

Magnification in your pocket - magnifiers

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Advantages of Magnifiers

- Magnifiers allow immediate access to print anywhere
- They are a relatively cheap, portable and immediate way to access print
- Maps and graphics can be viewed in true colours
- They can be used to view objects which are not easily enlarged on a photocopier (e.g. medicine bottles, insects, finger nails, etc.)
- Allow greater independence (and choice in reading materials!)
- Can be used post-school, whereas large print may not be available

I believe these last two points make the teaching of efficient magnifier use essential for many of our students. Magnifiers offer our students more independence and options for literacy at and after school.

What does research tell us about the efficiency of using magnifiers or large print?

- no significant difference in reading rates and comprehension found between individuals using large print and those using regular print with magnifiers (Corn, 1990)
- another study did find that reading speed declined with greater magnification
- shorter saccades lead to an increased number of fixations and slower reading speeds (Fotinakis & Dickinson, 1994)
- students with retinitis pigmentosa achieve better reading speeds when using cylindrical mirror magnifiers (with only vertical magnification) (Spitzberg, Goodrich & Perez-Franco, 1994)
- particular eye movements adopted by readers using magnifiers have greater influence on both speed and comprehension (Fotinakis & Dickinson, 1994)
- implications for teaching effective technique (Fotinakis & Dickinson, 1994)
- yet another study found that students who used magnifiers were more likely to progress beyond a 'year 8' reading level than those who used LP (Corn, 1990) This may be because the type of students who adapt to magnifier use are more likely to be brighter or more diligent students.

Prescription of magnifiers by an optometrist/orthoptist

For students with vision impairments, magnifiers should ALWAYS be prescribed as there are many optical considerations to be assessed to optimise the student's visual functioning. If a magnification device is prescribed for your student, there are a number of details which need to be asked of the optometrist or orthoptist.

These include:

- What is the intended purpose for the aid? - for reading books, labels, textbooks, just for maths, dictionary, telephone books, etc.

- What is its focal distance? (Distance from magnifier to page - see focal distance table.) - this is a fixed distance for stand or bar magnifiers.
- At what distance should the aid be held from the eye?
- Should it be used with or without spectacles?
- Is it intended as a monocular or binocular aid?
- Should the student have one eye closed or both eyes open? (For young students, the muscular strain of closing one eye can cause distortion in the open eye which may not be desirable. It may be preferable to leave both eyes open even while looking through a monocular aid.
- With which eye should the student use the aid?
- What magnification does it provide?
- (N.B.: Magnification = dioptres divided by 4. See table about magnification.)
- With what print size should the aid be used?
- What instruction has student already been given?

Factors that lead to successful use of magnifiers

- Initial exposure to magnifiers at a young age
- Desire for independence
- Student motivation to complete the same tasks as his or her peers
- Positive attitude toward the device
- Support from family
- Specific training which is inclusive of many environments
- Availability of device, including replacement if lost or damaged
- Co-ordination of efforts among the visiting teacher, student, family and other professionals
- The ability to maintain stability and motor co-ordination
- Orientation for educators regarding appropriate situational usage
- Orientation for peers to provide exposure to the device

Adapted from D'Andrea & Farrenkopf, 2000

Descriptions of Low Vision Magnifiers

Adapted from <http://www.mdsupport.org/library/magnifiers.html> March 2004

The following is a handy table about the types of magnifiers available for use by students with vision impairments.

Device	Description	Advantages	Disadvantages
Hand-held magnifier	"Sherlock Holmes" type portable magnifying glass.	Small and inexpensive. Fits in pocket. Available in a wide range of powers (1.5X - 8X). Socially-accepted.	Leaves only one hand free. Difficult to keep in focus if hand trembles. Clamps with flexible arms are available for attaching to table tops.

