Low Vision Rehabiliation

A workshop

CONGRESO PANAMERICANO DE OPTOMETRÍA
VISION + VALOR -FRONTERAS= #TU

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Cartagena, Colombia, 19 May 2016, 2.00-5.00pm

Today's workshop

Prescribing magnification devices for low vision

Part 1 Examination of the patient with low vision

History, visual acuity, visual fields, contrast sensitivity, effects of light levels
Reading acuity and reading performance

Exercise: Determine magnification needs for reading

Part 2 Understanding optical aids for magnification

Magnification and Equivalent Viewing Distance (EVD)
Spectacles for near vision; Hand-held magnifiers (power and EVD)
Stand-magnifiers (image distance, enlargement, EVD)
Telescopes (magnification, close-focus, EVD)
Video-magnifiers (enlargement, EVD)

Exercise: Measure equivalent power, find image distance, calculate enlargement

Part 3 Which magnifiers to prescribe?

Choosing magnifiers that provide the required EVD
Consider accommodation, reading glasses, eye-to-magnifier distance
Know the optical parameters of your magnifiers

Exercise: Find suitable magnifiers from lists that give the optical parameters

Part 1 Examination of the patient with low vision

Interview

Case history

Learn about the patients visual difficulties and needs
Establish goals for treatment

Measure the patient's visual capabilities

Acuity, contrast, fields, reading performance,
Effects of light

Color vision, binocular vision, adaptation, etc.

Decisions about treatment and advice

Consider low vision aids

improve visual capabilities, reduce patient's problems

Training and counseling

Referral *for other rehabilitation services (mobility, daily-living, technology)*

Case History

Standard questions — Reasons for the visit?
What are your visual problems?

Functional Problems - Distance vision *mobility, faces, TV, signage, audience*

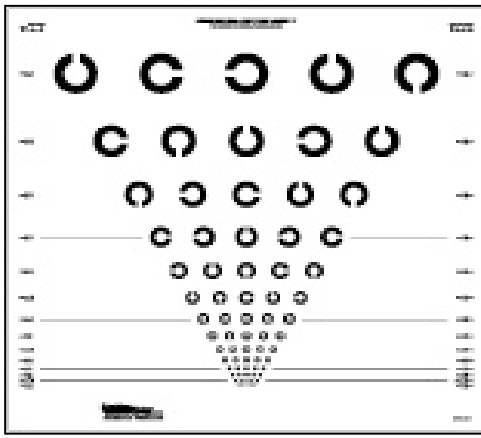
Functional Problems - Near vision - *reading, food, grooming, manipulation tasks*

Effects of lighting

Cause of visual impairment - - - history of medical treatment
history of low vision care and rehabilitation

Living situation — Independence and responsibilities
Current and past interests and activities
Computer use
Mobility and travel
Rehabilitation services

VISUAL ACUITY



Bailey Lovie Design principles *(1976)*

LogMAR charts , ETDRS charts

The visual task is the same at all size levels

Size is the only significant variable from one size level to the next

REQUIREMENTS

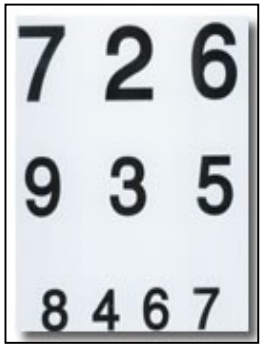
Same number of letters *(or optotypes)* at each size

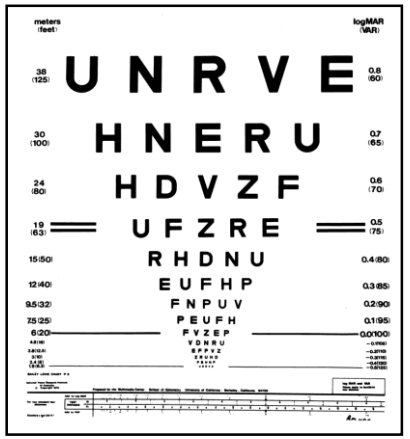
Logarithmic *(constant ratio)* progression of size

Spacings proportional to letter size

(between letters and between rows)

Average letter legibility should be the same for each size level

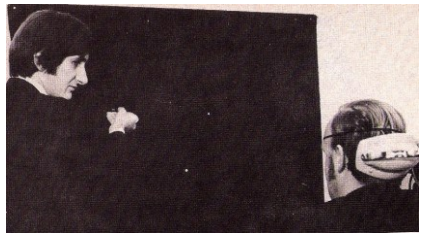




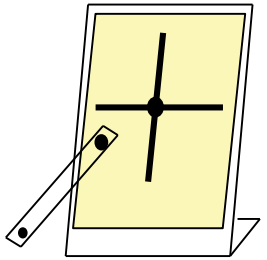
Same magnification *(optical,elargement, viewing distance)*

gives the same number of extra rows

VISUAL FIELDS

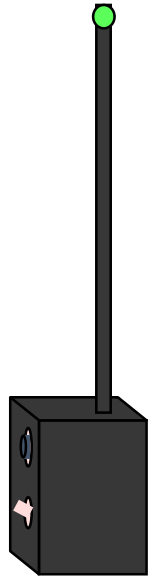


Visual Fields



Peripheral fields — Important for orientation and mobility
Search
Being aware of objects and activities

Central Fields — Important for
Reading
Faces
Guiding manipulation

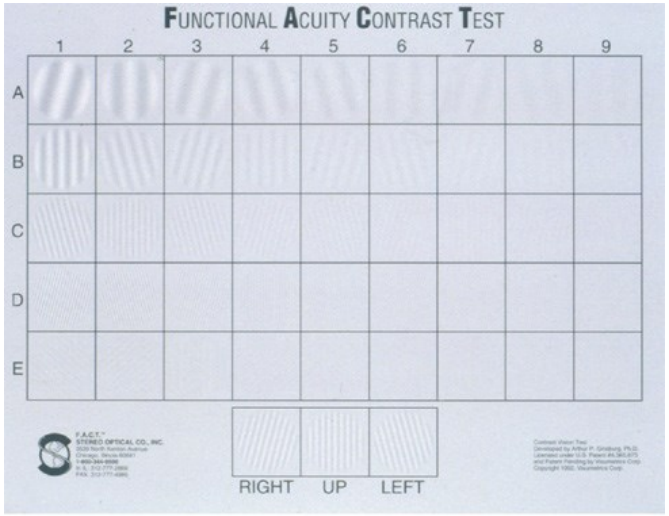


Automated perimeter *(Humphrey)* Best to monitor change

Tangent screen: good for functional central fields
Goldmann: best for functional peripheral fields

