of view • Stronger Powers reduce field of view more than weaker powers
Binocular telescope Max TV	2x-4x 2x		• Max TV very easy to use • Limited magnification • Can't get in stronger powers
Camera on phone	2- 10x depending on phone		• Normal device • Looks like you are just taking a picture • May not show a live view. • May be harder for people who do not like technology

Chapter 7

EXERCISE 7.1

List eye diseases where you feel lighting may be more likely to help and diseases where you need to be more cautious when recommending extra task light.

ANSWER

Conditions where extra light is usually helpful

- AMD
- Stargardt Disease
- Cataract

Conditions to be more cautious when thinking about extra lighting

- Achromatopsia
- Cone dystrophy
- Inflammatory eye disease e.g. uveitus
- Corneal opacity

EXERCISE 7.2

Explain why lighting can help some people with low vision read more efficiently.

ANSWER

Lighting can improve reading in several ways:

- Improving the contrast sensitivity of the persons visual system.
- Reducing the size of the pupil and increasing depth of focus.
- Reducing size of central scotoma.

EXERCISE 7.3

A child with albinism sits in a classroom facing a window which is causing difficulty with his work.

What actions can you take to make this easier for the child?

ANSWER

1. The child MUST be moved to a more comfortable place in the classroom, ideally with light coming from behind.
2. Introduce vertical blinds to allow control over the light coming into the classroom.
3. Advise a full low vision work up with a view to obtaining filters and optimum refractive error correction.

EXERCISE 7.4

List eye conditions where a typoscope is likely to help with reading.

ANSWER

Typoscopes help support people with conditions where glare is a problem, such as RP, cataract, anterior uveitis and corneal problems.

In addition, people with hemianopic field loss can also benefit using the device to hold their place on the line and help with line change.

EXERCISE 7.5

How would you help someone wishing to write?

How would you help someone with 0.1 (6/60) acuity better see to make a cup of tea?

ANSWER

Writing can be made easier with the following devices:

- Bold pen
- Writing board to enable a closer working distance
- Writing guide or heavy lined paper to help with writing straight

Spectacle magnifiers allow hands free magnification, but the close working position can be tricky to co-ordinate.

Making a cup of tea:

- Choose a color of mug that contrast with the drink. For tea a white mug allows the dark liquid to be seen more easily.
- Place the light mug on a plain dark surface to help identify the edges.
- If applicable, use a lamp to bring in extra targeted light.

Chapter 8

EXERCISE 8.1

Imagine you are the classroom teacher working with a young child with albinism. What sort of adaptations to the classroom can you make to help the child?

Imagine you are learning about farms. Your student cannot see the pictures at the front of the classroom; how can you help you him learn about what equipment and animals are found on a farm?

ANSWER

A child with albinism will have low acuity and glare sensitivity. Below is a list of just some of the things the considerations that can be made:

- Ensure glare is controlled
- Ensure that they sit at the front
- Ensure text is enlarged and bold
- Ensure the teacher verbally describes things they are demonstrating
- Encourage and allow the child to use low vision devices to use their residual vision
- Use models that the child can feel and bring close to explain visual concepts. When learning about a farm model animals and tractors can help the child build a picture of what others can see.

Chapter 9

EXERCISE 9.1

You are helping a visually impaired child and have supplied some magnifying devices for them to use in the classroom and at home.

Who else should you work with to best support the child?

ANSWER

You should include anyone else currently working with the child, this may include:

- Ophthalmologist (send a written report of your actions).
- Teachers (provide a written a report or arrange a meeting to discuss your recommendations).
- Family (discussing at the Center ideally with a written copy of your recommendations).