Device	Description	Advantages	Disadvantages
Illuminated hand-held magnifier	Portable lens with handle and built-in battery-operated light.	Small and inexpensive. Available in a wide range of powers (1.5X - 8X). Socially-accepted. Useful for when lighting is poor.	Leaves only one hand free. Difficult to keep in focus if hand trembles. Clamps with flexible arms are available for attaching to table tops.
Stand magnifier	Magnifier on a stand with built-in legs for table tops or books.	Maintains steady focal distance. Comes in a wide range of powers (1.7X - 8X). Possible to write beneath and use both hands.	Bulkier than hand-held device. Sometimes difficult to get sufficient light between the lens and the subject.
Hand/Stand magnifier	Combination of hand-held and stand magnifier.	Can be used as either by folding handle and legs, so more portable than a regular stand magnifier. Comes in powers of 2.5X - 3X).	None.
Illuminated stand magnifier	Illuminated magnifier on a stand with built-in legs for table tops or books. Light source is either a built-in battery-operated bulb, a halogen lamp (A/C), or the more superior LED illumination (D/C).	Provides shadowless light close to the subject. Maintains steady focal distance. Comes in a wide range of powers (1.7X - 8X).	Difficult to write beneath most models. Even more bulky than an ordinary stand magnifier. Battery-operated models (except LED version) can be expensive to run.
Illuminated bench magnifier	Same as above, but mounted on an adjustable arm mounted to a table top or work bench.	Good for using both hands for sewing, hobbies, etc.	Limited magnification (rarely above 3X). Comparatively expensive.
Dome/Bright Field magnifier	Half-spherical magnifier (like a paper weight) that rests directly on the page. Largest dome available is 90mm.	Always in focus. Distributes light well onto the surface.	Made of heavy glass, rather than plastic.
Bar magnifier	Semi-cylindrical lens which rests directly on the page, magnifying one line of print at a time. Often magnifies vertically and not horizontally.	Makes tracking of a line of text easier. Can make letter/word discrimination easier. Good for students with RP as perceptual span is wider.	Limited level of magnification power (up to 3X). Reflected light and distortion can be problematic.

Device	Description	Advantages	Disadvantages
Spectacle-mounted magnifier	Magnification lenses mounted on spectacles.	Leaves both hands free.	Short working distance, due to limited level of magnification power of up to 3X. Single magnifying lenses (for one eye only) are available from 4X to 12X.
Clip-on magnifier	Magnifying lens which attaches to regular spectacles. Binocular versions available in powers 2X - 4X. Monocular versions available up to 7X.	Leaves both hands free.	Short working distance, due to limited level of magnification power.
Hand-held or spectacle-mounted telescope	Telescopes of low magnification (up to 4X), which can be mounted on spectacles for near intermediate and distance viewing.	Good for reading music, viewing TV or plays, reading signs, etc.	Restricted field of view. Best for stationary viewing. Focus is fixed, except for the more expensive "Ocutech" model, which mounts on spectacles and features an auto-focus capability.
Field expanders/minifiers	Lenses which reduce the apparent size of the subject (like a "peephole" in a door).	Useful for people with good central vision, but diminished peripheral vision.	None.
Closed circuit television (CCTV)/Video magnifier	Device utilizing a camera and monitor to magnify a page or object. The display can be monochrome or full color, and the products are available in a variety of screen sizes and magnification levels. Some models are designed for interconnection with computers. All models allow adjusting contrast and reversing black and white.	Books and objects can be placed beneath the camera for viewing. Sufficient room to write.	Comparatively expensive. Not portable.

Device	Description	Advantages	Disadvantages
Portable closed circuit television (CCTV)/Video magnifier	Portable magnifying device utilizing a camera approximately the size of a computer mouse, plus an interface for connecting to a standard television or head-mounted display. Most models allow changes in magnification, adjusting contrast and reversing black and white.	Can be carried in a purse or backpack. Battery power option. Less expensive than stationary CCTV models.	Some practice required for smooth operation of the hand-held camera. One-handed operation. Cannot be used for magnification of writing or hand work.
Portable video magnifier	Portable magnifying device with a self-contained camera and viewing screen. Some models allow freeze-framing. Most models allow changes in magnification, adjusting contrast and reversing black and white.	Can be carried in a purse or backpack, or in its own carrying case. Battery power option. Less expensive than stationary CCTV models, but more expensive than a portable CCTV without a viewing screen. Useful for reading labels or menus, writing checks, and performing other close-up tasks not requiring a wide field of view.	Field of view is too small for reading books.

Focal distance chart

This should be used as a guide to the correct use of a magnifier.