Confrontation: Good for testing extreme periphery

CONTRAST SENSITIVITY



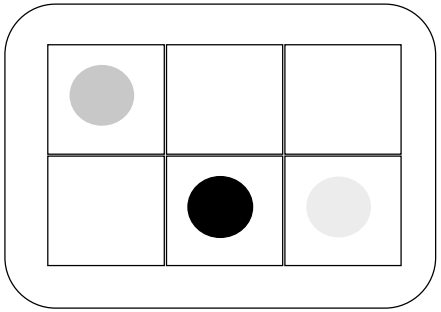
Contrast Sensitivity

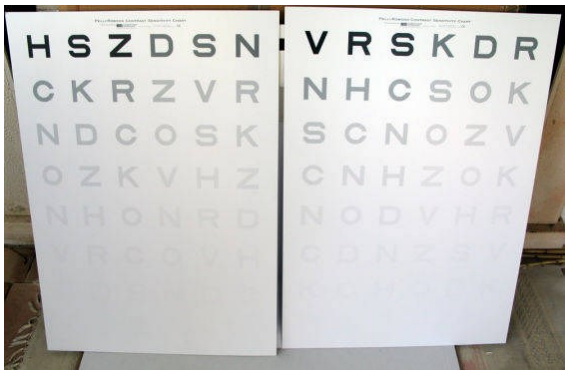
Important for orientation and mobility

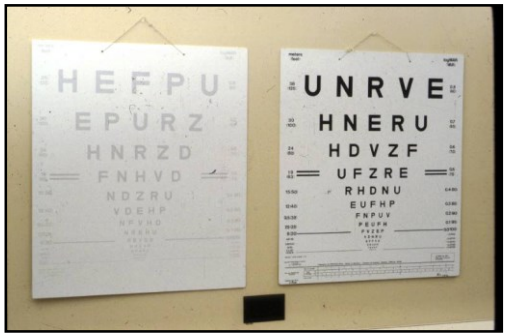
being aware of objects and activities

textures and shadows and shapes

search

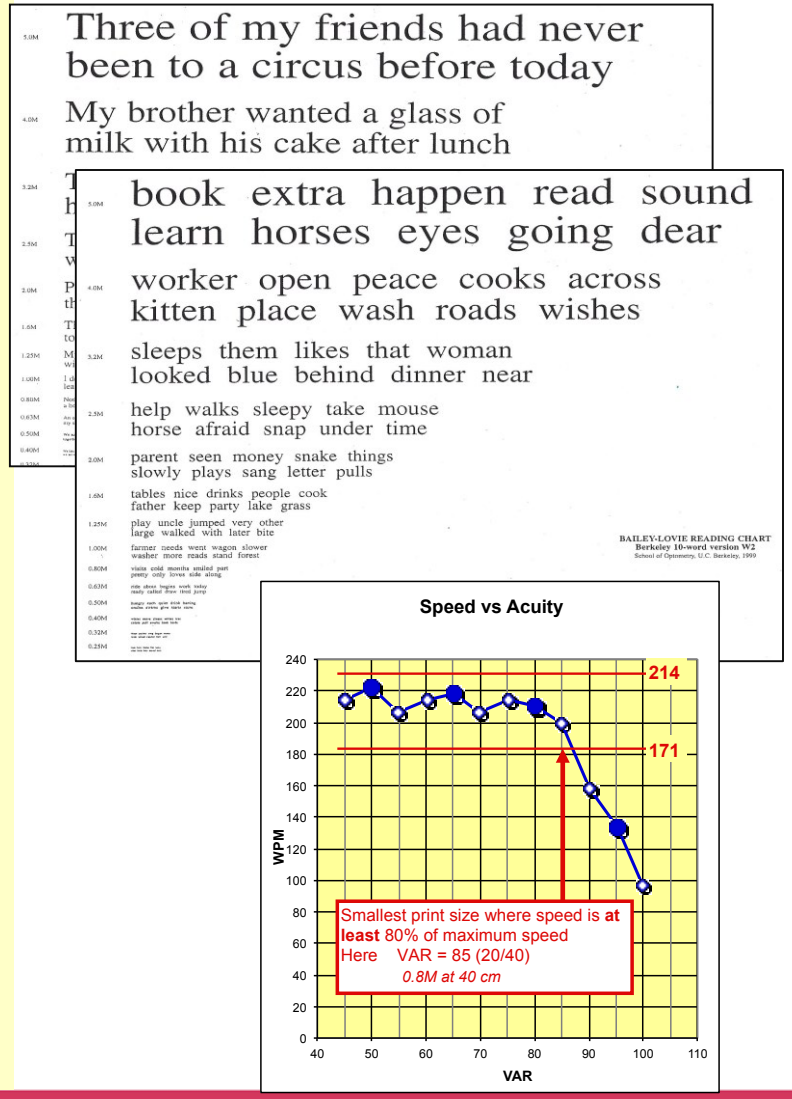






Reading performance

5.0M
4.0M
3.2M
2.5M
2.0M
1.6M
1.25M
1.00M
0.80M
0.63M
0.50M
0.40M
0.32M
0.25M



Size progression by constant ratio

1 step = 5:4
3 steps = 2:1
6 steps = 4:1
9 steps = 8:1
10 steps = 10:1

> Chart is held at a known distance
(perhaps 40 cm – in good focus)
> Patient reads aloud (or spells the letters)
> Optometrist listens

Record: Print size at first difficulty
Size of smallest print read.

