READING SPEED AND LOW VISION ASSESSMENT

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AIMS

This module aims to outline the importance of reading speed in low vision assessment via developing a:

- Protocol for assessing reading speed
- Systematic approach to determining the required magnification to achieve an adequate reading speed

LEARNING OUTCOMES

After completing this module, students should be able to:

- Assess the reading requirements of an individual patient with low vision
- Calculate required equivalent viewing distance (EVD) for the patient's desired task.

INTRODUCTION

The goal of any low vision assessment is to determine whether the patient's vision can be enhanced to enable him/her to take part in regular daily activities. The types of tasks that people might want help with range from "survival" type tasks such as cooking activities, reading labels on medications, etc., to demanding school or work reading. A common task for children will be reading a school book; for an older adult it might be reading a newspaper. Therefore one of the most important parts of the low vision assessment is to prescribe sufficient magnification to enable the patient to read whatever he/she wants to be able to read.

The patient's near visual acuity is the starting point for most calculations to determine the magnification required, but the reading speed required for the task also needs to be taken into account when considering the magnification required. Just as the print size that can be read improves (gets smaller) with increasing magnification, reading speed also improves (gets faster). For example, everyone, irrespective of the level of vision reads very slowly at their

threshold print size, which is defined as the smallest print size that can just be read. As print size increases, reading becomes easier and faster. Most people reach their maximum reading speed at print sizes between 2 times and 5 times larger than their threshold print size.

Thus, to calculate the magnification required for reading, both the required print size and reading speed needs to be considered.

DETERMINING NEAR MAGNIFICATION FOR READING

For the purpose of this discussion, tasks considered here are reading tasks, but the same steps can be used for other detailed near tasks by estimating, for example, an equivalent print size.

Lovie-Kitchin and Whittaker (1999) identified four major visual factors that significantly affect reading performance:

1. **Acuity reserve**: the ratio of the print size that the patient wants to be able to read relative to the patient's threshold print size (near visual acuity).
2. **Contrast reserve**: the ratio of the contrast of the print which the patient wants to read relative to the patient's contrast threshold (reciprocal of contrast sensitivity).
3. **Field of view** (or window size): the number of letters visible in the field of vision.
4. **Central scotoma size**: this is an impediment to reading performance in addition to the three factors listed above.

However, they identified lack of acuity reserve as the main impediment to reading. Accordingly, they proposed a step-by-step approach to determine the equivalent viewing distance (EVD) or equivalent power (100/EVD (cm)) and then to select an appropriate optical device for reading, taking into account reading speed requirements.

1) WHAT DOES THE PATIENT WANT TO BE ABLE TO READ? WHAT PRINT SIZE IS THE TASK?

The required magnification will depend on the print size and required reading speed of the task. So the patient's reading task needs to be specified in these terms.

For children who want help reading their school books, check samples of the school books or estimate print size based on information from the child, parent or teacher. Similarly for adults, view samples of the tasks they want help with if possible or estimate print size required.

2) HOW QUICKLY DOES THE PATIENT NEED TO READ THIS TASK?

Required reading speed can be estimated, at least qualitatively, from knowledge of the likely duration and accuracy of the task.

For example, for short reading tasks, such as reading labels, the reading speed required is minimal. Whittaker & Lovie-Kitchin (1993) called this "spot" reading, about 40 words per minute (wpm). Some school tasks like reading a map would come under this category. For other tasks such as reading school books or the newspaper, a faster reading speed is needed in order to understand the meaning; this needs to be about 100 wpm or more ("fluent") reading.

From steps 1) and 2) the patient's requirements can be defined. For example, the reading task for a patient who wants to read the newspaper would be defined as needing to read 1M print fluently.

3) HOW MUCH ACUITY IS NEEDED 'IN RESERVE' FOR THE REQUIRED READING SPEED FOR THE TASK?

As described above, if a very slow reading speed is needed, the patient can achieve this at a print size close to the print size of the task, maybe with one line of acuity in reserve. For example, for the student who wants to read place names on a map which are 0.8M in size, magnification needs to be prescribed which enables him/her to read 0.6M print (one line of acuity in reserve when reading 0.8M).

For the patient who wishes to read quickly, for example newspaper stories of 1M print size, sufficient magnification needs to be prescribed which enables the patient to read 0.5M print (3 lines of acuity in reserve to enable fluent reading of 1M print).