Dioptres	Power	Focal distance (in inches)	Focal distance (in centimetres)
+2	0.5 x	10.00	50.00
+4	1.0 x	15.00	25.00
+5	1.25 x	8.00	20.00
+6	1.5 x	6.60	16.67
+8	2.0 x	5.00	12.50
+10	2.5 x	4.00	10.00
+12	3.0 x	3.30	8.30
+14	3.5 x	2.90	7.14
+16	4.0 x	2.50	6.25
+18	4.4 x	2.20	5.50
+20	5.0 x	2.00	5.00
+24	6.0 x	1.70	4.16
+32	8.0 x	1.20	3.10
+40	10.0 x	1.00	2.50
+48	12.0 x	0.83	2.08
+56	14.0 x	0.71	1.78
+64	16.0 x	0.62	1.56
+72	18.0 x	0.55	1.38
+80	20.0 x	0.50	1.25

(Foundations of Low Vision pp129)

The 'mechanics' of reading with a magnifier

It is important to ensure that the mechanics of reading with a magnifier are explained to the student. The first consideration is the 'perceptual span'. The idea is to get the required magnification with the widest field of view or 'perceptual span'. Reading rate is directly influenced by the width of the perceptual span in reading. The typical perceptual span of a mature reader is 7 to 10 letters, i.e. amount of information the individual can decode and store in short-term memory in one fixation, before going on to next piece of information. A typical length of a saccade (the movement of the eye between fixations on the print) is 5 to 7 words or the width of newspaper columns. Students will often start reading with their eyes some distance from the magnifier, until they realise that with the eye closer to magnifier, their perceptual span widens. The student needs to be taught how to widen their perceptual span, i.e. get their eye/s closer to the magnifier.

If the optometrist prescribes a magnifier to be used with spectacles, we need to ask if, for sustained reading it can be used without spectacles to decrease the distance from the eye to the magnifier.

Eye-hand coordination is another important skill for a magnifier reader and is often one of the reasons that magnifiers are not often prescribed to younger children. (The other reason being that

young children can accommodate so close that they often get sufficient magnification from bringing the print very close.) Movement of an unsteady hand is 'magnified' on the page. The magnifier lens must remain parallel to the page. Any tilt will exaggerate lens aberrations. This may not be immediately apparent to a student with low vision.

Another important skill involves tracking and eye movements. Efficient, mature readers utilise smooth, rightward saccades with few regressions. Low vision readers using magnifiers have been found to adopt 'saw-tooth' eye movements. These are caused by the eye following the apparent leftward movement of the print as the magnifier is moved to the right. The 'saw-tooth' movement lowers reading speed and comprehension and increases fatigue (Fotinakis & Dickinson, 1994). Any training must attempt to minimise this. Also, the velocity of smooth eye movements must be well matched to that of the moving letters under the magnifier, otherwise comprehension is lost.

Lighting must also be considered. The magnifier may occlude light so the student must be made aware of where to position himself in relation to light when using the magnifier.

The teaching of reading with a magnifier

Positive modelling is often neglected for students with vision impairments because they are invariably the only student with vision problems in their school. Students need the opportunity to meet with and observe proficient readers with magnifiers. It can be difficult to be confident about mastering a new skill if you've never known anyone else capable of it.

I stress again the importance of teaching the student about the mechanics of reading with a magnifier. Students must understand how to find the focal distance and how to vary their perceptual span. One optometrist suggests attaching a piece of string to the magnifier with a knot to indicate how far it should be held from the page. The student should also understand the implications of and the need for smooth, rightward eye movements. You should also explain that initially reading may be slower as the student concentrates on use of the device rather than the reading task.

Should the student move the page or move the magnifier and eyes? This depends on the task and the type of material. It is OK to move a single page flat on a table top or reading stand. This becomes a bit too difficult with books.

The student will need to do some reading exercises with the magnifier to build up their skills. I would not recommend isolated letter or word exercises as the student should be trying to maximise his/her perceptual span.

Start with the print size recommended by the optometrist. Try larger print if the student is not coping, or go smaller if s/he is coping well. The student should be able to reduce the initial print size with practice.

The first exercise should comprise short phrases, well spaced between columns and lines. (See reading exercise charts.) The student can start with one column, moving to several columns, practicing smooth rightward movements. We should always try to spark the interest of our students. Make up phrases which will amuse, take phrases from a favourite book or pick a pet topic e.g. football.