Critical Angular size = size of smallest print that could be read with best efficiency

One step larger than print size for first difficulty

Exercise #1

Finding the Critical Angular Size

5.0M
4.0M
3.2M
2.5M
2.0M
1.6M
1.25M
1.00M
0.80M
0.63M
0.50M
0.40M
0.32M
0.25M

1 Use Word Reading chart

2. Position chart at a fixed distance (in good focus)
   Record the viewing distance

3. Have patient read aloud (or spell out the letters)

4. Note when patient's reading to becomes slower
   Record print size

5. Note smallest print that patient can just read
   Record the print size

#2. Viewing distance = 40 cm = 0.40 m
#4 First difficulty 0.40/2.0M
#5 Reading acuity 0.40/1.0M

Critical angular size (CAS) = 0.40/2.5M
= smallest "quick"

5.0M	Quick
4.0M	Quick
3.2M	Quick
2.5M	Quick
2.0M	Slightly slow
1.6M	Slow
1.25M	Very slow
1.00M	Extremely slow
0.80M	Impossible
0.63M	Impossible
0.50M	Impossible
0.40M	Impossible
0.32M	
0.25M	

Part 2 Understanding optical aids for magnification

Magnification and EVD (EVD = Equivalent Viewing Distance)

Plus lens magnifiers (reading glasses, hand held magnifiers)

Critical parameter = EQUIVALENT POWER (P_e)

Stand magnifiers

Critical parameters

IMAGE DISTANCE (v) and ENLARGEMENT RATIO (ER)