TABLE 1 - Acuity reserve requirements for different reading speeds (Lovie-Kitchin and Whittaker, 1999)

READING SPEED	MINIMUM ACUITY RESERVE (lines on a chart or ratio of sizes)
Spot (~40 wpm)	1 line (1.3:1)
Fluent (~100 wpm)	3 lines (2:1)
Maximum (~250 wpm; few people with low vision achieve normal reading speeds)	5-9 lines (3:1 to 8:1)

4) WHAT IS THE PATIENT'S CURRENT NEAR VA - THRESHOLD PRINT SIZE AND VIEWING DISTANCE?

Measure the smallest print that the patient can read with their current near prescription (or their natural accommodation) and note the viewing distance they use. For example, the student can read 1M print at 20 cm.

5) CALCULATE REQUIRED EQUIVALENT VIEWING DISTANCE (EVD) FOR THE PATIENT'S DESIRED TASK.

This can be done by a simple ratio:

Required EVD = (Required print size/Patient's threshold print size) X Current viewing distance

For example for the student who wants to read the map:

Required EVD =0.6M/1M X 20cm = 12cm

Table 2 gives a number of worked examples for sample patients using the steps described above, taking into account the reading speed requirements of the tasks.

NEXT STEPS

The next steps are to select one or more optical devices that can provide the required EVD and test the reading performance with these devices. Low vision children will always use some accommodation, so the equivalent power of the device selected needs to allow for this.

For example, Patient 2 (below) requires an EVD of 12 cm to read the desired material, which would be a required 8.25D. This 8.25D of power could be provided by one or more of the following:

- Accommodation
- uncorrected refractive error
- a high near addition
- hand-held magnifier or stand magnifier,

Each of these may have its own advantages and disadvantages.

Finally, to determine the appropriate near low vision device or devices to trial or prescribe, the final assessment must be a test of reading performance, preferably on the task that the patient would like to perform.

TABLE 2 - Calculating required equivalent viewing distance and equivalent power

Procedure	**Patient 1 - 12 year old with congenital nystagmus**	**Patient 2 - 18 year old with myopic degeneration**	**Patient 3 - 70 year old with diabetic retinopathy**	**Patient 4 - 85 year old with age-related macular degeneration**
1. Establish patient's desired reading task	Read school book more easily	To read map details	To read medication labels	To read local newspaper
2. Establish the print size and reading speed required for that task.	1.25M rapidly	0.8M slowly	0.6M slowly	1M fluently
3. Determine acuity reserve and required threshold print size for required reading speed	Ideally 5 lines acuity reserve for max. reading of 1.25M → 0.4M required threshold print size	1 line acuity reserve for 'spot' reading of 0.8M → 0.6M required threshold print size	1 line acuity reserve for 'spot' reading of 0.6M → 0.5M required threshold print size	3 line acuity reserve for fluent reading of 1M → 0.5M required threshold print size
4. Measure current threshold print size and viewing distance	0.8M @ 10cm with distance prescription (accommodation only)	1M @ 20cm with distance prescription (accommodation only)	2M @ 32cm with +3D add	2.5M @ 25cm[a] with +3D add
5. Calculate required EVD	0.4M/0.8M X 10cm = 5cm	0.6M/1M X 20cm = 12cm	0.5M/2M X 32cm = 8cm	0.5M/2.5M X 25cm = 5cm
6. Test reading performance with a magnification system giving required EVD[b]	1.25M rapidly at 5cm with 12D near add + 8D accommodation	0.6M comfortably @ 12cm with +5D near add +3D accommodation	0.6M slowly @ 8cm with 12D hand-held magnifier	0.6M with difficulty with 6X stand mag (EVD = 5cm with eye-magnifier distance = 10cm)

[a]This is satisfactory, although not ideal focus. Decreased viewing distance increases retinal image size (with slight blur). If viewing distance is <u>longer</u> or substantially shorter than focal length of current near add, the distance prescription needs to be checked.

[b]If expected performance is not achieved, decrease EVD (increase power) by repeating this procedure, or assess other aspects of vision which may be limiting performance.

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- Lovie-Kitchin JE, Whittaker SG. Prescribing near magnification for low vision patients. Clin Exp Optom 82: 214-224, 1999.
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