If the student has difficulty tracking, use an 'aperture' - a piece of cardboard which occludes all but one line of print. Depending on the magnifier, these can even be adhered to the magnifier itself. This way, the student only has to manipulate one thing. First use a black aperture on white paper, then grey, then a fine line under the print, then a 'white' mask so the student is reading only one

line. (Use white cardboard on the white page to occlude all but the one line without giving a contrasting aperture.) This will move the student away from concentrating on the aperture for tracking, and onto tracking the line of print.

Use a pointer at the beginning of the line, if movement from one line to the next causes difficulties.

Move to columns of text (of interest to the student). For this, one can use magazine articles about footy stars, kids magazines articles or any short, factual, interesting stories. Again use 'apertures', if needed. Aim not to use these permanently as the magnifier is enough to handle.

Finally, move to normal reading materials. Hard backs are easier than paper backs as the student needs to sit the book flat and paper backs don't open absolutely flat. As manual skills increase, give the student a specific purpose for reading (e.g. find out answer to question) so that his/her focus moves away from the magnifier and onto the reading task.

Reading Exercise Chart

the yellow ball	to the school	can live
has run away	will walk	it was
he was	on the chair	with us
up there	so long	has made
your mother	the new doll	the black bird
a big horse	could make	by the house
to the house	he would do	if you can
he would try	when you come	can run
the old man	to the barn	from the tree
went away	was made	they are

Increasing reading speeds

Typical reading rates for mature readers

Oral & silent reading rates (in words per minute)

Year level reading rates	Minimum oral reading rates	Typical silent reading rates
1	60	less than 81
2	70	82-108
3	90	109-130
4	120	131-147
5	120	148-161
6	150	162-174
7	150	175-185
8		186-197
9		198-209
10		210-224
11		225-240
12		241-255

(Foundations of Low Vision pp259)

Reading rates for people with low vision (in words per minute)

Ocular Media

Central Field	Clear	Cloudy
Intact	131	95
Loss	39	29

(Foundations of Low Vision pp284)

Teachers often believe that low reading rates are a natural outcome of having low vision and hence do not attempt to provide training to improve skills. Suggesting that the low vision student does every second question or reads fewer books because of time limits, whilst often practical, perpetuates the low vision student's poor skills and stamina and disadvantage in exposure to reading. Good readers become so through reading!

Strategies for increasing reading fluency and speed

(Corn & Koenig, 1996)

Repeated readings:

- short, interesting stories (3-5 min.)
- read and time
- re-read and re-time
- make student aware of rate increase
- repeat several times

Paired reading:

- choose classmate with similar reading level but faster rate
- have VI student read a passage on own (silently will do)
- let classmate read passage aloud while VI student follows text
- then two read together
- VI student will try to match speed of classmate

Choral reading:

- select easy reading material for a small group of children including VI student
- read aloud together
- since no-one is 'on stage' this is a comfortable way for slower students to try to match speed of faster readers

Echo reading:

- similar to choral reading, but teacher and student read together
- direct student to disregard meaning and concentrate on smooth eye movements
- teacher gradually increases rate of reading as passages are repeated

Fatigue

Vision impaired students should be taught to recognise the signs of both visual and postural fatigue. Offer the student strategies to deal with them. For example:

- take short breaks
- close eyes
- look into distance
- change task - listen to audio book for a while
- shift physical position of arms, neck, back, shoulders, etc.

The student may also try relaxation techniques. "Imagine a knot behind your eyes, close eyes and imagine the knot gradually untying, think of a peaceful place,"

Graphics

Tables are great to read with magnifiers because they are just like reading columns. The student may need to revert to the use of an 'aperture' if there are long gaps between columns. Ensure that the student is aware of the labelling conventions of tables.

For graphs, the student needs to look at it without the magnifier first. Although the student won't see detail, s/he can see the overall shape of the graph. If you use a photocopy of graphs in books, the teacher can circle specific parts to teach certain concepts. Again, the student may need an 'aperture' to track to points. Also, as with tables, ensure that the student understands the conventions of labels on graphs. There are some good mainstream books available to teach graphing skills. Use these as part of your student's magnifier training, if the student requires this.

For pictures and diagrams, again it helps to look at diagrams without the magnifier first. Diagrams are difficult to perceptualise in small chunks and there are few conventions to rely on. The student's instructions may need to be specific to individual diagrams. For example, instruct the student to use the key, read labels and follow arrows to diagram part, whether the diagram is shown with or without perspective.