Eye-to-image distance is important

MAGNIFICATION

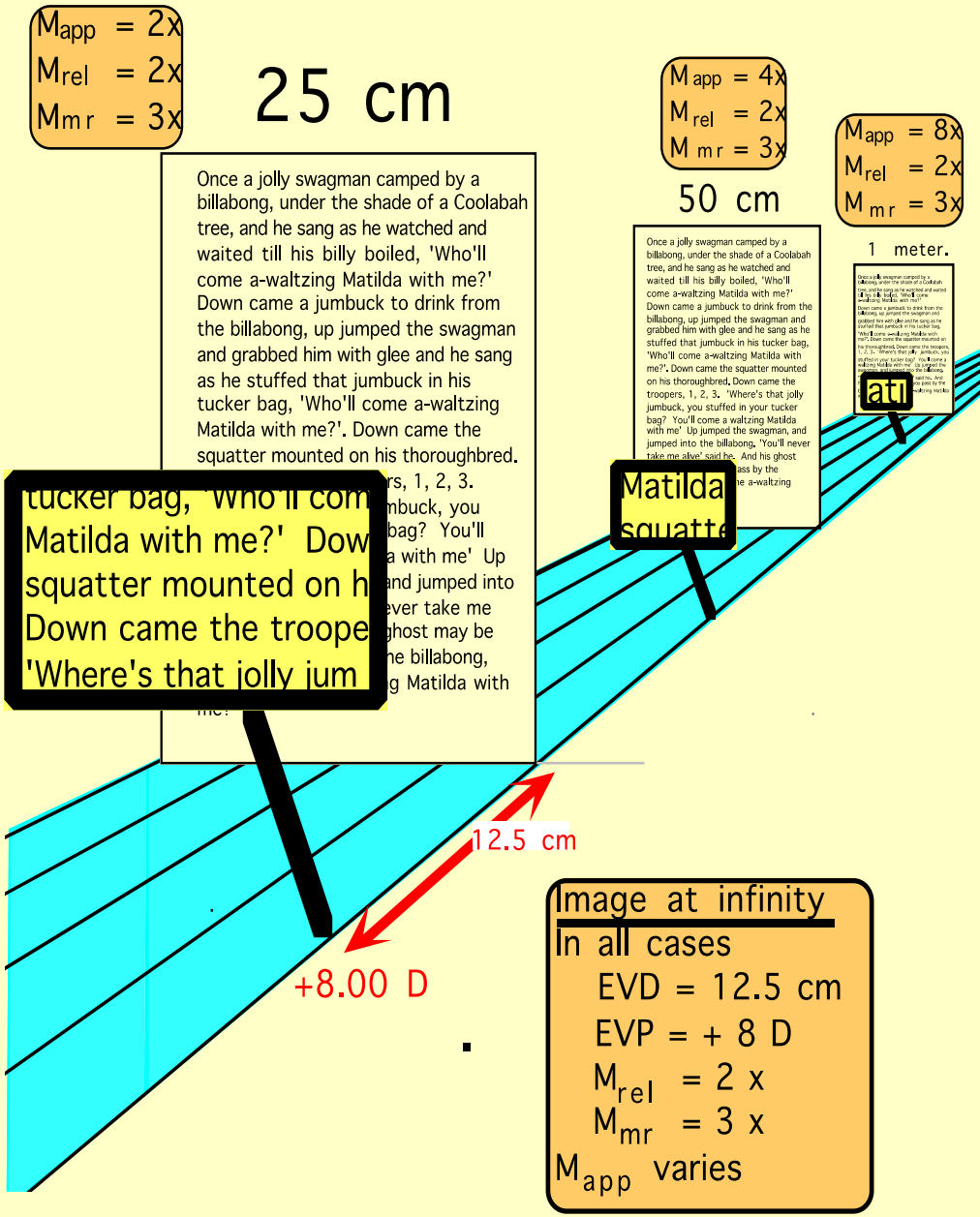
"Magnification" *has many definitions*

It is a comparative term

BUT *it is rarely obvious what two things are being compared*

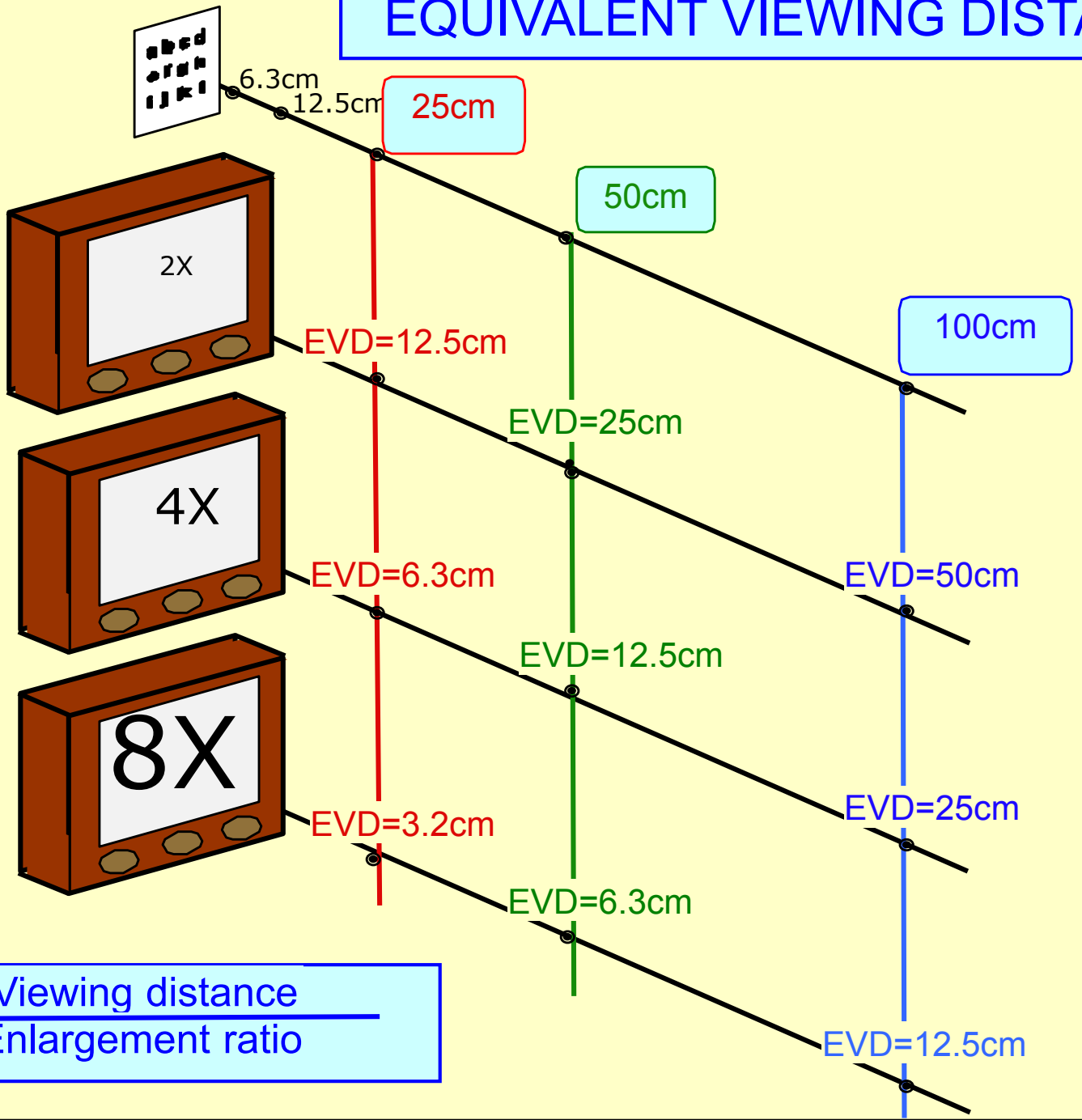
Do not use MAGNIFICATION

Use
Equivalent Viewing Distance



EVD = distance at which the object would subtend the same angle that the image subtends

EQUIVALENT VIEWING DISTANCE



$$EVD = \frac{\text{Viewing distance}}{\text{Enlargement ratio}}$$

Predicting changes in resolution

Proportional to viewing distance (or EVD)