The beauty of using a magnifier with diagrams is that the student can use the colour copy instead of a black & white enlargement.

Motivational activities to encourage magnifier use

Adapted from D'Andrea & Farrenkopf, 2000

Rock hunt: Go for a walk to pick up rocks. Use magnifier to examine rocks and the find descriptions in a rock identification book. The end product could be a rock collection that is labelled and displayed.

Fingerprints: Use the magnifier to distinguish the fingerprints of a few people. Make thumbprint creatures with felt pens. Make a cartoon strip with fingerprint characters and captions.

Stamp/coin collections: Buy stamps or coins at a Post Office based on the interests of the child. Use the magnifier to identify and sort them, determine their value on the stamp/coin or in a valuation catalogue. For foreign stamps and coins, locate the country on a globe or map using the magnifier.

Picture game: Cut out small pictures from magazines or old workbooks, etc., and paste them onto construction paper to make cards. Do not laminate as this produces glare problems. Develop an individualised board game where the student rolls a dice, draws a card, and identifies the picture using the magnifier. If identified correctly, the player moves forward.

Cards: Use a regular deck of cards to play games such as 'Go Fish' using the magnifier to identify the cards.

Life skills reading with a magnifier: Examples:

cooking	warranties	CD album covers	recipes books	packet food instructions
menus	newspapers	food labels	maps charts	oven dials and temperatures
radio dials	maps/charts	medicine bottles	cosmetic instructions	SMS messages/iPod screen

Board games: Use magnifier with board games which require reading cards with fine print e.g. Monopoly, Trivial Pursuit, etc.

Lego assembly: Try to construct Lego by following instructions.

Mirrors: Use magnifier to examine student's own face and eyes. This can be a good conversation starter to talk about vision and vision impairments.

Magazines: Children's magazines or the school magazine (if they have one) are great motivators. Use magnifier to try to spot friends, read captions on pictures, use the contents or index, identify detail in pictures or diagrams. Make sure the magazine is age-appropriate, e.g. teenage girls love 'Dolly' and 'Girlfriend', younger boys might like skateboarding or car magazines.

Calorie counting: Often older students are interested in the calorie or energy levels in foods. Use magnifier to read this information on food packaging.

Collections: Almost any child will have a 'collection' of something (Beanie kids, matchbox cars, McDonald's toys, rocks). Have a 'collections day' at school and use magnifier to examine each other's collections.

Nature hikes: Pack several reference guides (fossils, birds, rocks, plants) in a backpack and go for a hike with students. Use magnifier to examine objects and access information in reference books.

Trip planning: Get students to help plan a trip by consulting phone books, bus schedules, maps, etc. Use magnifier to access the information in the planning stage and on the trip.

CD packages: Play a CD and ask student to locate a song on the CD package or make a choice of a track to be played.

Treasure hunt: Have a treasure hunt with clues presented on a variety of materials which require different magnifier techniques and possibly even different magnifiers. Clues could be on curved surfaces, hidden in other visual information, written on specific pages of a reference book. This is an easy activity to modify for an age level.

Secret message: Write secret messages one letter at a time with lines connecting each letter in a pattern which mimics good scanning technique. Students need to follow the lines correctly to decipher the message. Leave messages or jokes in small print stuck to student's desk and ask student to check message daily.

Riddles: Hide riddle answers by writing the answer one letter at a time on a surface.

Looking table: For younger students, set up a 'looking table' in the classroom where there are interesting small objects and several magnifiers. The whole class can enjoy this.

What to tell teachers when your student reads with a magnifier

Teachers should be told to expect a slower reading speed (at least initially!). It is helpful if they are made aware of some of the mechanics such as the fixed focal distance and that a close reading distance is OK and often necessary when using the aid.

Teachers need to know that, whilst the aid will solve many problems it may create a few, too. Visual and postural fatigue may be increased at least in the early stages of using the magnifier. The student's field of view will be reduced by the aid. This is especially important to know when the student is viewing graphics.

Make teachers aware of which activities might be assisted by using a magnifier so that they can encourage appropriate and efficient use.

Conclusion

Although there are some disadvantages to using an optical magnifier, and students need to commit to some training and practice, their independence and options for reading will be unlimited if the skill is attained. This skill will remain with them beyond their school years when large print will be much more difficult to obtain.

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