Provided the retinal image is kept in good focus

Patient reads 4.0 M print (6 mm) at 100 cm *VA ≈ 20/80*

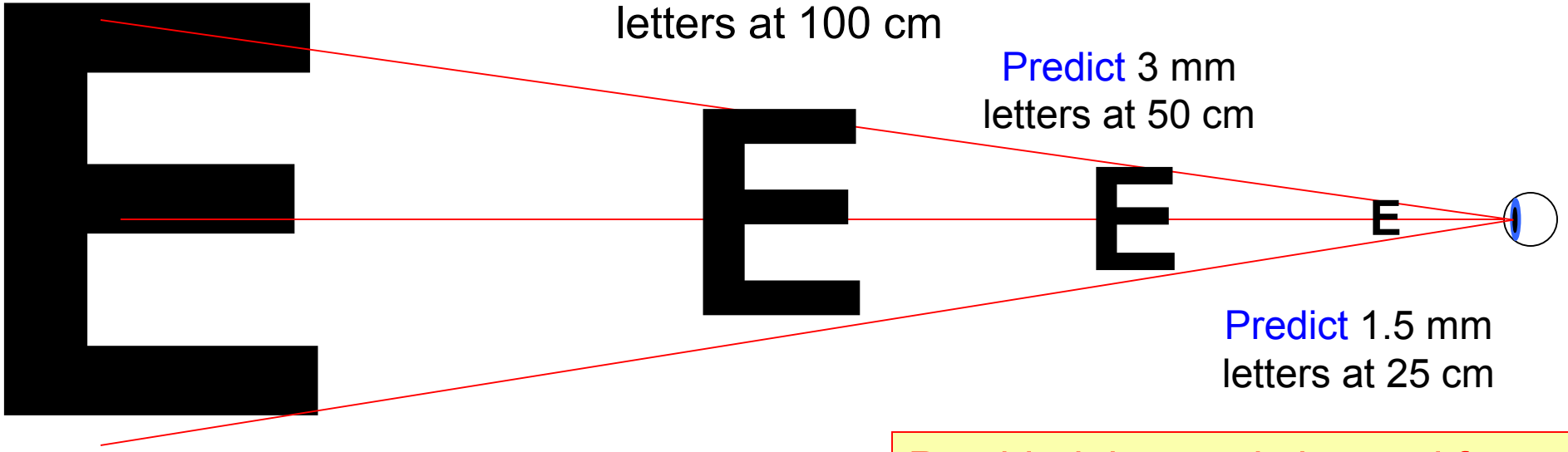
VA ≈ 20/80

Predict 12 mm letters at 200 cm

Measure: 6 mm letters at 100 cm

Predict 3 mm letters at 50 cm

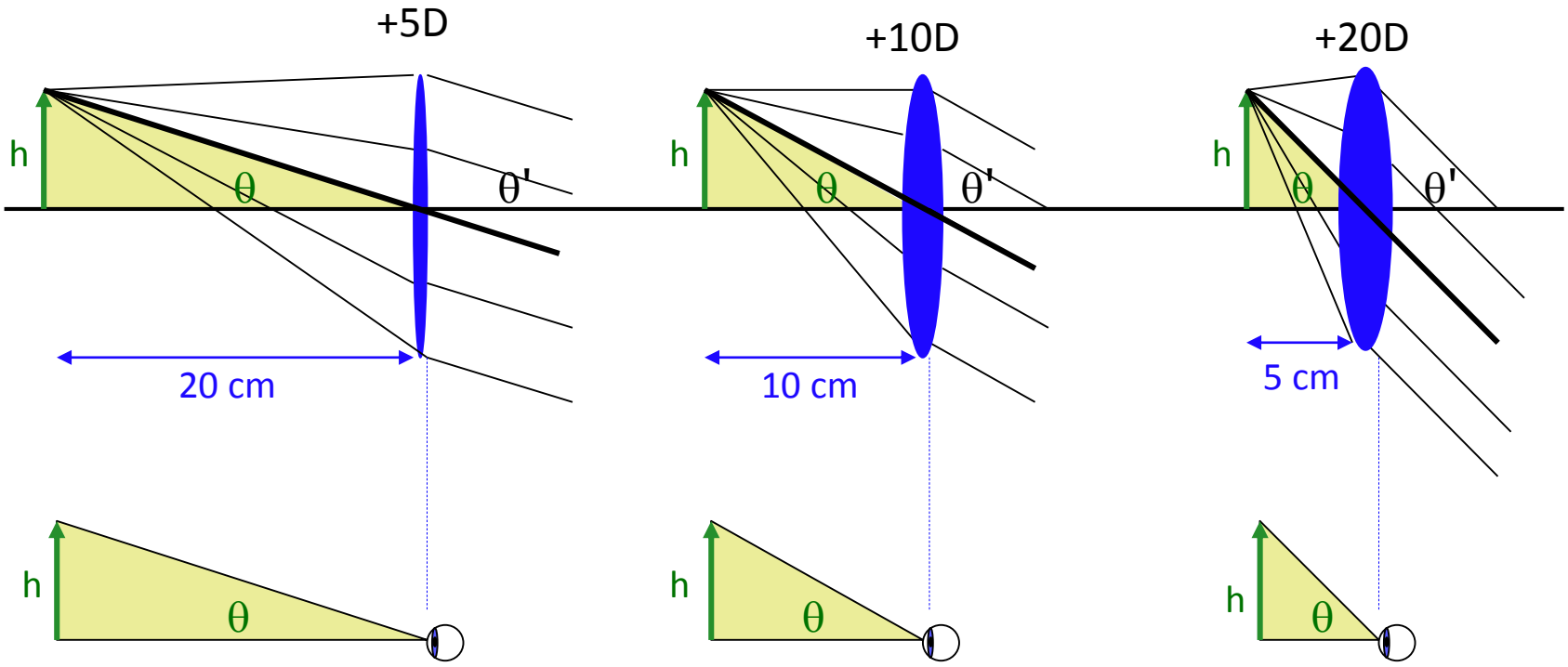
Predict 1.5 mm letters at 25 cm



Provided the eye is in good focus

Plus lenses *Images at infinity*

EVD = focal length



EVD = 20 cm

EVD = 10 cm

EVD = 5 cm

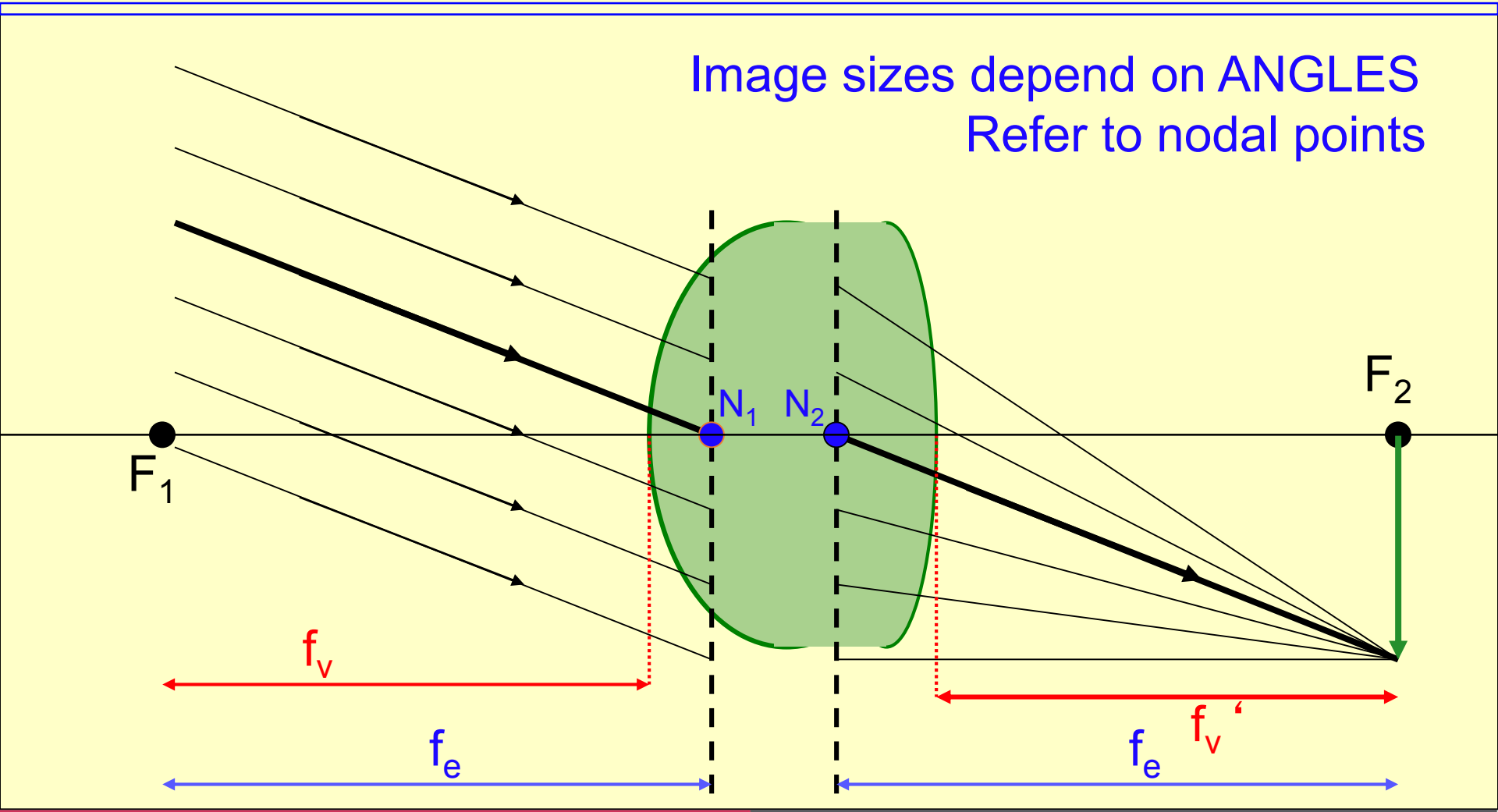
Hand-Held Magnifers *When image is at infinity*

EVD = focal length of the lens

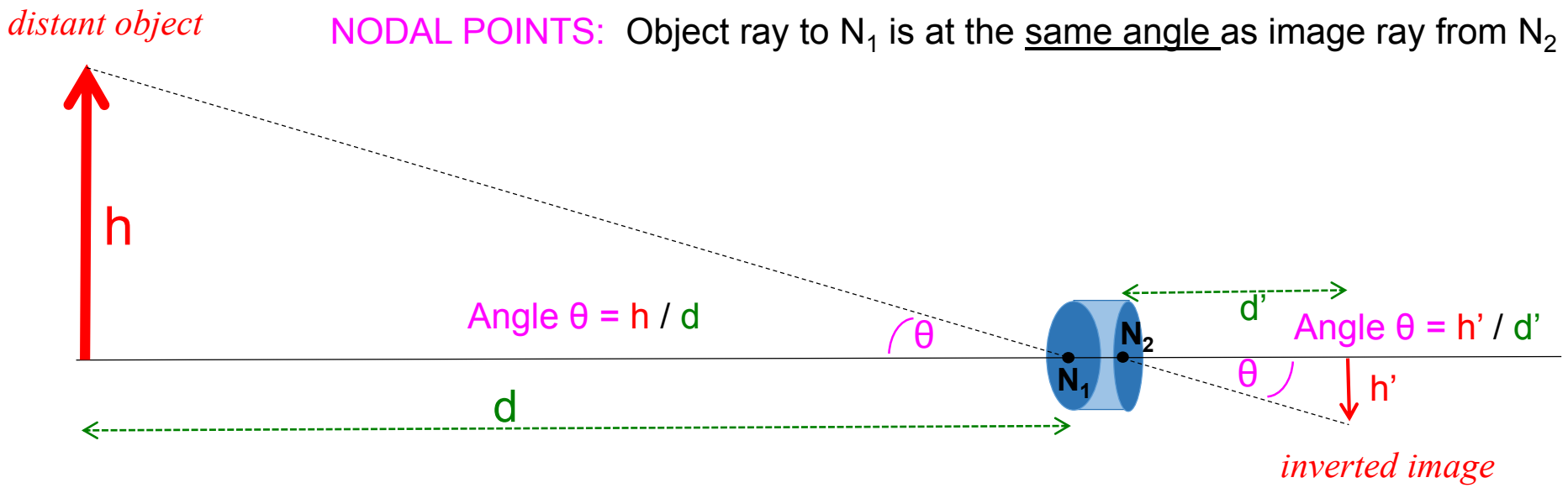
Image sizes depend on the Equivalent Power

Equivalent focal length = distance from focal point to nodal point

This is the same in object space and image space



Measuring the Equivalent Power



Tan θ = h/d = h'/d'

1. Measure object distance d and object height h

   Assume: d = 5 meters, h =1 meter Ratio = 5:1

2. Measure height of image on screen h'

   Assume: h' = 20 mm

3. Calculate d' d' = h' x (d/h) = 20mmx(5/1) d'= 100mm

Focal length f ≈ d' Lens power = 1/d' = 1/0.1m = +10D

Stand Magnifiers

Images are not at infinity

They are at some close distance

(usually between 100 cm and 2cm from lens surface)

The image is a fixed location and enlarged

Larger than the object

What are you asking the patient to look at?

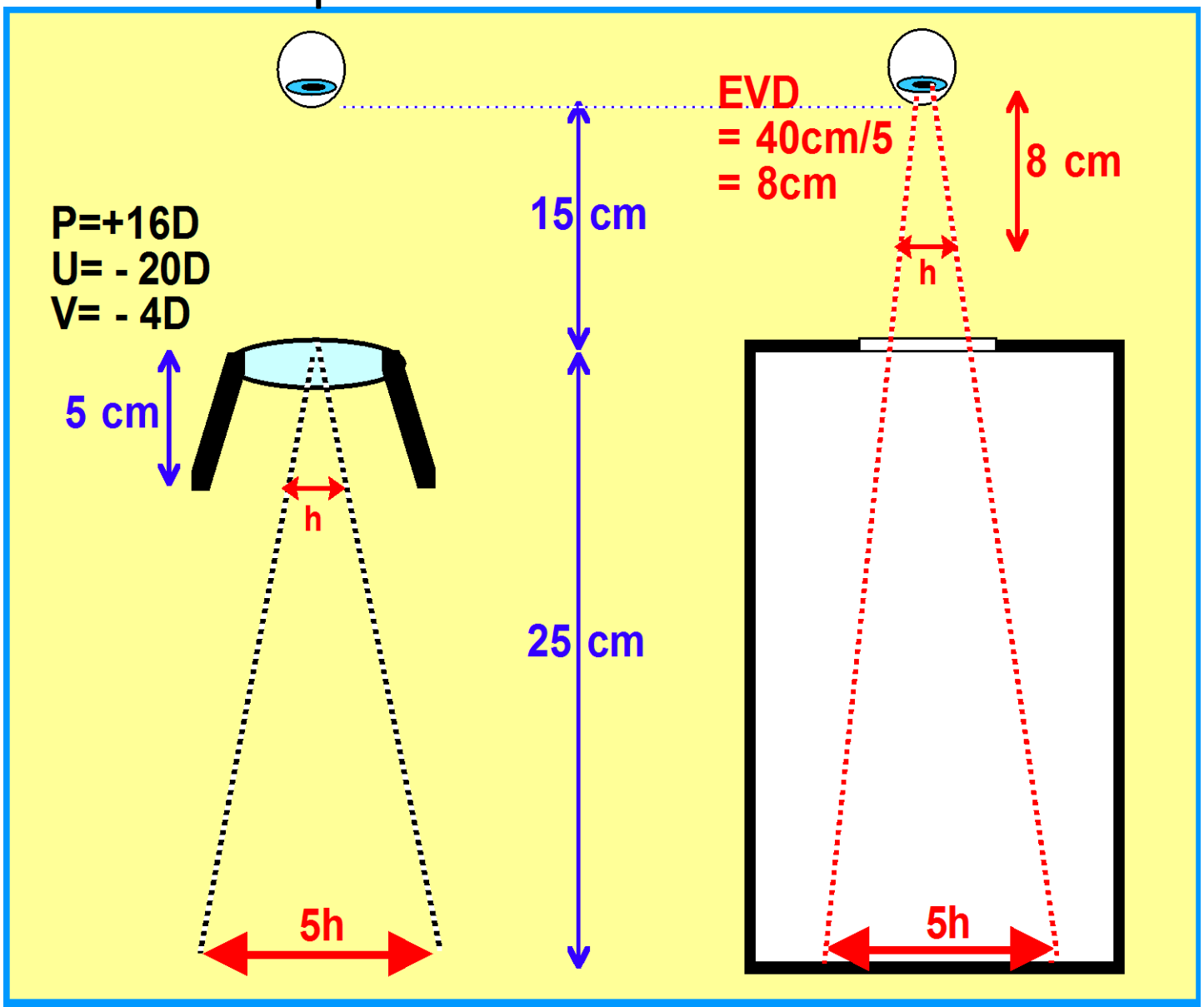
Where is the image? (*Accommodation demand?)*

By how much has it been enlarged?

What is the EVD (*what can be resolved?)*

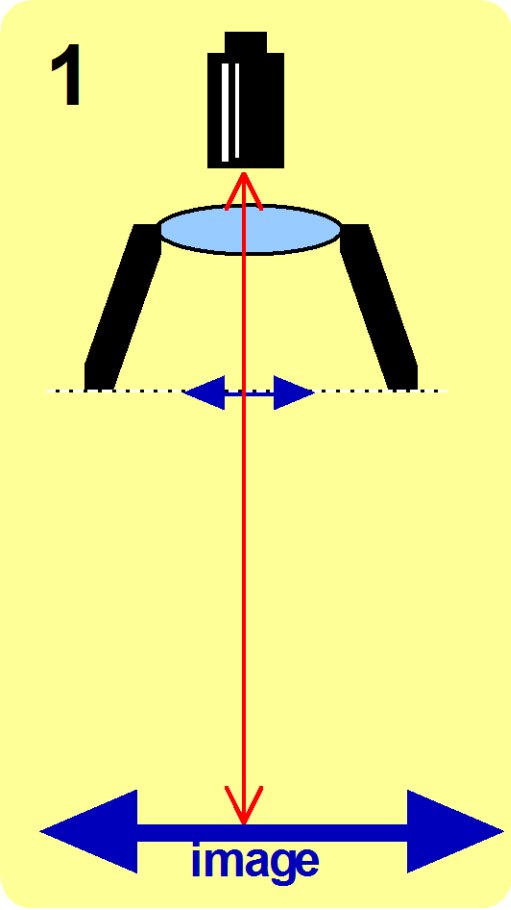
Stand Magnifiers

EVD = (z-v)/ER



Finding the image location in Stand magnifiers

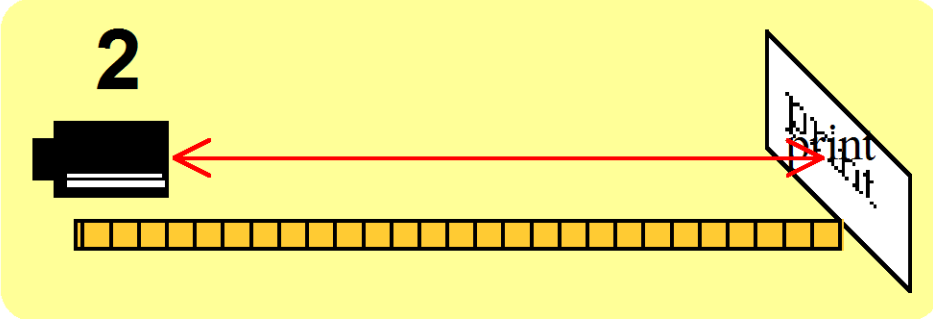
How to determine image location in stand magnifiers



1. Close–focus telscope
   Adjust to focus on image

2. Do not adjust focus.
   Point telescope towards some object

3. Vary the distance until clear focus
   Measure the distance



Calculating the Enlargement Ratio

1. Know the Equivalent Power of the Lens (P_e)
2. Know the image distance (v)
3. Calculate the image divergence V = 1/v *(and this is negative)*
4. Calculate the object vergence U
   U = V-P_e and U is also negative because rays are divergent

Enlargement Ratio (ER) = U/V = (V-P_e) / V

EXAMPLE: Power P_e = +20D, image distance v= 25 cm So V= - 4D

U = -4 -20 = -24D *ER = U/V = (-24) / (-4) = 6x*

Part 3 Deciding which magnifiers to prescribe

Optical factors

EVD

Choose a magnifier that provided the required EVD to meet the patient's needs

Eye-to-image distance

Which eyeglasses should the patient need

Field of View

Field of view is determined by the EVD, the lens diameter and the distance to eye

Practical factors

cost, appearance,
weight, size, portability, comfort
illumination, power source,
maintenance

Determine the EVD

Lens Power P_e = + 20 D

Image distance = 25 cm

Enlargement Ratio = 6x

Eye-to-lens distance z = 15 cm

Eye-to-image distance = 15 cm + 25 cm = 40 cm

Enlargement ratio ER = 6x

EVD = Eye-to-image distance / ER

= *40cm / 6x = 6.67cm*

Paperweight magnifiers

dome, hemisphere, bright magnifiers, visolet

For a hemisphere

Image is in the same plane as the object

Enlargement ratio = 1.5 x (refractive index)

Not affected by surface curvature

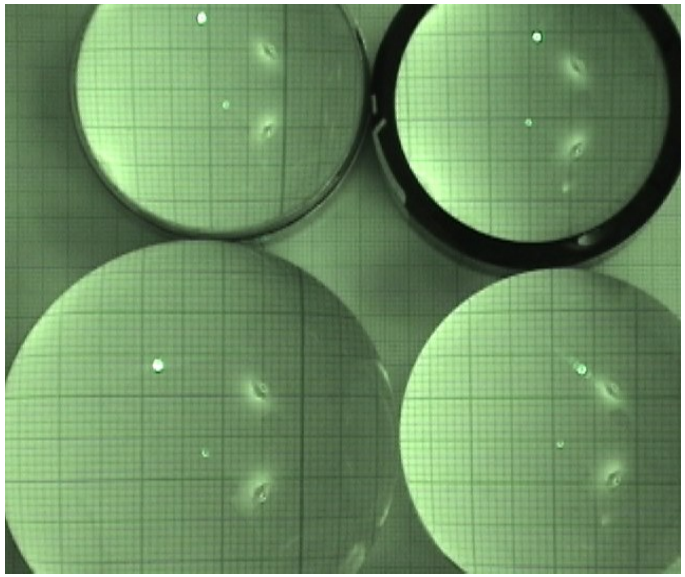
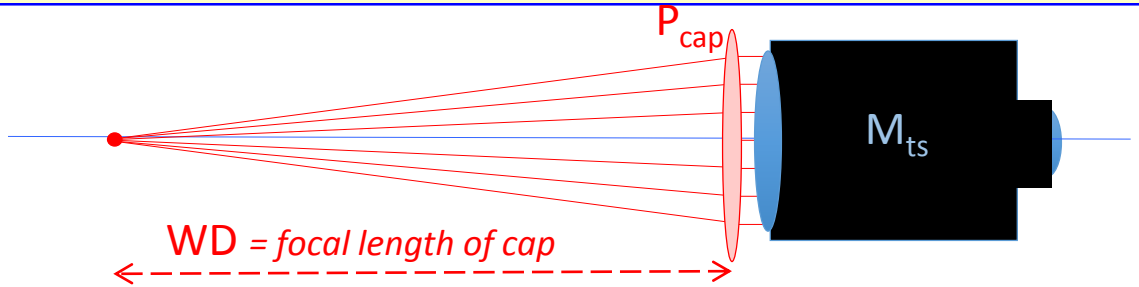


Image is brighter ($1.5^2 = 2.25$x)

Field of view = diameter / 1.5

Good for children because they can continue to use their close viewing distance

Telescopes for Near Vision



1. Distance telescope with a lens cap

Lens cap power (P_{cap})

determines the working distance

Example P_{cap} = +4.00D, WD = 25 cm

$$EVD = WD / M_{ts}$$

2. Close-focus telescope (increase length)

$$EVD \approx WD / M_{ts}$$

More accurately $EVD = (WD / M_{ts}) - 1$

Video Magnifiers and computer access

Video magnifiers

Desk models (CCTV)
Portable models

Access technology

Computer based systems
Smart modifcations of visual displays
Smart alternative outputs (speech, tactile)

Most important control of visual display

Variable enlargements
Reverse contrast
Change colors

Choosing a magnifier that gives the required EVD

Need to make an estimate of how close the eye will be to the magnifier lens

Knowing v and ER, can predict EVD, accommodation demand, and field size

		Measured			Predicted Performance					
DEVICE	*diam*	P	v	ER	z= 10 cm			z=2.5 cm		
	mm	D	cm	cm	EVD	eye/im	FoV	EVD	eye/im	FoV
Eschenbach 1557	*30*	46.8	38.6	19.1	2.6	48.6	*8*	2.2	41.1	*26*
Eschenbach 1550	*35*	37.5	34.2	13.8	3.2	44.2	*11*	2.7	36.7	*37*
Eschenbach 1551	*35*	27.2	31.5	9.6	4.3	41.5	*15*	3.5	34.0	*50*
Eschenbach 1552	*47*	21.8	28.5	7.2	5.3	38.5	*25*	4.3	31.0	*81*
Eschenbach 1553	*55*	17.8	22.1	4.9	6.5	32.1	*36*	5.0	24.6	*110*
Eschenbach 1525	*50*	16.7	13.3	3.2	7.2	23.3	*36*	4.9	15.8	*98*
Eschenbach 1554	*65*	14.9	18.9	3.8	7.6	28.9	*49*	5.6	21.4	*146*

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Thank you

Muchas gracias

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